UTILISING MOBILE APPLICATIONS TO CLUSTER THE CYCLING COMMUNITY

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DBA

2023

UTILISING MOBILE APPLICATIONS TO CLUSTER THE CYCLING COMMUNITY

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A thesis submitted in partial fulfilment of the requirements of the University of Northumbria at Newcastle for the degree of Professional Doctorate of Business Administration

Research undertaken in Newcastle Business School

JANUARY 2023

ABSTRACT

The rapid expansion of mobile applications (referred to as apps) is significant following the impact of Covid 19. This global growth has seen a 122.98% increase in app downloads, from 64.4 billion downloads in 2015 to 143.6 billion in 2021 (Business of Apps 2022a). Not only are app downloads at an all-time high, but this also transfers to revenue derived from mobile apps. Global app revenues saw a 19% increase between 2020 and 2021, with the market worth $133 billion (Business of Apps 2022b).

Specifically, the growth in fitness based mobile apps has been even more pronounced. In 2021 this market saw an increase of 45% in app downloads and a 54% increase in revenues, with this hyper-growth resulting in an estimated 385 million users (Business of Apps, 2022c). The growth in fitness apps transfers across to the cycling context. Strava reported 95 million active users in January 2022, adding two million users monthly, leading to an increase of 70% in membership levels and $167 million annually in revenue since 2021 (Business of Apps, 2022d). Thus, mobile fitness apps are the new battleground of audiences’ healthier lifestyle choices (Zhao & Zhang 2021).

With the phenomenal growth in fitness mobile apps and cycling, this thesis aims to investigate the new battleground (Zhao & Zhang 2021) of mobile apps within the context of cycling. As such, this study seeks to test a method to cluster cycling audiences based on their engagement in the functions of mobile apps and then overlay their attitudes and behaviours.

This thesis has adopted a multi-staged exploratory method of data collection and analysis. This resulted in a full-scale survey collecting 434 responses from active cyclists during a period from December 2021 to March 2022. The survey explored: involvement in cycling, mobile apps for cycling, motivations for cycling, mobile engagement, and demographics.

Findings utilised two-step cluster analysis to identify four distinct segments of cyclists using; themes of Badge of Honour (aligned to mobile app Strava) and World of Rules (aligned to mobile app Zwift) (Hofacker et al. 2016). The study builds on Hofacker et al. (2016), “badging” (p.28) as it provides visual identifiers, which transfer across to cyclists as a Badge of Honour. Hofacker et al. (2016) stressed the importance of game-centric, with the new immersing worlds of Augmented Reality (AR) and Virtual Reality (VR), which transfer to cyclists as World of Rules.

The four clusters described within this thesis as The Old-School Fanatic /Ultraconservative, Technology Movers, Mobile Savvy, and Fully Immersed, have conclusions drawn based on their motivations for cycling, involvement within cycling, attitudes, and behaviours towards mobile apps in cycling and mobile app engagement. In addition, these clusters varied in their usage and engagement in game-centric apps and social-centric apps and the use of indoor cycling, as influenced by Strava and Zwift.

This thesis adds to the existing literature, especially the initial work of Zhao and Balugue (2015) through empirical testing of a framework of the five functions of mobile apps which are adopted to cluster cycling audiences. In further aiding the research of Lamont & Jenkins (2013) the study segments the four clusters’ motivations for cycling, the behaviour of cycling along with their attitudes towards cycling – resulting in the first time a rich depth of insight for each cluster.

Keywords: Mobile applications (apps), Segmentation, Cycling sector, Mobile Marketing

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GLOSSARY

APP	Mobile application
AR	Augmented Reality
CE	Customer Engagement
CMI	Cyclists Motivation Instrument
DBA	Doctorate in Business Administration
EFA	Exploratory Factor Analysis
eWOM	Electronic Word of Mouth
KMO	Kaiser-Meyer-Olkin
LMS	Leisure Motivation Scale
LOV	List of Values
PII	Personal Involvement Inventory
MTAM	Mobile Technology Acceptance Model
MSA	Measure of Sampling Adequacy
SDT	Self-Determination Theory
SPSS	Statistical Product and Service Solutions
UGC	User Generated Content
VALS	Values and Life Styles
VR	Virtual Reality

ACKNOWLEDGEMENTS

Undertaking the DBA has been the longest ride of discovery, in particular, while studying part-time alongside full-time work and other life commitments. With so many demands on life, there have been several occasions when it did not feel possible that this ride would be completed. At those times the support of family, friends, and the cycling community got me back on the road.

There are numerous academic colleagues who have supported my ride of discovery. Firstly, a massive thanks to my supervision team Dr David Hart and Dr Simon Lillystone, who have assisted me on the ride of discovery. Additional thanks go to those past and previous colleagues who have been a wheel to follow when seeking a piece of advice and guidance. A massive thanks to Vignesh, Victoria, Tommy, and Michael. A special thanks to a long-term friend, Michelle, who has been along on this ride to help me navigate the junctions and always make sure I take the right direction.

An essential part of this ride of discovery has been the cycling community, whether it be those who are friends or other new acquaintances that I've discovered along the way. Two particular cycling friends who have listened to one-to-many discussions of my DBA are Graham and Andrew – thank you, that thinking time was priceless. The cycling community has been a massive part of the DBA, from those who shared surveys, and completed surveys, to those help me format my ideas via discussions – thank you.

Finally, the support of those loved ones has been never-ending. Without question, the most supportive have been those close to me: my loving wife Clare, along with my inspirational three children: Ashton, Sophia and Logan. Their constant support, guidance, and belief in what I can achieve, has been my motivation. At times when the self-doubter kicked in, they have been there to support me through, and inspire me to cross that finish line of the longest discovery ride.

DECLARATION

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas, and contributions from the work of others.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the Faculty Ethics Committee on 1st March 2020.

I declare that the Word Count of this Thesis is 66, 786 words (excluding tables)

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Chapter One: Background and Introduction

1.0 Chapter Overview

The overarching aim of this thesis is to investigate mobile applications' (referred to as apps) influence on consumers within the cycling sector. In investigating apps, this thesis will consider alternative methods to cluster cycling audiences based on their engagement in apps, along with other segmentation variables of behaviours and attitudes.

This introduction chapter will present the scope of the thesis, the rationale for the study and personal motivations for undertaking this research. The chapter will then present the overall research aims and objectives, provide a brief overview of the methodology and framing of the research context and present the initial contribution to practice and theory. This chapter concludes with an outline of the chapters that are to follow in the thesis to signpost the thesis journey.

1.1 Background to the Study

This section will explore the context in which this study is situated, examining the areas of mobile marketing, the cycling sector, and the use of mobile fitness apps. This section, therefore, provides a foundational appreciation of the contextual environment surrounding this study due to the embryonic nature of research mobile background of the study. Both studies by Zhao and Balugue (2015) and Kim, Lin and Sung (2013) highlighted the fact that the early stages of existing research into mobile apps requires significant development in order to aid mobile marketing strategies.

1.1.1 Mobile Marketing

Firstly, mobile marketing is explored to understand both practical implications and theory. The rapid growth of mobile marketing is highlighted within its simplest form as the growth in retail sales. In 2019, £50.36 billion was spent on mobile devices through apps and mobile webpages within retail in the UK, a figure which is predicted to rise to £105.28 billion by 2024 (Statista, 2022a). As such, the rise in the significance of mobile sales acknowledges the need to understand how this purchasing channel alignment with strategies for acquiring and retaining customers is of crucial importance to business practice (Ho & Chung 2020), making this thesis timely in both practical and theoretical application.

The need to understand the impact and positioning of mobile sales is further exacerbated by the global expansion of mobile apps use. To illustrate this in context, the worldwide growth of mobile app downloads grew from 64.4 billion in 2015 and to 143.6 billion in 2021, showing growth of 122.98% (Business of Apps 2022a). Breaking this down further, platform apps in Google Play saw 111.3 billion downloads in 2021 vs 32.3 billion downloads in IOS in the same year (Business of Apps 2022a). These figures show significant engagement with mobile technology.

The smartphone can be considered the essence of modern-day life, with 96% of UK phone users having a smartphone (Statista 2022b). In line with this significant level of usage mobile marketing has increasingly become a popular tool within the marketing strategy described as a growing area of practice (Wang, 2021; Tong, Luo & Xu, 2020). This has led to a rise in the number organisations using this platform as an area of competitive advantage to engage and connect with audiences (Kolb, 2013). This rapid expansion has led to the need for further academic research, to understand the value of mobile apps, following calls from Kim, Lin and Sung (2013) and Zhao and Balugue (2015). Moreover, academic literature notes apps as the ultimate marketing vehicle for building customer engagement within their brands (Alalwan et al., 2020; Watson, McCarthy & Rowley, 2013). However, there is a lack of studies which connect such academic exploration within the context of cycling.

Mobile technologies contrast to other technologies due to consumers' 24/7 connected world. Relationships differ with the elements behind the device, through which we associate with unique and specialist 'me time' (Staff, 2013). As technological developments of the mobile have been enhanced, research has focused upon the consumer of mobile technology along with their changing behaviours (Shankar, Venkatesh, Hofacker & Naik, 2010; Varnali & Toker, 2010; Hanjaya, Kenny & Gunawan, 2019). In daily life, the smartphone not only captures more of our attention, but it also provides an opportunity for marketing engagement which leads to commerce and forms of relationship (Pasqua & Noah, 2012). This is due to the mobile device capturing more passive user time (Pasqua & Noah, 2012) from which the relationship evolves and the need to develop relationships with organisations through the medium of mobile apps. This form of engagement is increasingly becoming more important within daily practice (Holmes at al. 2013).

The growth in mobile apps is reflected in revenue derived, between 2020 and 2021 the market saw a 19% increase in downloads with revenue reaching $133 billion (Business of Apps 2022b). This growth has resulted in the average user having an average of 40 apps stored within their smartphone based on a study of 3756 mobile phone users worldwide (Simform, 2021).

As this market grows, the usability of mobile apps is becoming of paramount importance as consumers are increasingly astute and demanding and look for benefits of usability and engagement (Compuware, 2013; Rowles 2017; Baek, & Yoo, 2018; Bitrián, Buil, & Catalán, 2021). In the above study, less than half of those apps (18) are used on a regular basis (Simform, 2021), with one in four mobile apps being abandoned after a single use (CIM, 2016). The rush for organisations and brands to obtain downloads has now been achieved. However the benefits sought by customers through mobile apps differ on a case-by-case basis for a sector (Kim, Lin & Sung, 2013, Zhao & Balugue, 2015), this study contributes to this investigation within the cycling sector.

1.1.2 Cycling Sector

The cycling sector is primed for further research, due to its increasing commercialisation and significance of marketing (Gerike & Parkin, 2016). Research in the area of cycling has historically focused upon encouraging participation in the sport (Yang, Sahlqvist, McMinn, Griffin & Ogilvie, 2010; Brog, Erl & Mense, 2002; Mayers & Glover, 2021; Useche, Montoro, Sanmartin & Alonso, 2019) or reducing barriers to participation (Bauman et al., 2008; Beck et al., 2019; Aldred, Watson, Lovelace & Woodcock, 2019). Therefore, the literature shows a significant gap with little research existing on cycling relating to the commercial business and marketing context.

The thesis addresses this gap in knowledge and will contribute to further research in the cycling sector and examine mobile apps as a method to cluster audiences and understand their motivations, engagements and involvement in cycling (Cox, 2005; O'Connor & Barkatsas, 2009; Lamont & Jenkins, 2013)

The cycling sector is quite simply on a continuous high within the UK, at the forefront of this has been success on the track and the road at multiple Olympics, along with continual road cycle successes over the last decade (BBC, 2016; England, S. 2020). The UK government and cycling bodies in the UK have been keen to capitalise on this success, with British Cycling leading the way with the implementation initiatives to stimulate the growth in participation (British Cycling, 2009; British Cycling, 2022). This has resulted in UK British Cycling Association membership doubling from 50,000 in 2012 to 100,000 in 2014 (British Cycling, 2014) and surpassing 150,000 in 2019 (British Cycling, 2019). The increase in cycling take-up is supported by a Mintel (2022) report, with 34% of adults identifying as cyclists. Not only is this resulting in an increase in membership but more significant increase in regular cyclists for leisure, commuting and enthusiasts with 21% of adults cycling at least once a week, a rise of 7 percentage points since January 2019 (Mintel, 2022).

The size and scale of the cycling sector has been dynamically impacted by COVID, as consumers using physical activities such as cycling increased as part of the response to a global crisis (Mintel, 2022). More significantly this is represented in terms of the growth of cycling revenues within the last year of 40%, returning estimated revenues of £560.5 million in 12 months ending April 2021. This growth was despite the challenges of global supply issues (Mintel, 2022) which could have skewed sector growth. The total UK market size is estimated at £2.15 billion, with bikes accounting for 60% and bicycle accessories (including parts, accessories, clothing, and servicing) accounting for 40% (Mintel, 2022).

Whilst the growing significance of mobile apps is evident (as discussed earlier in the chapter) the growth and expansion as an overarching market turns the focus to both fitness apps in general and then cycling apps specifically where there has been a significant expansion (Business of apps, 2022d) – this is explored within the next section of this chapter.

1.1.3 Fitness Mobile Apps

The growth of cycling in the UK is echoed by growth in fitness mobile apps with the sector seeing a significant increase in line with the impacts of Covid19. This is illustrated by exploring the revenues of fitness apps. In 2016 mobile fitness apps returned a revenue of $0.68bn, which is in sharp contrast to figures five years later in 2021 when the fitness mobile apps market totaled $5.35bn (Business of apps, 2022c). Such hypergrowth in such a short timeframe shows fitness apps are the new battleground for technology and sports companies (Zhao & Zhang, 2021).

Revenues derived from fitness apps increased by 54% in 2020 alone, due to higher usage during the lockdown and new subscription models by several apps (Business of apps, 2022c). The number of fitness app users saw an increase in 2020 of 45% with an estimated 385 million users in 2021 (Business of apps, 2022c). In terms of fitness mobile apps that are cycling-focused, revenue increased in 2021 for the two biggest players Strava and Zwift by $167 and $5.8m respectively. This tells us that Strava and Zwift are the fitness apps of choice for cyclists and have become the market leaders. It is worth observing the business model and income stream of these two significant apps. Zwift is a monthly or annual subscription, following an initial short trial. Strava offers users a very simplified and basic version free, with the premium paid either monthly or annually offering further advanced features. Both of apps have undertaken a subscription-based model in recent years simulating the hypergrowth of both businesses, by creating a steady and stable income base (Chang, 2006).

The significant growth of both the cycling sector and fitness apps provides an ideal platform from which to argue the rationale for further investigation. Both areas are under-explored fields in academic research (Romanillos, Zaltz Austwick, Ettema & De Kruijf, 2016) and provide further opportunities to aid practical knowledge.

1.2 Rationale for the Study

When deciding on the rationale for the focus of this thesis the academic literature was consulted, in order to understand the current position, gaps in knowledge, and future research opportunities. Firstly, the literature explored mobile marketing in its broader sense before becoming focused on mobile apps. Overall, due to the embryonic nature of research, mobile apps present a unique opportunity to aid the existing understanding of mobile marketing strategies.

1.2.1 Mobile Marketing

As discussed in the context of the study (Section 1.1.1), mobile marketing in terms of retailer's sales has witnessed significant growth (Statista, 2022a). On reviewing the extant academic literature in commencing the thesis, the work of Holmes et al. (2013) for the first time noted the role of mobile phones in the stages of information search and subsequent consideration of alternatives in the buyer behaviour process. Some authors argue the use of mobiles is revolutionising the entire buying process due to its unique characteristics of personal and customer-centric approach (Martin, 2011; Shokouhyar, Dehkhodaei & Amiri, 2021). Subsequently, this has led Holmes et al. (2013) to identify the importance of consumers in today's world, who are increasingly influenced by mobile phones in what is described as a fast paced world (Beauvisage & Mellet, 2020). This has resulted in the identification of 'me time', being attributed to mobile phones (Staff, 2013).

Personalisation of mobile technology is consistently mentioned within the academic literature (Xu, 2006; Tong, Luo & Xu, 2020) as organisations use mobile phones as a medium for customer-centric approaches. Therefore, the study of mobile phone use offers the opportunity for further research and exploration in two parts: firstly, the infancy stage of mobile phone use in this field in both academic and research contexts (Kim, Lin & Sung, 2013; Zhao & Balugue, 2015); secondly the growth and significance in the reliance on mobile phones as individuals and the relationship formed with our devices (Staff, 2013; Pasqua & Noah 2012; Zhao & Balugue, 2015).

In reviewing extant research on mobile marketing (Rowles, 2015; Dorcic, Komsic & Markovic, 2019) it is acknowledged that little academic literature focuses on mobile apps, given such significant growth. However, the initial stages of academic research on mobile apps position the need for the expansion of knowledge, as it is not only an unexplored field, but at the embryonic stages of academic research (Kim, Lin & Sung, 2013; Zhao & Balugue, 2015). To address this need for further research, the thesis will review the literature on mobile apps.

1.2.2 Mobile Apps

As previously discussed, (in Section 1.2.1), the need to engage consumers and users through mobile apps is of interest in practical terms due to significant growth and academic terms, as its acknowledgment of the embryonic stages of mobile app research (Kim, Lin & Sung, 2013; Zhao & Balugue, 2015). The extant literature divides mobile apps into distinct groups as being paid for and free apps (Tang, 2019). Turning attention to the focus of this study, it is the apps' ability to form different relationships which ultimately leads toward engagement (Wang, Liao & Yang, 2013; Kim, Lin & Sung, 2013; Zhao & Balugue, 2015) that is pertinent for this thesis.

In exploring the extant literature studies have often seen reviews of the top 100 branded apps providing an overview into branded apps and their engagement (Kim, Lin & Sung, 2013; Zhao & Balugue, 2015). From such studies, Kim, Lin and Sung (2013) note the significance of customised app interfaces appealing to the specific needs and interests of individual consumers. This insight leans towards usability features of mobile apps, in particular their consumption value of motivation and epistemic impact on consumer behaviours and engagement (Wang, Liao & Yang 2013). As consumers are seeking different benefits from downloading mobile apps from gamification to purchasing, it is vitally important to consider the benefits on a case-by-case basis (Kim, Lin and Sung, 2013).

The top 100 branded apps were reviewed by Zhao and Balugue (2015) to investigate the benefits and features of mobile apps. This initial study by Zhao and Balugue (2015) conceptualised the five functions of mobile apps as: tool-centric (function elements of app e.g., location checker for stores), game-centric (gamification), social (social functions such as social sharing of information), m-commerce (purchasing) and design (brand messages). However, Zhao and Balugue (2015) acknowledged the need for further research with the quote; “features included in app designs should be chosen on a case-by-case basis” (p. 313). Thus, drawing conclusions from Zhao and Balugue (2015) there is the need for further research to aid knowledge and understanding about mobile apps.

The framework of Zhao and Balugue (2015) of the five functions of mobile apps is reviewed further in Chapter Two. The chapter provides a detailed review of the extant academic literature on the key factors of tool-centric, game-centric, social-centric, M-commerce-centric, and design-centric. In applying this approach this thesis refines the framework of Zhao and Balugue (2015) by applying the framework in the context of the cycling sector with key factors of the five functions of mobile apps and provides a critical toolkit for marketing professionals to cluster audiences within cycling.

1.2.3 Cycling and its Impacts on Motivations, Involvement and Engagement

Research shows that both cycling and fitness-based apps have seen significant growth in recent years (Business of apps, 2022c; Mintel, 2022). Therefore, the development of applications in cycling is seen as a new battleground (Zhao & Zhang, 2021) for technology and sports companies. As such, expansion of mobile apps in cycling has come a long way in such a short period of time, as evidenced by consulting research in the areas of motivations for sport, involvement in cycling, and engagement in mobile apps. All of these are central to the study to understand consumers’ motivations (Barratt, 2017; Fenton, Cooper-Ryan, Hardey & Ahmed, 2022).

The extant literature on segmentation notes the importance of understanding sub-cultures of cyclists, due to the hobby-like state (Bloch & Bruce, 1984; Lamont & Jenkins, 2013) of the sport. In order to understand the subculture of cyclists the literature explores, both the product and consumer involvement are noted as starting points (O’Cass, 2000).

However, the need to be immersed further into this subculture is evident with the culture of cycling considering involvement within this research as segmentation of cyclists stressing the importance of open involvement through self-identity of a cyclist (Lamont & Jenkins, 2013). The literature on consumer involvement in the cycling context is further aided by research of customer engagement (CE), in order to form an emotional bond (Bowden, 2009). Research on CE stresses the importance of the object within the case (cycling in this study), in particular Zaichowsky (1985) stated "the object is based on inherent needs, values, and interests" (p. 342). As technology influences the adoption of CE (Van Doorn et al., 2010) it is important to consider mobile apps' unique characteristics (Thakur, 2016). This led Thakur (2016) to test and validate six typologies of consumer engagement in mobile shopping – which the study will explore in Chapter Two.

Motivation for sports presents both the intrinsic and extrinsic incentives as to the audience engagement within the sport, through Self-Determination Theory (SDT). SDT is a well-established research field in a variety of areas (Pelletier at al 1995; Sebire, Standage & Vansteenkiste 2009; Vansteenkiste, Niemiec & Soenens 2010). Previous studies provide evidence of understanding such motivations through SDT in cycling, however there is a lack of knowledge of how these motivations transfer into the mobile apps in cycling (Cox, 2005; O'Connor & Barkatsas, 2009).

In summary, this section has presented an overview of the literature on mobile apps, consumer involvement and motivation for the sport along with mobile application engagement. Core themes can be drawn from the bodies of literature as being mobile apps (Zhao & Balugue, 2015) consumer involvement in cycling (Lamont & Jenkins, 2013; O'Cass, 2000), exploring SDT in sports motivation (Pelletier at al 1995) and mobile app engagement (Thakur, 2016) with the six typologies being presented in the literature review, in Chapter Two.

Furthermore, reviewing literature pertaining to the above themes is crucial to the study, to develop the theoretical framework and critical toolkit from which mobile application functions can be illustrated and used to create distinct cluster solutions for cyclists (Zhao & Balugue, 2015). Following this, the study uses consumer involvement in cycling (Lamont & Jenkins, 2013), motivation for cycling (Pelletier at al 1995) and mobile app engagement (Thakur, 2016) to develop a deep understanding of the motivation of each of these clusters of cyclists.

1.3 Research Aims and Objectives

The purpose of this study is to determine a suitable framework for investigating mobile apps in the cycling sector. To meet this, the thesis will conceptualise the five functions of mobile apps within the context of cycling, therefore creating a framework to be used to cluster (or segment) audiences within the cycling sector.

The thesis responds to the research aim:

> ***Identify and develop a testable method to cluster cycling audiences based on their engagement in the functions of mobile apps and additionally their attitudes and behaviours.***

To allow for thorough evaluation of the research aims the following research objectives have been created:

- RO1 Critically evaluate the existing academic knowledge and implications in practice of the five functions of mobile apps.
- RO2 Evaluate existing frameworks and models of motivations for participation in the sport, consumer involvement and engagement, as potential means of clustering in the cycling sector.

- RO3 Conduct quantitative research to explore cyclists' perception and usage of mobile apps of the five functions of mobile apps and the associated frameworks of involvement, motivations for sport and engagement.
- RO4 Analyse primary and secondary data to develop a testable framework of the five functions of mobile apps which is appropriate for cyclists.
- RO5 Apply the framework of the five functions of mobile apps alongside motivations for sport, consumer involvement and engagement, to identify distinct cluster of cyclists and draw conclusions for practice and theory.

As outlined in the research objectives above, the study aims to identify a method to cluster cycling audiences through the five functions of mobile apps, before presenting distinct clusters using this framework. The chapter now turns its attention to introduce and explore the potential outcome of the study.

1.4 Potential Outcomes of the Study and Implications

Review of the literature shows that limited research exists which explores the five functions of mobile apps, most notably Zhao and Balugue (2015) with a review of 100 branded apps, presented as a first stage overview of the functions. While this study is significant in its positioning there are limitations, with Zhao and Balugue (2015) lacking a conceptualisation framework of the five functions of mobile apps. The literature review also shows that no empirically tested model of the five functions of mobile apps currently exists, which this thesis seeks to address.

This thesis uses a multi-stage exploratory methodology to investigate the five functions of mobile apps. This exploratory approach commences through an exploration of the academic literature, which includes a review of fifty mobile apps in cycling. This allows for the evaluation of current practices and academic knowledge and assess gaps that currently exist within the five functions of the mobile apps model (Zhao & Balugue, 2015). Further stages of the exploratory research contribute to the study by conceptualising and empirically testing the framework of the five functions of mobile apps, specifically within the context of cycling. Thus, this study will contribute to the understanding of the theory, making a significant step forward in testing the framework of the five functions of mobile apps. This study goes further to adopt the use of the five functions of mobile apps as a method to cluster cycling audiences. In using mobile apps to cluster audiences in this way, this thesis makes academic contributions and will aid cycling and sports management. Furthermore, this thesis is built on pre-existing research (British Cycling, 2015; Lamont & Jenkin, 2013; Damant-Sirois & El-Geneidy, 2015) to further understand consumers' motivations within cycling.

The requirement of the thesis, as a Doctorate in Business Administration (DBA), is to contribute towards practice. In response to this, the study furthers practical knowledge in presenting marketing professionals with a critical toolkit for clustering audiences within the cycling sector. This critical toolkit adopts the use of mobile apps as a method to segment audiences, alongside motivations and involvement for cycling and engagement in mobile apps to present distinct segments.

In positioning this study, the uniqueness of mobile apps presents an opportunity for this research to respond to the new battlegrounds of mobile apps (Zhao and Balugue, 2015). In doing so, the study contributes by adding value to the extant knowledge of mobile marketing strategies. Furthermore, the study contributes by developing a unique method to segment, with no prior study adopting mobile apps to cluster audiences. In using mobile apps to segment for the first time, not only is existing knowledge expanded but also presents a much richer understanding of audiences' behaviours and attitudes. Presenting this richer understanding of audiences aids the practical applications of mobile marketing strategies. This study contributes to marketing professionals in presenting a new method of clustering audiences which aids their strategic decisions on future app development and additionally adds value to retailers with unique clusters, to inform mobile decisions.

1.5 Rationale and Motivations for the Study

My lived experiences, both personal and professional, have stressed the importance of health and wellness for human beings to perform at their optimum. In previous industry experience, I was given the opportunity to work with an online behavioural coaching system, which was the first to launch into the UK marketplace. This resonated with a burning interest in technology that can be used to engage and connect with audiences and assist healthier lifestyle choices. Moving into the world of academia, I wanted to use the DBA as an opportunity to investigate developments into how mobile apps were being utilised as the new battleground which stimulates audiences' healthier lifestyles (Zhao & Zhang, 2021).

During the timeframe of this research, the industry has witnessed significant growth and expansion in terms of mobile applications in cycling. Cycling has long been a sector that embraces change in technologies (Cox, 2019; Dauncey, 2012), whether this is developments of technology on the bike or off the bike with technology to aid recovery. This embracing of technology in cycling is important, given mobile apps in cycling such Zwift (launched in 2014) being the first to launch to a new marketplace.

As a regular cyclist myself I could see the cycling community exhibit behaviours that were becoming close to obsession with applications such as Strava. For example, a comment from a regular riding colleague, "if it's not posted on Strava then it doesn't count" presented an opportunity for further investigation into the academic literature and understand whether further research was needed.

In investigating the academic literature further, the instrumental work of Zhao and Balugue (2015) positioned the need for further investigation into mobile apps in the context of the app/sector. In my involvement as a cyclist and discussions with fellow cyclists, it became evident that mobile apps in cycling and the mobile phones themselves were becoming essential tools that cyclists regularly engaged with to support the hobby of cycling. Thus, seeing a gap that existed within the academic research Zhao and Balugue (2015) stressed the importance of understanding apps on a case-by-case basis for each sector. Additionally, mobile phones were heavily involved in the consciousness of consumers, who were placing more emphasis on the importance of how they assisted in forming relationships with the “me time” of the device (Staff, 2013).

In turning to the existing mobile applications, I started to review apps that existed in the cyclist's toolkit. This showed that there was a range of cycling content led by both the industry and consumer, which focused on driving consumers towards mobile apps for cycling. In these early investigations what became apparent was a significant pace of expansion of features within mobile apps for cycling, for example Strava and leader boards and king/queen of mountains. Such features of mobile applications in cycling are underexplored in academic research (Zhao & Balugue, 2015; Lamont & Jenkins, 2013), and due to its expansion at such a rapid pace, was the sector ideally positioned to further investigate how such features connected with audiences.

As the research evolved into consumer involvement and motivations for cycling it became clear that existing research identified the hobby-like nature (Bloch & Bruce, 1984; O’Cass, 2000) of cyclists. Additionally, further research into the segmentation identified the importance of sub-cultures of cycling (Lamont & Jenkins, 2013). Both the hobby-like nature (Bloch & Bruce, 1984; O’Cass, 2000) and sub-culture of cycling (Lamont & Jenkins, 2013) are influenced by consumers’ movement towards cycling based mobile apps such as Strava and Zwift.

In further discussions with cyclists, it became apparent there were different clusters of motivation and engagement, for example, those who bought into sharing their badges and kudos of Strava, those who embraced the virtual world of Zwift, and those who are quite simply remained core to the traditional forms of cycling. Thus, the sub-culture of cycling was mirroring mobile applications, which ideally positioned the research to respond to Zhao and Balugue's (2015) call for further research into five functions of mobile apps, which this study has chosen to focus on specifically in the context of cycling. The importance of this subculture of mobile apps in cycling is further evidenced by additional discussions with the cycling community, for example on sharing my research with the cycling community through discussion, audiences have responded in different approaches, with those highly engaged seeking the next mobile app they must download, whereas more traditionalist cyclists showing no engagement in mobile apps.

The motivation for this study, therefore, is to bridge the substantive gap in knowledge of mobile applications in both practical and academic fields, specifically in the context of cycling. The emphasis is on determining a method of using mobile applications to cluster audiences in the cycling sector, in addition to further an understanding of what motivates each cluster to adopt the use of mobile apps in cycling and in understanding the motivations for engaging in cycling. In developing a framework to cluster based on mobile apps for cycling, the thesis will inform the cycling sector and other leisure and sports sectors of the importance clusters place on mobile apps.

1.6 Thesis Outline

Chapter Two presents an in-depth literature review of consumer involvement, Self-Determination Theory (SDT) motivations, engagement, and mobile apps. For each of these theoretical concepts, a conclusion is drawn on existing frameworks/models to be used, consumer involvement in cycling (Lamont & Jenkins, 2013), SDT motivations

(Pelletier et al., 1995), and engagement (Thakur, 2016). The literature review critically appraises different theoretical perspectives, to reach conclusions and determine suitable frameworks and models for mobile apps. The review of the literature is used to determine the five functions of mobile apps (Zhao & Balugue, 2015), and includes the five functions tool-centric, game-centric social-centric, m-commerce-centric and design-centric ideally positioned to respond to the study's research objectives. Due to the infancy stages of mobile apps, further literature from mobile, co-creation and gamification is drawn upon to conceptualise the model (Hofacker et al., 2016; O'Hern & Kahle, 2013; McGrath & McCormick, 2012; Khajehzadeh, Oppewal & Tojib, 2014; Watson, McCarthy & Rowley, 2013; Schmitz Weiss, 2013; Blazquez, 2014; Chang, Chen & Zhou, 2009).

Chapter Three introduces the research strategy, presenting the research methodology including design, methods and justification of the research approach used within this study. This chapter also presents the four stages of data collection and how an exploratory study of the inclusion of refinement at each stage, aids the conceptualisation of the five functions of the mobile apps model. This chapter also introduces the philosophical stance of positivism which underpins this thesis.

Chapter Four presents the data analysis and findings of the study. The chapter initially focuses on stage three, the pilot stage of data collection and presents findings and analysis of the five functions of mobile apps through exploratory factor analysis, before presenting a conceptualisation of the model of the five functions with further testing and analysis within stage four of the study. It then moves its focus onto stage four of data collection; the full-scale study presents the analysis using Exploratory Factor Analysis to empirically test the results of the five functions of mobile apps. The five functions of the mobile apps model are used as a method following with a two-step cluster analysis being applied to find distinct audiences within cycling. Results are presented using data-visualisation sharing insights into each cluster and their levels of involvement in cycling, motivations towards cycling and engagement in mobile apps of shopping.

Chapter Five brings the study to a close with a discussion of the major findings, before drawing conclusions of the thesis. This chapter reviews the study's aims and objectives, discussing the main findings of the thesis before presenting the contribution and value of the thesis in both practical and theoretical terms.

Chapter Two: Literature Review

2.0 Introduction

This chapter explores the literature surrounding the various core lines of inquiry underpinning the thesis. Firstly this chapter investigates product involvement in order to understand the lens of consumer involvement within cycling before moving on to explore consumer involvement in cycling, with the theoretical perspective of segmentation and self-determination theory in order to understand the motivations of cyclists. The chapter then moves on to review the literature surrounding customer engagement and its factors, focussing on mobile applications, before providing an overview of the history of mobile marketing and the context in which mobile marketing confines itself. Finally, the chapter then moves to mobile app research to date and the short nature of the academic research and knowledge already accumulated in this dynamic and emerging field.

This chapter ends with the justification of the need for further research in the areas of mobile apps and their five functions highlighting gaps in knowledge which this thesis aims to contribute to in both theoretical and practical arenas. For example, by building on theoretical knowledge through the justification of the refinement of Zhao and Balugue's (2015) framework, in the context of the cycling sector and building on practice through the creation of a practical tool kit when using mobile apps, to segment audiences for marketing professionals in the cycling sector.

A breadth of literature was investigated due to the embryonic stages of academic research on mobile apps. When investigating Zhao and Balugue's (2015) five functions of mobile apps, such was the early stages of research of apps, that existing knowledge resulted in many unexplored avenues of research. Reviewing the breadth of literature for the study was essential in order to meet the study's objectives given the lack or theoretical underpinning on mobile apps within existing knowledge. Figure 2.1 shows the structure of the literature review chapter:

2.1 Product Involvement

- Context and Definition.
- Product Involvement.
- Consumer Involvement

2.2 Segmentation and Motivation for Cycling

- Introduction, Context and Definitions of segmentation.
- Methods of Segmentation
- Methods of Segmentation in the cycling sector
- SDT and Motivations in Sports
- Segmentation and SDT in Cycling
- Sports Management Scales and SDT in Cycling

2.3 Customer Engagement

- Context, Defining and Evolution
- The demensions of Customer Enagagement: Cognitive Measure, Trust and Commitment
- Customer Engagement Literature to date
- Positioning the Research (Six Motives for Customer Engagement Mobile Apps)

2.4-2.9 Mobile Apps and Functionality

- Context and Defining
- The impact of mobile apps on consumer behaviours
- The Five functions of mobile apps
- **Tool-Centric App**
- Review and Context
- Review of current tool of mobile apps within Cycling
- Tool Centric – Navigation
- Tool Centric – Cycling Computer/Data Performance
- Tool Centric – Training Platforms
- Tool Centric – Virtual Reality
- Tool Centric – The wallet of mobile apps
- **Game-centric app**
- Review and Context of Gamification
- Game Mechanism Element
- Story Element
- Aesthetic Element
- Technology Element
- **Social-centric app**
- The Growth of User Generated Content and definition
- Themes within User Generated Content Literature
- Informing
- Co-Communicating
- Co-creating
- Pioneering
- **M-Commerce- centric app**
- Scan barcode/QR code/Vouchers and Coupons
- Location Awareness
- Augmented reality and Virtual Mirror
- Mobile payments
- **Design-centric app**
- Reviewing literature and defining M-Branding
- Brand Name
- Brand Logo
- Brand Design: Typeface, layout, colour, Stimuli: shapes/icons
- Brand Content:Imagery, copy relationship features, sound/video.

2.10 Conclusion

- Positioning of the research gaps and scope of further research in both theory and practical terms

Figure 2.1 – *Literature Review Chapter*

This literature review will critically explore product/consumer involvement, segmentation and motivation for cycling, customer engagement and finally mobile apps and their functions. In order to investigate such an embryonic stage of research in the field of mobile apps, the thesis acknowledges the need to draw upon a wider research area, in order to underpin the currently non-existing theoretical contributions of mobile apps.

2.1 Product and Consumer Involvement

2.1.1 Context

Product and consumer involvement has emerged as one of the most important concepts in consumer research (Barari, Ross, Thaichon & Surachartkumtonkun, 2021; Lim, Rasul, Kumar & Ala, 2021; Nagar, 2015). The literature exploring involvement derives from two distinct areas pertinent to the nature of the thesis: product involvement (Laurent & Kapferer, 1985; Mittal, 1989; Zaichkowsky, 1985) and consumer involvement (O'Cass, 2000).

On reviewing the extant literature, product enthusiasm was noted within the work of Bloch and Bruce (1984) entailing a strong, abiding, hobby-like interest within a product class in question, which transcends the temporary purchase process and leads toward arousal investigation. Product enthusiasm leans towards the concept of consumer involvement, which O'Cass (2000) explained as placing involvement on a continuum from total attachment or absorption of the individual with the product and related activities (high involvement) to complete detachment or automaticity (very low involvement). Here literature demonstrates a developing paradigm between the two themes of product involvement and consumer involvement (Laurent & Kapferer, 1985; Mittal 1989; O'Cass 2000; Zaichkowsky 1985), often due to the hobby or passion nature of consumer involvement (Lőrincz, Banász & Csapó, 2020), as demonstrated within individuals' engagement in cycling.

Moving forward the next part of the chapter commences by defining product involvement and consumer involvement, followed by appraisal of the body of literature, and finally positioning the gaps that exist within the literature.

2.1.2 Defining the Concept of Involvement

Literature presents several contrasting definitions of product involvement, for example Bloch and Bruce (1984) defined product enthusiasm as entailing a strong, abiding, hobby-like interest in the product class in question which transcends the temporary purchase process arousal investigated in most involvement research. The product enthusiasm is supported by Laurent and Kapferer (1985) who noted there is more than one kind of consumer involvement, depending on the antecedents of involvement (product's pleasure value, the product's sign or symbolic value, risk importance, and probability of purchase error). This leads this thesis down the route of consumer involvement, due to 'hobby-like interest' (Bloch & Bruce, 1984).

In consulting the literature, a definition of customer involvement posted by O'Cass (2000) is particularly relevant for this study:

> "fundamentally involvement should focus on a consumer's interaction with a product or stimulus in a marketing context. The more the focal object is placed in a prominent or key position in the consumer's life the more involvement or the more involved the consumer is said to be in the focal object" (p. 570)

This thesis adopts this definition due to the acknowledgment of the nature of 'hobby-like interest', resonating with both fashion and cycling sectors (Bloch & Bruce, 1984; Bloch 1986; O'Cass, 2000).

2.1.3 Product Involvement

As discussed earlier in the chapter, involvement has emerged as one of the most important concepts in consumer research, (Barari, Ross, Thaichon & Surachartkumtonkun, 2021; Lim, Rasul, Kumar and Ala, 2021; Nagar, 2015). The seminal study of Laurent and Kapferer (1985) introduced the concept of different levels of consumer involvement and proposed the four-faceted framework of importance/interest, sign value, pleasure value, and risk. Their work is not without critique, most noticeably importance/interest being the only involvement facet, whereas the other three facets of sign value, pleasure value and risk are antecedents (Mittal, 1989; Mittal & Lee, 1989) which need to be present to for an object to be involved (Mittal, 1989; Mittal & Lee, 1989), which is a well-versed area of literature.

More recent research, such as Bezençon and Blili (2010), reviewed ethical products and consumers, with the conclusion that generic models provide insufficient understanding to encompass consumer motivations for ethical product involvement. Bezençon and Blili (2010) noted the need for further studies to develop a great level of understanding of product involvement as product category required different augmentations or labels which need to be tested for nuances of different product categories. The nature of the product categories is noteworthy for this thesis, as the cycling level of involvement is driven by the hobby.

The seminal study by Zaichkowsky (1985) is regularly consulted in academic research, as the study devised a scale of the Personal Involvement Inventory, (PII) which measures the motivational state of involvement. The empirical findings developed a measure, which is mainly validated using the four constructs of importance/significance, relevance/essentialness, hedonic and attitude (Zaichkowsky, 1985). Later work by Zaichkowsky (1994) applied PII to the advertising context conducting a larger scale study and amended questions on the validity of PII within the context-free nature, and thus draws support evidence of the importance of context when it comes to involvement. This work provides indications that the revised PII may then be broken into two subscales representing a cognitive and affective grouping, whilst devising the need for further research to capture the level and type of involvement (Zaichkowsky, 1994). Of particular significance to the thesis is need for further research on knowing the effects of the product category.

The work of Mittal (1989) further develops Zaichkowsky's (1985) study by discovering the extent to which consumers care about products they buy and what specifically motivates them to make the right purchase. Mittal (1989) devised a scale for measuring product decision involvement (PDI), compromising of four facets: degree of caring, perceived brand differences, importance of right brand selections and concerns with the outcome. The simplistic nature of the research is often illustrated, as the three constructs combine the significant element of attitude (Mittal 1989; Mittal & Lee 1989).

Mittal is not without its critique, Mittal's (1995) later work offering the most relevant critique, that only one theme remains consistent across all frameworks: PII, PDI and Laurent and Kapferer (1985). Thus, involvement is perceived as the importance of the stimulus, which is the product itself or the purchase decision task (Mittal, 1995). In this study cycling is more than just merely product involvement, given the high involvement in the sport itself. Moving on, the literature review turns its focus to consumer involvement and consumption involvement to consider the 'hobby-like' nature of consumer involvement rather than a purchase decision, to assist in meeting the study's objectives.

2.1.4 Consumer Involvement

The early work of Bloch and Bruce (1984), whilst focusing on product involvement, provides insight that most products are low involvement whilst in sharp contrast many consumers exhibit a relatively high level of enduring involvement with a small number of product categories (Zhu, Mou & Benyoucef, 2019). At a very high level, enduring involvement may be termed product enthusiasm and is characteristic of product enthusiasts such as car buffs, wine connoisseurs or avid video gamers (Bloch & Bruce, 1984). This work is supported by Mittal (1995) who noted if a consumer is uninvolved with an object, it means they perceive it to be unimportant and is uncaring or indifferent about it.

The nature of the object is of central interest, to this thesis that is most significantly cycling. Within the nature of cycling there are different levels of involvement exhibited which supports Bloch and Bruce (1984) and other studies such as Willis, Manaugh and El-Geneidy (2013). In addition, Bryan (1979) argues that intrinsic satisfactions are primary motivators of highly involved recreational specialists, while lesser involvement is associated with the pursuit of extrinsic rewards.

A study by O’Cass (2000) which takes insights from previous studies by Zaichkowsky, (1994) and reviews these in the context of fashion is of significance. O’Cass (2000) places consumers’ involvement with a focal object on a continuum from total attachment or absorption of the individual with the product and related activities (high involvement) to complete detachment or automaticity (very low involvement), with respect to the person-stimulus dyad. This study shows the more the focal object (fashion) is placed in a prominent or key position in the consumer’s life the more involved the consumer is. Thus, levels of involvement experienced by consumers for the product fashion clothing, fashion clothing advertising, purchase decisions for fashion clothing and consumption of fashion clothing formed a continuum, reaching from minimal to high levels.

O’Cass’s (2000) work provides a framework to measure the level of consumer involvement using four measures of involvement: product involvement, purchase decision involvement, consumption involvement and advertising involvement. Te'Eni-

Harari and Hornik (2010) adds support to this with the notion that it is no longer relevant to simply divide the population according to product involvement level, but rather to create segments that examine the different involvement within each group. O'Cass (2000), stresses the importance of investigating consumer involvement through the lens of context (or sector) as being vital to meeting the objectives of the study. This stance has influenced the approach to this thesis resulting in the chapter now turning to involvement in cycling.

The literature review now moves to consult research in the field of cycling events. The study of this field within a marketing context offers the potential to segment based on participants' involvement in cycling (Lamont & Jenkins, 2013). Whilst numerous studies have reviewed the motives as to why consumers take part in cycling (Ritchie, Tkaczynski & Faulks, 2010; Faulks, Ritchie & Fluker, 2007; Nkurunziza, Zuidgeest & Van Maarseveen, 2012; Streicher & Saayman, 2010), the weakness of these studies is a lack a research into understanding how those using cycling events are segmented in order to tailor marketing activities (Nkurunziza Zuidgeest, Brussel & Van Maarsevee, 2012; Reid, 2011; Ritchie, Tkaczynski & Faulks, 2010). This limitation is often attributed to research assumptions that cyclists represent a homogenous group (Lamont & Jenkins, 2013).

This limitation has led to Streicher and Saayman (2010) stating that in order for marketing in cycling to be successful, cyclist motivations along with their behaviours need to be understood. This view is shared by other studies (Ritchie, Tkaczynski & Faulks, 2010; Kruger & Saayman, 2014; Kruger Myburgh & Saayman, 2016), which support the idea that audiences participate in cycling for different reasons. Therefore, using motivations for involvement within cycling as the purpose of grouping segments will not only inform planners and decision makers to create interventions to encourage participation (Damant-Sirois, Grimsrud, & El-Geneidy, 2014; Nkurunziza et al., 2012). More significantly for the purpose of this study, understanding the level of involvement in cycling is currently a gap in the literature, which this thesis seeks to address.

One particular study which has sought to investigate motivations via cycling events is Lamont and Jenkins (2013). This investigated cycling participation through an event in Australia which operationalised the use of recreation specialisation items, which are seen in Table 2.1. Prior to this study the use of recreation specialisation is limited as a concept when segmenting cyclists, as prior use only sees one published study (Chen & Chen, 2013) previously applying the concept.

The rigour of the study by Lamont and Jenkins (2013) which conceptualised the 14 items of recreation specialisation furthers studies by McIntyre and Pigram (1992); Hopkin and Moore (1995); Thapa, Graefe and Meyer (2006). These items measure: 1) behavioural dimensions (length of time involved in cycling and frequency), 2) effective dimensions (enjoyment of cycling, recognition as cyclist), and 3) cognitive dimensions (level of competency in tasks specific to cycling such as riding safely and performing basic mechanical tasks). These measures were validated by 623 survey responses completed online from participants who part took in a cycling event (Lamont & Jenkins, 2013). Recreation specialisation was used to create distinct groups of segments (Table 2.1), through a two-step cluster analysis, which:

> *"profiled attendees at a participatory cycling event in south-eastern Australia, identified high levels of recreation specialization among these amateurs, and found that cycling played a central role in these peoples' lifestyles."* Lamont and Jenkins (2013 p. 404).

Recreation Specialisation Items	**Theme**
Ride defensively in traffic	Cognitive specialisation items

Cycling is an important part of my life	Effective specialisation items
Safely ride in a “bunch” of cyclists	Cognitive specialisation items
Take sharp corners at speed	Cognitive specialisation items
Ride in a straight line	Cognitive specialisation items
Cycling is one of the most enjoyable things I do	Effective specialisation items
I organise a lot of my life to fit around my cycling commitments	Effective specialisation items
Perform basic mechanical tasks e.g. change a flat tire, adjust gears and other components	Cognitive specialisation items
I like other people to recognise me as a cyclist	Effective specialisation items
For how many years have you been a regular recreational cyclist?	Behavioural specialisation items
How many competitive events have you actively participated in during the previous 12 months?	Behavioural specialisation items
For how many years have you been actively participating in events to do with cycling?	Behavioural specialisation items
On average, how many recreational rides do you go on each week?	Behavioural specialisation items
How many non-competitive cycling events have you actively participated in during the previous 12 months?	Behavioural specialisation items

Table 2.1 The recreational specialisation from Lamont and Jenkins (2013 p.398)

Recreation specialisation has been used in more recent studies including Tian, Qiu, Lin & Zhou (2020) and Chou (2020) which further supports the adoption of the framework to understand the level of involvement in the product category of cycling, including motivations (Andersson & Getz, 2020).

This thesis adopts the use of the recreation specialisation, as validated by Lamont and Jenkins (2013), optimised for use within this cycling sector, in order to meet the study’s aims and aid clustering cyclists. As such it offers the ideal framework to capture respondents' level of involvement within cycling, and thus will be used for the study's primary data collection.

So far, the literature review chapter has explored research defining product involvement and consumer involvement, appraised the body of literature, and finally positioned the adoption of recreation specialisation (Lamont & Jenkins, 2013) to aid the completion of the objectives of this thesis. Moving forward this literature review sees a switch towards research on segmentation before reviewing this academic concept through a sporting lens.

2.2 Segmentation

Moving forward, the literature review will explore research on segmentation, firstly with a definition, before then considering the methods of segmentation through to understanding the motivation of audiences taking part in cycling through Self Determination Theory (SDT).

2.2.1 Definitions of Segmentation

When consulting the extant literature for definitions of segmentation, work by Smith (1956) is widely accepted as the founder of the concept, positioning the following;

> "Market segmentation involves viewing a heterogeneous market as a number of smaller homogeneous markets, in response to differing preferences, attributable to the desires of customers for more precise satisfactions of their varying wants." (Smith, 1956 p. 65)

Tynan and Drayton (1987) offer an alternative definition to “identify and delineate market segments or sets of buyers which would then become targets for the company’s marketing plans” (p. 301). Looking ahead to more contemporary literature, it becomes apparent not much has changed in terms of definitions. Lovelock and Wirtz (2011) defined marketing segmentation as “the process of dividing the population of possible customer into distinct groups” (p. 57), with customers in the same groups sharing common characteristics, and helping businesses target customer more effectivity (Lovelock & Wirtz, 2011). This thesis adopts the definition used by Lovelock and Wirtz (2011) as an underpinning concept.

Whilst the definitions note a lack of development over time, the analytic basis for segmentation has been widely applied to both consumer and industrial markets (Hosseini & Shabani, 2015; Wedel & Kamakura, 2000: Dolnicar, 2020; Griva, Bardaki, Pramatari & Doukidis, 2022). Literature identifies that both markets and customers are segmented on the potential (Kotler, 1991; Tynan & Drayton, 1987; Dolnicar, 2020; Griva, Bardaki, Pramatari & Doukidis, 2022). Of particular interest to the thesis is the application within the context of consumer markets.

The remainder of the chapter will shift the focus to the significance of the motives for cycling participation and sport. The largest problem for segmentation has long been considered how to subdivide the market (Jenkins & McDonald, 1997; Moriarty & Reibstein, 1986; Yang, 2022) and hence a review of the major methods of segmentation is drawn upon.

2.2.2 Methods of Segmentation Introduction

Methods of segmentation take a number of approaches (Kotler, 1991; Lovelock & Wirtz, 2011; Tynan & Drayton, 1987; Dolnicar, 2020) as seen within Table 2.2 noting widely cited academic studies. Here, the literature explores the need to consider consumer demographics as the traditional variables and the origins of segmentation (Lockley, 1950; Jones & Tadajewski, 2016; Melović et at, 2021). As such, understanding audience demographics has long been accepted as the building block of segmentation (Chin-Feng, 2002; Suh & Chow, 2021). Demographic labels including gender, age, income, and education, can be used to explain the characteristics of the sub-markets and classify the key factors (Chin- Feng, 2002; Dolnicar, 2020). However, this generates a homogenous nature to segmentation, and lacks a distinction in terms of customer profiles and needs which was determined as a key component (Kolter, 1967; Sood, & Kumar, 2017). As such, using demographic data creates a limitation in exploring and understanding audiences, lacking focus and clarity due a wide variety of different psychographic makeups (Hayes & Slater, 2002; Kotler & Armstrong, 1999; Ashton & Gowland-Pryde, 2019). In order to aid demographics, the need for geographical-based insights into target audiences becomes apparent (Bruwer & Johnson, 2010) which considers the physical location or region of the audience, taking in contexts of place.

Segmentation Variable	**Characteristic**	**Examples**
Demographic	Characteristics of the population such as; age, gender, income, education, socio-economic status, family size or situation	Socio-economic status ABC1C2DE Family life stage: Empty-nester, Full-nester
Geographic	The physical location and or region.	Country, Region, City
Psychographics	The lifestyle, social or personal characteristics, in most cases include basic demographic	young professionals and socially aware.
Behavioural	The behaviours from purchase, consumption, or usage	benefit-sought, usage occasion, purchase frequency, customer loyalty and buyer readiness.
Contextual and situational	Digital technologies ensure marketing can make use of context	GPS data via smartphones provide a

	and situations/	location to retailers.

Table 2.2: Methods of segmentation

Critiquing the focus on demographics challenges this approach to segmentation and raises a question regarding other methods of understanding customer needs to present the building blocks of lifestyles (Solomon, 1999; Stringfellow, Nie & Bowen, 2004; Noguerol, Pagán, García-Segovia & Varela, 2021). For example, consumers identify their lifestyles with consumption choices, which transfers across to a variety of product categories, which provide insights into their psychographics and aids the understanding of the customers (Solomon, 1999; Noguerol, Pagán, García-Segovia & Varela, 2021).

Literature defines psychographics as the study of cognitive attributes such as attitudes, interests, opinions, and beliefs, while lifestyle should apply to the study of overt behaviour, for example activities (Anderson & Golden, 1984; Thomas & George, 2021). This leads to creation of a range of academic theories, for example in terms of values and lifestyles (VALS) and the list of values (LOV), which identifies the characteristics of lifestyle, social, personal value, consumptions, and personality as a method to gain insight into the motives of the customer (Karasev, 2020). Whilst not without critique, Chin- Feng's (2002) study states psychographics creates pre-defined prejudice lying in the utilisation of the variables, and the degree of each variable.

What can be drawn from segmentation literature for the nature of this thesis, is a range of variables that can be used to divide audiences (see Table 2.2), in order to understand consumer profiles and needs (Karasev, 2020). In order to apply segmentation approaches the literature suggests that the context of the study is important (Dolnicar, Grün & Leisch, 2018; Walters, 1997). This has influenced the focus of this thesis in the aim to explore the motivations for consumers engaging in cycling. Some of the traditional motivations such as health and fitness, wellbeing, weight control, may be identified as motives for engaging in cycling (Brown, O'Connor & Barkatsas, 2009). However, the nature of the added complexities of equipment, type of engagement, body shape and size, culture of belonging, sociality (Strong, 2005) provide additional constraining factors which warrant cycling specific study and is identified in a gap in existing literature which this thesis seeks to address.

Moving forwards, the remainder of this section of the literature review will explore segmentation through an investigation of further interest for taking part in cycling, motivations for cycling and studies in the field.

2.2.3 Methods of Segmentation in the Cycling Sector

Whilst segmentation in extant academic literature (Kotler, 1991; Lovelock & Wirtz, 2011; Solomon, 1999; Tynan & Drayton, 1987), can provide insights to assist with the identification of demographics and sociographic. Cycling was originally seen as a mode of transport utilising two wheels dating back to 1817, designed in German and named the draisine. However, the term bicycle did not come to fame until the 1860s to describe the symbolic penny farthing cycle. The initial offering of the bike was as a mode of transport and serve the functional purpose of moving people. Moving forward 200 years and the bike is no longer solely a method of transport (Ton & Duives, 2021; Wardman, Hatfield & Page, 1997). The need to understand the motivations of cyclists is significant to this thesis, due to the development and growth of recreational cycling (Downward & Lumsdon, 2002; Lumsdon, 2000; Nguyen & Pojani, 2022).

The question of motivations of cycling is not new with several studies exploring this. Simonsen and Jorgenson (1998) stipulated a standardised based approach, with all cycling participants falling into one homogeneous group. Whilst the work of Faulks, Ritchie and Dodd (2008) further developed the significance of the 'bicycle' as the item of motivation, it does little to understand the unique characteristics of different market segments. When exploring the literature, the need to review the differences in motivations of road vs mountain bike becomes apparent. For example, research by Brown et al. (2009), Streicher and Saayman (2010) draws similar conclusions on the typologies of road cyclists: i.e., typically in their mid-thirties, male, bilingual, highly educated, from surrounding provinces, whereas a number of studies into mountain bike typologies concluded a younger male audience (Cessford, 1995; Getz & McConnnell, 2011; Morey, Buchanan & Waldman, 2002). In addition, Getz and McConnnell (2011) defined the mountain bike typology of: late thirties, professional background and active personality type. This was further supported with the notion of mountain bike cyclist having a high level of education, a high degree of club involvement and high level of experience in the sport, alongside being involved in other sports such as tramping, running and walking (Getz & McConnnell, 2011). Whilst the insight into the characteristics of cyclists acts as starting point of segmentation, the need to understand motivations of the cyclist are of significance to this thesis, in order to devise higher levels of understanding of the intrinsic and extrinsic motivations (Locke & Schattke, 2019; Frederick-Recascino & Schuster-Smith, 2003). Moving on, this chapter moves to defining motivation, appraising the body of associated literature, and finally positioning the gaps that exist within the literature.

Motivation as a term is used in different ways to serve the nature of the context; in its simplest form, motivation can be described as any sort of general drive or inclination to do something (Baumeister & Vohs, 2007). Thus, motivation is the driving force to compel an individual to take action, however it requires sufficient pressure to drive the person to act (Kotler & Gertner, 2002). This leads to literature of self-determination theory (SDT), (Deci & Ryan, 1985) which distinguishes the two themes of intrinsic motivation and extrinsic motivation. Pride and Ferrell (2000) define intrinsic motivation as the internal energising force that orients a person's activities, in order to experience pleasure and satisfaction inherent in the activity, whereas extrinsic motivation, pertains to a wide variety of behaviours where the goals of action extend beyond those inherent in the activity itself (Deci & Ryan, 1985). Often SDT, along with intrinsic and extrinsic motivation, is applied within sporting and leisure contexts (Ryan & Patrick, 2009). Due to critique of earlier work, Deci & Ryan (2000) evolved the debate further and stipulated opposite ends of the spectrum with varying degrees of individual autonomy being proposed.

For the nature of this thesis, the most encompassing definition posited by McNeal (2007) is adopted. This definition suggests that "motivation occurs when a need is aroused that the consumer wishes to satisfy leading to motives driving purchases and all other human behaviours (except reflexes)" (McNeal p. 303). The need to understand the motives from the consumer perspective is inherently significant to the scope of this thesis. Moving forward, this chapter will examine literature on sports motivations, in order to further understand the Self Determination Continuum as other studies have utilised this framework within the sports field.

2.2.5 Self-Determination Theory and Motivation in Sport

Haggar and Chatzisarantis (2007) draw the conclusion that SDT has been consistently applied to the context of sport and exercise, in terms of participation and achievement. Consulting the extant literature it become apparent there are differences between motives for sports and exercise. Frederick & Ryan (1993) investigated the reason individuals engage with sport and exercise through a survey approach noting the importance of intrinsic motivation for engagement in both sport and exercise. However, respondents who engage in sport were significantly more intrinsically motivated, whereas exercise was significantly more motivated by extrinsic motives such as physical appearance. In addition, Frederick and Ryan (1993) concluded the level of involvement in sport being of importance, along with amateur levels of sport being more intrinsically motivated.

This insight leads to the understanding that sports are played for extrinsic goals such as interest and enjoyment (Lamont & Kennelly, 2012). Due to the motivation of interest and enjoyment for playing sport, numerous studies have identified factors which limit engagement: sports participation, controlling coaching climates, contingent reward motivators, and evaluative pressures (Fortier, Vallerand, Brière & Provencher, 1995; Vallerand & Losier, 1999). However, the long-term sustained motivation of sports participation is supported by fostering perceived competences and autonomy-enhanced enjoyment (Goudas, Biddle & Fox, 1994; Goudas, Biddle & Underwood, 1995; Hagger, Chatzisarantis, Culverhouse & Biddle, 2003).

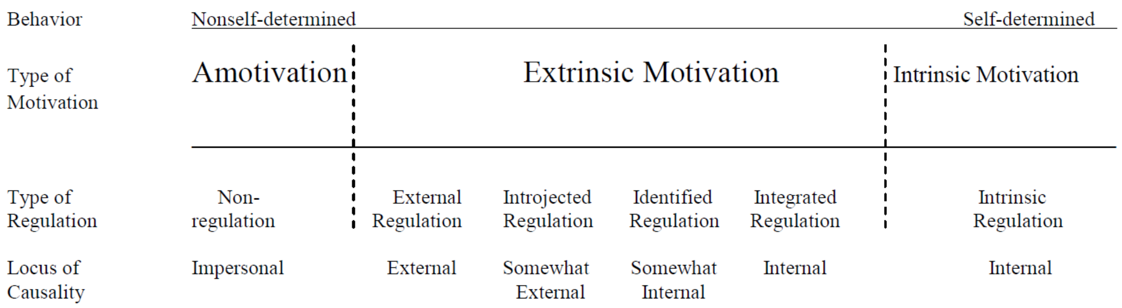


Figure 2.2. Self-determination continuum (Ryan and Deci 2002)

The academic literature concludes that participation in sports is more intrinsically motivated than exercise as in order to maintain exercise over time, the importance of extrinsic motivation is vital (Ryan et al., 1997; Wankel, 1993; Sheehan, Herring & Campbell, 2018). Whilst people initially engage in exercise for extrinsic motivations (e.g. appearance, health, improved fitness), if they do not discover its inherent satisfaction they are unlikely to persist (Ryan, Frederick, Lepes, Rubio & Sheldon,1997; Wankel, 1993).

Moreover, additional studies support the notion of balance, suggesting the need for both intrinsic and well-internalised extrinsic motivation to strike the balance (Matsumoto & Takenaka, 2004; Vlachopoulos, Karageorghis & Terry, 2000; Wilson, Rodgers & Fraser, 2002). In order to exercise more, intrinsically motivated research has noted that people can be given choices about when and how they engage in the activity; exercise goals can create optimal challenge; an atmosphere of relatedness can be created; guided using methods that are autonomy supportive (Hagger, Chatzisarantis, Culverhouse & Biddle, 2003; Mandigo & Holt, 2004; Wilson, Rodgers, Blanchard & Gessell, 2003). Whilst research finds differences within motivations for taking part in exercise and sport, the particular interest in the field of self–determination theory in the context of sports will be explored next within this chapter.

The exploration of SDT is a well-ridden path in terms of sports motivation (Teixeira, Carraça, Markland, Silva & Ryan, 2012). Research commences with the concept of basic physical needs, as the starting point of the understanding, with Ryan and Deci (2002) arguing the basic psychological needs of autonomy, competence, and relatedness being essential to the psychological health and the development of internal motivation (seen in Figure 2.2). Once these needs are satisfied this results in increased feelings of vitality and well-being (Ryan & Deci, 2002). This highlights the significance of engaging in sport and exercise and results in being more or less conductive to having one's psychological needs realised (Wilson, Rogers, Rodgers & Wild, 2006).

The study by Teixeira et al. (2012) critically appraises the literature of SDT in sport linking the importance of the social milieu as being of critical importance. The social milieu is important throughout the three stages: through supports needs of autonomy (supporting choices), relatedness (creating a positive environment) or competences (providing continuous challenging takes). Deci and Ryan (2000) noted the concept of needing support, thus largely explained as an individual difference in the development and enactment of motivation across the lifespan. This leads to research into the field of design of health behaviour focusing on exercise and physical activity and the ability to enhance satisfaction as much as a focus on SDT studies (Fortier, Sweet, O'Sullivan & Williams, 2007; Silva et al., 2010).

Later research focuses on SDT exploring goal contents, through a range of behaviours being of significance to this study within sport (Sebire, Standage & Vansteenkiste, 2009; Vansteenkiste, Niemiec & Soenens, 2010). Whilst a vast array of literature draws on motivations (Fortier, Sweet, O'Sullivan & Williams, 2007; Silva et al., 2010), the theory goal contents draws the outcome of the individuals, by engaging in the behaviour especially where the goal contents are being differentiated, according to their ability to meet and satisfy basic psychological needs (Deci & Ryan, 2000). Literature on SDT draws a distinction between intrinsic goals (e.g. seeking affiliation, personal growth, or health), as they offer the ability to meet basic psychological needs or extrinsic goals (e.g. seeking power and influence, wealth or social recognition), with studies showing the predicted differential consequences of intrinsic versus extrinsic goal importance (Grouzet et al., 2005; Kasser & Ryan, 1996, Teixeira et al., 2012). The view of motivation into cycling is important to consider for the nature of the thesis and the next section will now move to this element.

2.2.6 Segmentation in Cycling

Academic literature on motivations and segmentation in cycling is fragmented, from a range of disciplines most notably: research into sport and public transportation (Kim, Fredline & Cuskelly, 2018; Haustein & Møller, 2016). However, reviewing this literature it is important to understand the motives, attitudes and behaviours of cyclists. The importance of this is stressed by Fernández-Heredia, Monzón and Jara-Díaz (2014) showing that attitudes can directly influence the intention of cycling, but also the perception of the benefits of and barriers towards cycling. The barriers towards cycling seem to be paramount through the research (Parkin, Ryley & Jones, 2016), resulting from basic ideas upon the demographic of the cycling commuter (Deakin, 1985) or grouping of cyclists by the length of trip and purpose of the trip leading towards several segments based on commuting length (Li, Wang, Yang & Ragland, 2013). Whilst these studies begin to demonstrate how audiences can be segmented, the analysis lacks a development beyond functional uses of cycling.

Further critiques of earlier research are offered by Damant-Sirois and El-Geneidy (2015), who considered both the frequency of commuting and utilitarian cycling trips (i.e. shopping, grocery shopping and social activities). The use of 35 variables using factor analysis created seven components: impact of weather and effort, time efficiency, peer and institutional encouragement, cycling identity and enjoyment, presence of bicycle infrastructure on the decision to cycle, and the presence and speed of cars, and the parental encouragement during childhood. This resulted in the creation of four consumer typologies: Dedicated cyclists, Path-using cyclists, Fairweather utilitarians, Leisure cyclists. These typologies are reviewed in Table 2.3, through a study based in Montreal and offer the first significant insight into segments of cyclist types (Damant-Sirois & El-Geneidy, 2015)

Segment	Motivations cycling	Identity Cyclist	Environmental
Dedicated cyclists (24%)	Speed, predictability, and flexibility of cycling.	Strongly identify as enjoying riding their bicycle	Less keen on using separate infrastructure. Not deterred by adverse weather conditions
Path-using cyclists (36%)	Cycle both as a sport or recreational activity, as well as to reach various destinations.	Strongly identify as cyclist motivates them to cycle and enjoys riding their bicycle	Not strongly impacted by weather conditions Dislike cycling near cars. Prefer infrastructure that separates cycling traffic.
Fairweather utilitarians (23%)	Contextual users, choose another mode if they perceive it as more convenient.	Do not identify as cyclists'.	Unlikely to cycle in bad weather. Prefer to use bicycle paths Influenced by peers and institutional encouragement
Leisure cyclists (17%)	Cycle because they enjoy cycling as a hobby or as a family activity rather than for transportation.	Identify themselves strongly as cyclists	Prefer to use infrastructure segregated from traffic. Prefer not to ride close to parked or driving cars.

Table 2.3: *Four consumer typologies for using the bike. Adpated from Damant-Sirois and El-Geneidy, (2015)*

However, the focus on generic groups is too broad to provide the level of context need to define distinct groups, particular in the context of behaviours, this could in part be down to the focus on transport as the theme of the research, and the differences that exist for commuter cyclists. In understanding the reactional cyclist, the behaviours are of paramount importance.

A study conducted by British Cycling (2015), which looked at segmentation in response of the growth of road cycling and found the importance of behaviours aligned to two themes: my place to marvel (values and meanings associated with the extended distances that cycling in the countryside encourages) and simple joys (the feelings aroused by the physically challenging and thrilling terrains that are negotiated). This study of middle-aged men, who defined themselves as serious reactional cyclist, stressed the importance of behaviours being multifaceted experiences outlining the following qualities: volition in selecting one's physical challenges; opportunities to feel pleasure; the chance to engage with natural aesthetics; to experience mindful awareness; and to enjoy solitude yet also connect with others. These motives for engaging with cycling boost the participants' perceived psychological wellbeing not only in the immediacy of green cycling but afterwards also.

The study by British Cycling (2015) poses a potential interplay between these qualities and as such suggests motives for partaking in cycling do not exist in isolation, with clear links to SDT in sport with goal content discussed early in this chapter. However, the British Cycling study (2015) is not without its critique, most noticeably sample selection of an engaged audience as its sample selection invited members of British Cycling and thus does not collect a representative sample of UK cyclists. However, it stipulates the opening of new avenues that warrant further investigation including nature's potential to engage more self-determined behaviours.

2.2.7 Sports Management Scales and SDT in Cycling

Research by Brown, O'Connor and Barkatsas (2009) stipulates serious leisure' cyclists are fitness seeking enthusiasts who attach different meanings to the act of cycling and participate in different physical, social and natural environments in comparison to other (non-serious) cyclists. In other words, they are highly engaged and motivated in a leisure interest, or as Mintel (2022) defined as serious cyclists. The resulting literature combines a range of frameworks most noted for the sports science field of study: Sports motivation scale, Leisure Management Scale, which measure both intrinsic and extrinsic motivations for engaging with the desired sport.

Whilst these insights provide an interesting context for this thesis, it is noted these scales were created in the sports management field to understand the interest and reasoning for engaging in sport (Funk, Mahony, Nakazawa & Hirakawa, 2001). Taking into consideration the context, Cox (2005) highlighted the need for research to examine the varied sub-cultures of cycling and cyclists beyond an oversimplistic “one size fits all” (p.5) interpretation. Drawing on sports management and leisure management scales in cycling is important to understand the context of this thesis, given the hobby nature of cycling (Lőrincz, Banász & Csapó, 2020) and along with the high level of product (i.e. cycling) involvement (Bloch & Bruce, 1984).

The work of Brown, O’Connor and Barkatsas (2009), leads to the development of the Cyclists Motivation Instrument (CMI) and uses its 39-item instrument. This leads to the first instrument incorporating themes of: social, cultural, economic and ecological factors associated with the motivation of an understudied sub-group of ‘serious-leisure’ cyclists. Data was collected through 32 focus group interviews of series leisure cyclist established the content validity and assured the general themes. The survey yielded 422 respondents resulting in scale reliability of $\alpha = .92$ with four out of five subscales demonstrating moderate to high reliability. Whilst the reliability is highly regarded for such a scale in cycling, what is important is “to understand lifestyle sports…to start with the participants and their understandings” (Tomlinson et al., 2005, p. 38), in part due to the 32 group interviews with serious cyclists. This study does encounter some critique, most noticeably the low female response of approximately 12% and the lower reliability of the final factor of physical health outcomes as the low internal consistency level, α = .63.

The aforementioned study by Lamont and Jenkins (2013) to understand the motivations for participation within the adoption of Leisure Motivation Scale (LMS) originally found within the study by Beard and Ragheb (1983). Having already been applied across several leisure interests the 31-point scale measures participant motives in a range of leisure activities (Mohsin & Ryan, 2007; Ryan & Glendon, 1998; Ryan & Huyton, 2000).

Within the work of Lamont and Jenkins (2013) critique can be levelled at the utilisation of the sample selection of intermediate cyclists and expert cyclists. However, converting this leisure management scale to the sport of cycling sees the creation of a context focus motivational scale which supports the views of Brown, O'Connor and Barkatsas (2009) and thus the understanding of motivations for cycling (Lamont & Jenkins, 2013), which is central in supporting the study's aim. As their study was concluded on cycling-based event the factors on the level of involvement with the sport cycling will be used within the final conceptualised framework. The rationale for using involvement in cycling by Lamont and Jenkins (2013) is particularly strengthened by the context of these questions (e.g. length of time as cyclist) as this has been validated within a cycling study.

On closer inspection into motivation in sport, literature draws on the significance of the seminal study by Pelletier et al. (1995), the sport motivation scale (SMS). The SMS resulted in the creation of seven subscales, which measure the three types of Intrinsic Motivation (IM to Know, IM to Accomplish Things, and IM to Experience Stimulation), three regulation for Extrinsic Motivation (Identified, Introjected, and External), and finally Amotivation (Pelletier at al 1995) Within this initial research seven scales were tested over three studies, with the outcome being that self-determined forms of motivation were associated with more positive responses on related consequences (Pelletier at al 1995). As such, SMS has become influential in informing other studies, with the original paper (Pelletier at al., 1995) being cited 2,753 times when consulting Google scholar (December 2022). Additional studies into SMS have consistently supported the scale and maintained internal consistency, construct validity, and simplex-like pattern across multiple samples (Chatzisarantis et al., 2003).

More recent research including Pelletier et al. (2013) conducted meta-analysis comparing the SMS subscale with correlation coefficients, across 21 studies, which provided robust support for the construct reliability and validity of the scale along with Dwyer and Kim (2011) and has used the same scales to investigate motivation of sports into SDT. Other studies such as Schlemmer, Barth and Schnitzer (2020) and Karisman (2022) have used SMS specifically in cycling based studies. The scale of using SMS over a long period of time ensures its validity and credibility as an instrument to measure intrinsic motivation, extrinsic motivation and amotivation (Chatzisarantis et al., 2003; Pelletier et al., 2013).

In understanding the motivations of the SDT, this thesis will use SMS to segment cycling audiences to understand the motives of cyclists as using the seven sub-themes: Intrinsic Motivation (IM to Know, IM to Accomplish Things, and IM to Experience Stimulation), three regulations for Extrinsic Motivation (Identified, Introjected, and External), and Amotivation. These themes are seen within other fields of motivations of taking part in sport and cycling through the SDT literature (Deci & Ryan, 1985) and as such posited as the ideal themes to investigate further into motivations for cyclists.

Moving on, the literature review will move to investigate customer engagement, to gain a deeper understanding of customer engagement before moving onto engagement through mobile apps.

2.3 Customer Engagement

2.3.1 Customer Engagement Context and Definition

The concept of engagement differs across a variety of different contexts. Management literature views engagement as an organisational activity that focuses on internal stakeholders (Catteeuw, Flynn & Vonderhorst, 2007; Crawford, LePine & Rich, 2010; Greenwood, 2007; Noland & Phillips, 2010) whereas marketing literature notes engagement viewed as activities of the customers towards the organisation and is commonly termed customer engagement (CE). (Kumar et al., 2010; Brodie et al., 2011; Vivek et al., 2012). Marketing literature is of significance for the purpose of the thesis as research into CE is an outcome measure of the firm’s activities, in the recent past (Kumar et al., 2010; Brodie et al., 2011; Vivek et al., 2012). This section of the literature review explores the context of engagement, commencing by defining CE, followed by appraising the body of literature, and finally positioning the gaps that exist within the literature.

2.3.2 Customer Engagement Defined

Engagement as a concept was created by Kahn (1990), whose research viewed it as a psychological pre-condition. Literature demonstrates a change within the definition of customer engagement over time. Forrester (2007) suggested customer engagement to be a level of consumer involvement, interaction, intimacy and influence an individual has on brand over time. Whilst Forrester provides an interesting starting point the work of Vivek et al. (2012) furthers the definition, suggesting CE is to be an intensity of an individual’s participation in and connection with an organisation’s offerings and/or activities, which either the customer or the organisation initiate. Vivek et al.’s (2012) definition develops the initial workings of research to include ‘initiate’ coming from the customer or the organisation composed of cognitive, emotional, behavioural, and social elements.

For the nature of this research the definition offered by Vivek et al. (2012) is used as the basis for the remainder of the study, which states that “CE as the intensity of an individual’s participation in and connection with an organisation’s offerings and/ or organisational activities, which either the customer or the organisation initiate” (p. 127). This work suggested that when a relationship is satisfied and has emotional bonding, it then progresses to the stage of “engagement” (Vivek et al., 2012). Additional research supports CE comprising cognitive, emotional, and behavioral dimensions (Patterson, Yu & de Ruyter, 2006; Vivek, Beatty & Morgan, 2010; Hollebeek, 2011; Mollen & Wilson, 2010). This further supports the rationale for using Vivek’s definition for the remainder of the thesis.

2.3.3 Customer Engagement Origins

Since 2005, the term “engagement” has been increasingly adopted in academic marketing literature (Brodie et al., 2011), with Roderick et al. (2011) noting that prior to 2005 very few academic articles used the terms ‘‘consumer engagement,’’ ‘‘customer engagement,’’ and/or ‘‘brand engagement’’.

When consulting more recent research into CE, Harmeling et al. (2017) further noted the exponential expansion of research into the CE over the decade period. Often the growth of CE studies is attributed to digital technologies as further platforms are developed to collect data and engage with consumers (Lim et al., 2021). Literature notes the expansion of CE in line with social media coming of age (Nielsen, 2012) and then rising as social media continued to thrive (McFadden, 2020), thus drawing the conclusion that growth of CE was accelerated by social media, as it provides its primary facilitation (Lim et al., 2021). This is illustrated in Figure 2.3, taken from a literature review of CE by Lim et al. (2021) showing a fivefold increase from 2006-2010 (35 articles) through to 2011-20 (117 articles), to the most number of outputs in 2016-2020 (649 articles) showing "the popularity of CE and the mushrooming of its research" (Lim et al., 2021, p. 440).

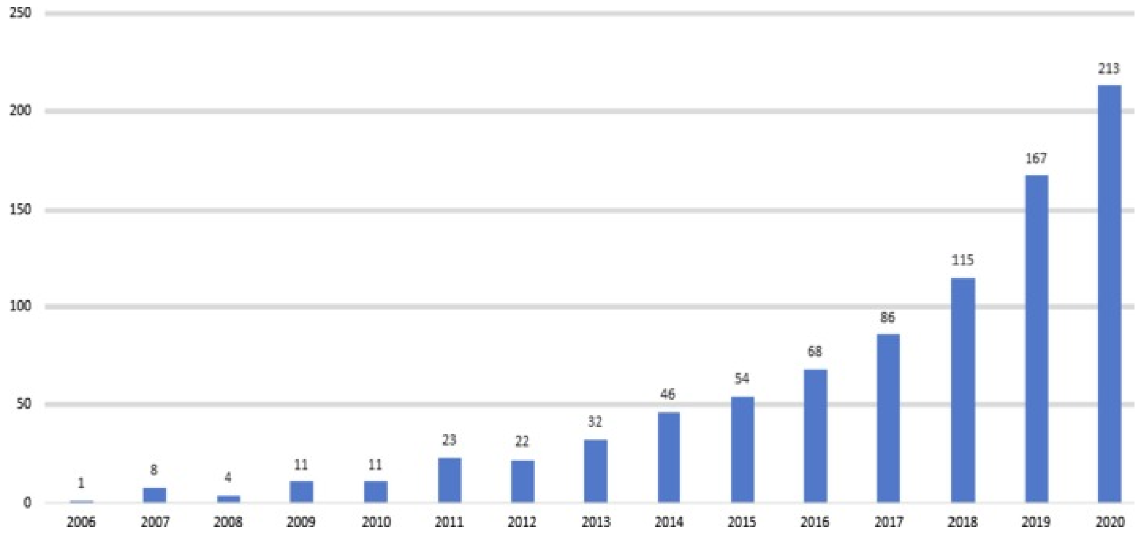


Figure 2.3. *Customer engagement growth of academic published papers (Lim et al., 2021)*

The origins of CE are seen within Figure 2.4 below, which sees an evolution from a transactional approach, through to relationship marketing (Morgan & Hunt 1994; Berry 1995) over a period of the late 1990s and the early 2000s, showing a positive relationship of customer engagement leading towards satisfaction and ultimately loyalty. The evolution to term "engagement" has risen among marketing academics and marketing professionals to develop the satisfaction and emotion. More recent research by Pansari and Kumar (2017) is significant to the study, concluding that when a relationship is satisfied and has emotional bonding, it then progresses to the stage of "engagement".

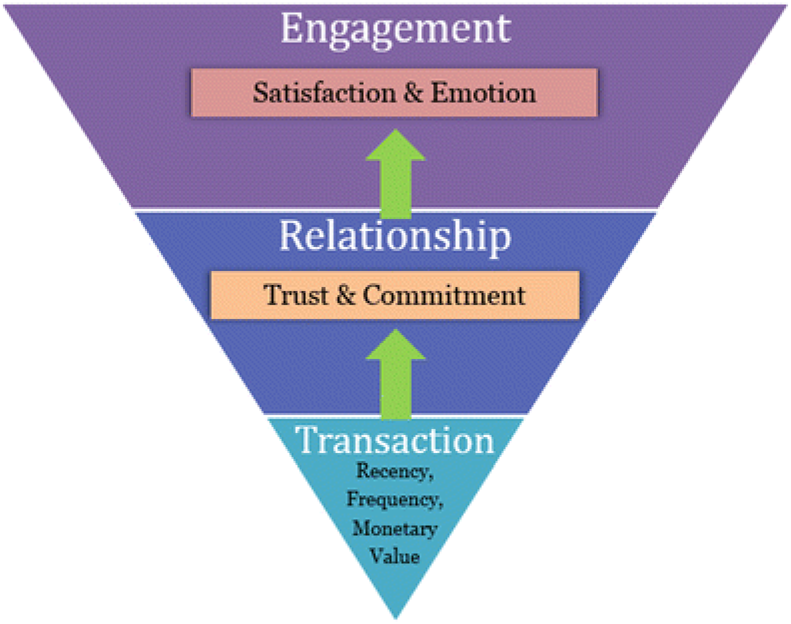


Figure 2.4 – *Origins of Customer Engagement* (Pansari & Kumar, 2017)

Literature has a variety of constructs, which are used to define and contextualise CE. In order to appreciate CE and to define the scope of the study this chapter will now look at reviewing the constructs of CE with literature consistently drawing upon the customer centric measures of customer satisfaction, customer involvement, customer loyalty, customer trust, customer satisfaction, customer commitment, and customer brand value to generate the constructs of CE (Pansari & Kumar, 2017).

Customer involvement is a vital dimension of CE contributing to the “relevance of the object based on inherent needs, values, and interests” Zaichowsky (1985, p. 342). Customer involvement as noted by Delgado-Ballester and Munuera-Aleman (2001) is the information seeking stage of purchase in order to reduce the risk of decision-making processes. The nature of this occurring pre-purchase leads to critique that CE can encompasses both purchase and post purchase stages of decision-making processes (Pansari & Kumar, 2017). Thus the role of customer experience is often considered as holistic in nature and includes customers’ cognitive, affective, emotional, social and physical responses to the entity, product and service (Verhoef et al., 2009), suggesting that customer experience can be examined through a number of lenses and number of marketing activities such as the customer experiences.

On consulting recent research from Lim, Rasul Kumar and Ala (2022) and Stocchi, Pourazad and Michaelidou (2022) stresses the reimagining of CE through virtual reality, augmented reality, and gamification. Whilst the themes are reviewed in greater depth through the literature review of mobile apps in Sections 2.4-2.9. The recent review of mobile apps by Stocchi, Pourazad and Michaelidou (2022), synthesizes the existing knowledge of mobile apps, with a comprehensive in-depth bibliographic analysis of 471 studies. In the synthesis of existing academic research Stocchi, Pourazad and Michaelidou (2022) combine customer experience, customer journey, value creation and co-creation, digital customer orientation, market orientation, and competitive advantage.

The study of Piccoli, Brohman, Watson and Parasuraman (2009) viewed apps as dynamic packages of service provision which offer bundles of functionalities and experiences that facilitate value creation and including opportunities for co-creation (Kumar, Purani & Viswanathan, 2018; Lee, 2018). Of particular significance to the studies, is "considering existing marketing research on always on points of interaction, substantial gaps emerge in relation to apps' marketing mix" (Stocchi, Pourazad & Michaelidou 2022, p. 216). This substantial gap in the marketing app strategy is proposed as being vital for the provision of positive customer experiences and rewarding journeys and for the creation and co-creation of value. (Stocchi, Pourazad & Michaelidou, 2022). This leads Stocchi, Pourazad and Michaelidou (2022) to argue the importance of further research on "different types of apps and different consumer segments, the trigger of positive customer experiences and journeys lies in ensuring that the consumer sees value in the app" (p. 216). The focus on understanding mobile apps functions is a vital element of the thesis, along with clusters deriving value from the functionality of mobile apps (Zhao & Balugue, 2015), which are reviewed in the literature review of mobile apps in Sections 2.4-2.9.

2.3.5 Customer Engagement Theoretical Underpinning

Whilst the literature exploring CE is emerging, it is accepted that literature within this field is within its infancy (Brodie, Hollebeek, Juric & Ilic, 2011; Gambetti & Graffigna, 2010; Hollebeeck, 2011). This literature review draws upon a wide amount of conceptual work and a smaller amount of empirical research within customer engagement to further understanding of the CE concept.

The first significant study of CE came through the work of Bowden (2009), who conducted research into the business to consumer relationship. Through a study of restaurant dining experiences Bowden (2009) discovered CE through both brand and loyalty is fostered at different consumption stages, concluding that new and repeat purchase segments of customer exhibit different attitudes and behaviours, further research supports this through studies by Vivek et al. (2012), Hollebeek (2011) Kumar et al. (2010), Kumar and Pansari (2015), Pansari and Kumar and (2017). Whilst the body of literature identifies both the attitude and behaviour-based attributes, others such as Van Doorn et al. (2010) only identify behaviour whilst Brodie et al. (2011) only identity attitude due to the research looking at the concept of CE through service dominant logic. (See Appendix 6 for an overview of key literature).

The debate exploring attitude and behaviour offers different viewpoints, for example Oliver (1999), defined loyalty as a customer’s positive attitude and behaviour towards a brand which is manifested through a customer's propensity to repurchase a preferred brand. However, as the world of digital technologies evolves its argued engagement is more than purchase attitude and behaviour (Wirtz, 2013). Thus, attitudinal engagement improves the feelings towards an organisation/brand with the propensity to transition from attitudinal to behavioural loyalty (Harrigan, Evers, Miles & Daly, 2018; So, King, Sparks & Wang, 2016). Behavioural engagement is noted as directly influencing firm performance (Verhoef et al., 2010), with referral of a new customer and/or providing positive reviews in social media enhancing firm performance (Kumar & Pansari, 2016).

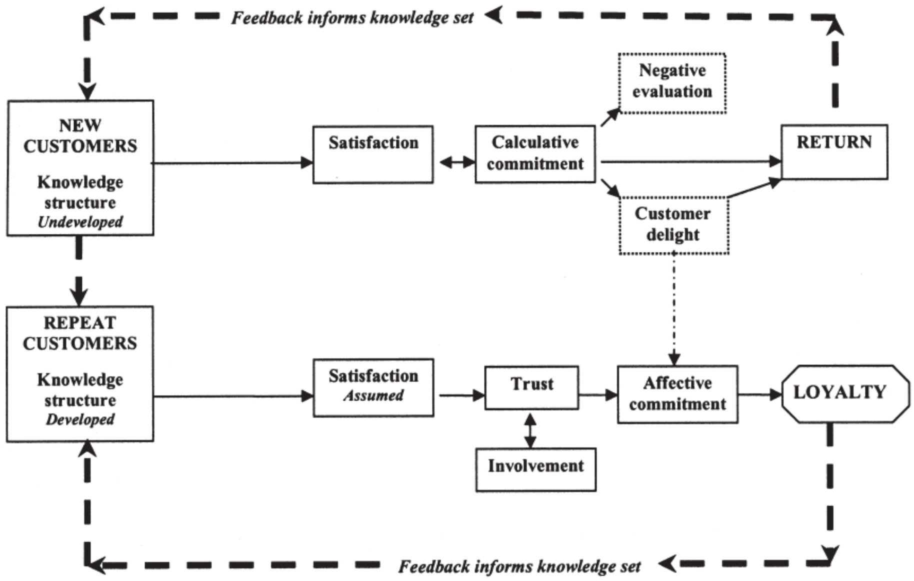


Figure 2.5; *A Conceptual Framework for the Process of Engagement (Bowden, 2008)*

The initial study by Bowden (2009), resulted in conceptual findings concluded with a devised model as illustrated in Figure 2.5 above with the underlying mechanisms by which new customers form loyalty (satisfaction, calculative commitment) and the mechanism forhow loyalty can be maintained for repeat purchase customers (involvement and trust) and how it affects commitment and brand loyalty within the context of a service brand. Van Doorn et al. (2010), Vivek et al. (2012) and Brodie et al. (2011) show similarities within the conceptual frameworks of Bowden (2009). Van Doorn et al. (2010) presented the dimension of framework including valence, form/modality, scope, nature of impact, and customer goals. The dimension of valance is defined as from a firm’s perspective customer engagement can be classified as positive or negative

(Brady, Voorhees, Cronin & Bourdeau, 2006), which shows similarities to Bowden (2009). This is further explored with studies by Kumar et al. (2010) and Pansari and Kumar (2017) who stipulated that customer satisfaction can lead to two outcomes: customer referral behaviour and customer influence behaviour.

The work of Van Doorn et al. (2010) however, differs in terms of form and modality of customer engagement, it notes the customer behaviours (in-role behaviours, extra-role behaviours, elective behaviours) stem from motivational drivers such as word-of mouth activity, recommendations, helping other customers, blogging, writing reviews. Bowden (2009) lacked focus on any time sensitive nature or geographical opportunities, which is in sharp contrast to Van Doorn et al. (2010) who defined the need for scope as both temporal and geographic, with temporary being momentary or ongoing. With the nature of momentary engagement, organisations should assess the likely brand/firm level outcomes and act accordingly and monitor the ongoing customer engagements. Van Doorn et al. (2010) noted the significance of customer engagement going beyond local reach and the global impact of co-creation further supported by Brodie et al. (2011), Kumar at el (2010) Kumar and Pansari (2015 and 2017) due to the virtual interactive nature of customer engagements.

The virtual nature of customer engagement is further investigated with Van Doorn et al. (2010) exploring impact, which is conceptualised in terms of the immediacy of impact, intensity of impact, breadth of impact, and the longevity of the impact. Technology is affecting the speed of impact, due to Internet-based customer engagements and multi-channel platforms customers can choose to engage with brands. Customer goals are stipulated within the study by Van Doorn et al. (2010) who offered questions directed towards the level of planning of the engagement and alignment with customer and organisation goals. Other research draws different conclusions, particularly Vivek et al.

(2012) which shows CE activities can be initiated by either the customer or organisation and goes on to cover the significance of trust as a consequence of CE. Van Doorn et al.'s (2010) study is not without its criticism, due to the proposed CE behaviour as a uni-dimensional construct (Thakur, 2016). Many other scholars have conceptualised research on engagement as a multidimensional construct (Bowden, 2008; Calder, Malthouse & Schaedel, 2009; Hollebeek, 2011; Mollen & Wilson, 2010). An overview of the literature review for customer engagement is provided in Appendix 7. Moving forward, this chapter will look at customer engagement within the context of mobile and mobile apps to position the research.

2.3.6 Positioning the Research

Research within CE is considered to be in its infancy (Bowden 2009) and often conceptualised in nature and descriptive (Brodie et al., 2011; Sashi, 2012; Van Doorn et al., 2010; Viveket al., 2012) which offers scope for further research. The literature review turns towards and explores the empirical findings of CE within the context of sectors and mobiles apps to further position the research.

Fernandes and Fabia (2016) examined differences within customers' propensity to engage and loyalty behaviours in two service settings, health care and retail, via a cross-sectional survey of 516 consumers. The nature of the two settings differed in product involvement from high (healthcare) and low (retail) and resulted in differences in exhibited behaviours. Healthcare showed more favourable behaviours though more likely to spread word of mouth, less price sensitive along with less likely to complain in contrast to the retail sector (Fernandes & Fabia, 2016).

Whilst the study attempts to explore the level of product involvement and its impact upon CE, it creates need for further research due to its use of sector as level of involvement rather than product. Additionally, Harrigan et al. (2017), demonstrated a difference between customer involvement with a tourism social media brand is an antecedent of customer engagement; while customers' behavioural intention of loyalty is a consequence of CE. The work of Fernandes and Fabia (2016) is critiqued by Harrigan et al. (2017) as their study based on the utlisation of the tourism sector, which demonstrates more advancements in terms of customer engagement. The customer involvement in spreading word of mouth, being less price sensitive (Fernandes & Fabia, 2016) can be seen as antecedent of customer engagement rather than measuring the customer behaviour intention of loyalty as the consequence of the customer engagement (Harrigan et al., 2017).

A study by Thakur (2016) is of particular significance to the research topic, given its focus on developing and validating a measurement model for customer engagement with specific focus on mobile devices for shopping. The study resulted in construction of six different customer experiences: social-facilitation, self-connect, intrinsic enjoyment, time-filler, utilitarian and monetary evaluation experiences. This study identifies customer use mobile platforms to satisfy different motives, for example the research notes mobile is preferred by consumers in certain shopping situations that create higher emotional values such as filling spare time. Exploring this study there is a clear link to the five functions of mobile apps presented later in the chapter by Zhao and Balague (2015). In addition, of particular importance to this thesis is that Thakur (2016) established a significant role of customer engagement in predicting customer loyalty in addition to existing constructs of satisfaction and convenience, seen within figure 2.6.

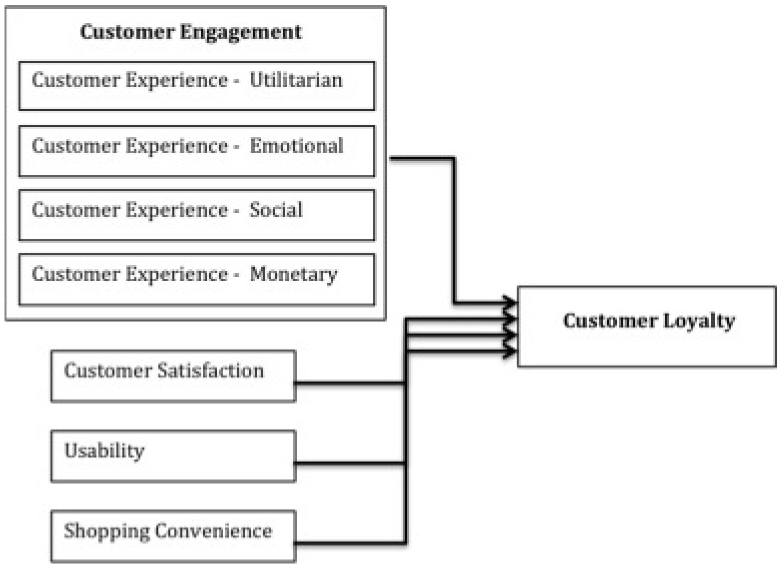


Figure 2.6: *Six Motives for Customer Engagement Mobile Apps* Thakur *(2016)*

The empirical findings were presented over three stages of research; firstly creating 74 items identified through 10 interviews with engage mobile retailers, before screening with CE stakeholder panels including consumers, managers and academics, and finally a survey that resulted in 42 items (Thakur, 2016). The methodical approach with multiple stages of data collection builds the conceptualising of customer engagement with mobile apps to the empirical findings of six motivations for consumers to engage with mobile apps.

The six motives of customer experience (social-facilitation, self-connect, intrinsic enjoyment, time-filler, utilitarian and monetary evaluation experiences), are the first-time engagement reviewed through the lens of mobile apps. As mobile apps have influenced consumer attitudes (Zolkepli, Mukhiar & Tan, 2021), then the significance of engagement including mobile apps is vital to the study to achieve its aims. The six motives for CE of mobile apps presented by Thakur (2016) provide the thesis with a framework to segment audiences according to their engagement with mobile apps.

Moving forward, the next part of the literature review will investigate mobile apps with the focus being on functions of mobile apps in the cycling context.

2.4 Mobile Apps

2.4.1 Context and Defining

When Apple launched the smartphone in June 2007, this game changing technology revolutionised the marketplace due to its laser eye focus on meeting the user experience (Tidd & Bessant, 2020) and debuted the mobile application (mobile app) via the introduction of Apple App store on the 10th of July 2008. Originally there were 500 apps (135 were free apps) further aiding the user experience.

Over time development has occurred with the marketplace of apps stores with the competitive landscape now including: Google Play, Microsoft Stores, Amazon Appstore place, Blackberry Word, Ovi (Nokia), Samsung Apps, Opera Mobile Store and F-Droid. However, the biggest apps stores in the current market at the end of quarter three in 2022 are Apple App store (1,642,759) Google Play (3,553,050) and Amazon Appstore (483,328) (Statista, 2022c). The size of the three mobile apps stores stresses the importance that consumers and brands place upon apps, giving rationale to the focal point of this thesis, as an underexplored field of academic research (Sciandra, Inman & Stephen, 2019). Whilst the smartphone and mobile app was Steve Jobs's vision, for the technology world to have platform to share software, it is important firstly to consider the smartphone and how it has revolutionised the world (Forbes, 2020), a fact commemorated by the mobile phone museum 2021 (BBC, 2021).

When consulting academic literature, definitions of mobile phones are drawn from "any marketing activity conducted through a ubiquitous network to which consumers are constantly connected using a personal mobile device" (Kaplan 2012, p. 130). The smartphone engages consumers as the devices capture users' attention (Pasqua &

Noah, 2012) and enables users to indulge in ‘me time’ (Staff, 2013). It is critical to state that ‘me time’ (Staff, 2013) distinguishes the mobile phone over other technologies and allows users to form a different relationship with the device and, importantly for marketing practitioners and academics, beyond the device with brands and communities.

The mobile app needs to be considered through the branded mobile app for the nature of this study, as the focus on the thesis is within this domain. Bellman, Potter, Treleavean- Hassard, Robinson and Varan (2011) defined the nature of the branded app as software that is downloadable to a mobile device and prominently displays a brand identity, throughout the user experience, often displaying the name of the app and/or the appearance of a brand logo or icon.

The growth in mobile apps seen within a recent Mintel report (2022), with sales of mobile apps in 2021 reaching an all-time record breaking high of £3,247.5m, while 2.2 billion apps were downloaded in the UK in the same year. The expansion of mobile apps in terms of downloads has resulted in consumers indulging in more ‘me time’ through the mobile (Staff, 2013) and creating a more immersive user experience. Thus giving the rationale for the expansion of ‘me time’ of mobile apps provides an ideal focus for the study.

Moving on, the literature review chapter will draw on mobile phones and the impact upon consumer behaviour in order to set the context. It then moves onto mobile apps and draws on the ‘functions’ of mobile apps as explored by Zhao and Balugue (2015) as being Tool-centric app, Game-centric app, Social-centric app, M-commerce centric app, Design-centric app and explore and explain how they meet the thesis objectives of understanding how consumers wish to use mobile apps.

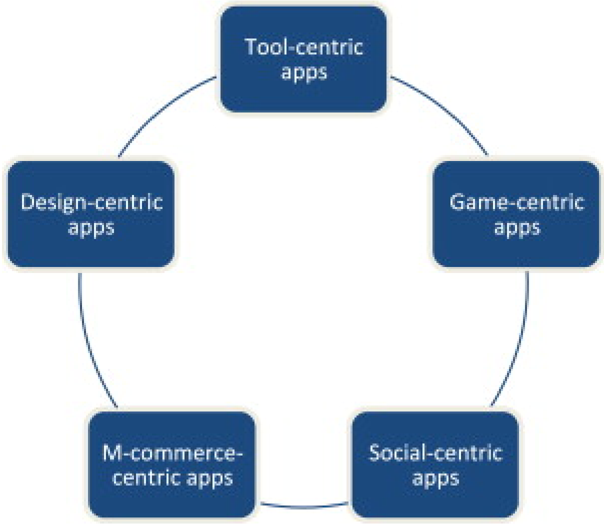


Figure 2.7. *The five functions of Mobile Apps Zhao and Balugue (2015)*

2.4.2 The Impact of Mobile Apps on Consumer Behaviours

Mobile marketing represents a qualitative change from past marketing methods offering fully interactive “pull it forward” interface, which means it is up close and personal and always on (Martin, 2011). This has been led by the growth of technological advancements but more importantly an evolution of changing patterns of consumer behaviour (Martin, 2011; Shankar, Venkatesh, Hofacker & Naik, 2010; Varnali & Toker, 2010) has defined the technology advancements leading to a consistently connected consumer who is linked 24/7 through mobile technology. This therefore changes the role of the consumer in this interaction with the characteristics of mobile consumers continually valuing convenience and accessibility (Holmes, Byrne & Rowley, 2014). There are some critiques of research on mobile marketing, as research focusses on consumers defining mobiles as their personal devices (Shankar et al., 2010; Varnali & Toker, 2010), however little research exists on consumer behaviours combined with their usage of mobile phones (Shankar & Balasubramanian, 2009).

When consulting this literature on mobile apps, it can be argued that research in this field of understanding consumer behaviour is still within its infancy (Holmes, Byrne & Rowley, 2014). Some authors such as Martin (2011) stress the importance of mobile marketing revolutionising the entire buyer process, whereas Holmes, Byrne and Rowley (2014) in their pivotal study concluded that mobile phones impact consumers within the information search and subsequent consideration of alternatives (Holmes, Byrne & Rowley, 2014). Rowles' (2017) work shows, due to its tactical planning, the importance of mobile being at the discovery phase and engagement stage of consumer behaviours. Of significance to this thesis is that consumers' first motive is not to purchase through mobile marketing (Persual & Azhar, 2012), as in the cycling sector in particular the retailers have driven towards mobile commerce as the focus of their mobile strategies. Additionally, the other significance that can be drawn from this literature is that mobile technologies and mobile apps are revolutionising consumer behaviours like no other technology has before, due to the multifaceted communication capabilities and customer centric approach (Martin, 2011). The nature of how the customer-centric approach manifests itself within mobile apps needs further exploration, not only to meet the studies but more importantly to find out how consumers want to engage with the mobile apps.

The switched on 24/7 life of mobile phones has changed the attention spans of consumers, as users spend more of the time on mobile phones than ever, for example within the US adults will spend an average of three hours, 35 minutes, a growth of 9.3% within one year (emarketer, 2018). This interface has been enhanced with the introduction of the smartphone. For example, the length of time to complete a task on a mobile pre–smartphone was three minutes before switching to something else (González & Mark, 2004). However, when consulting research by a mobile app company that encourages better behaviours, Rescue Time (2018) concluded via its 11,000 users, 70% of screen time sessions are less than two minutes in length and chain reaction effect of 50% of screen time sessions start within three minutes of the previous one. Drawing conclusion due to instant gratification (Lee, 2015), that being constantly connected along with the need to fill time as the reasons for this change, of further mobile screen time.

Of particular interest is how often users interact or check their phones, most people check their phones 58 times a day (30 of those during working hours). Most people spend slightly more time on their phones during the week than on weekends (Rescue Time, 2018). When considering this alongside mobile apps the average user has 50 apps stored in their smartphone (Kantar, 2017) half of these (25 apps) are used on a monthly basis, while one in four mobile apps are abandoned after a single use (CIM, 2016). This suggests that consumers are becoming more astute and using the apps that provide benefit, usability and engage (Compuware, 2013). The average mobile phone user has a set of six mobile apps they use on a daily basis (CIM, 2016).

Literature suggests consumers seek different benefits when downloading mobile apps ranging from gamification through to purchasing with the benefits differing on a case-by-case basis (Kim, Lin & Sung, 2013). Mobile apps could be categorised in to functions as presented by Zhao and Balugue (2015) as tool-centre (function elements of app e.g. location checker for stores), game-centric (gamification), social (social functions such as social sharing of information), m-commerce (purchasing) and design (brand messages) from a study of the top 100 branded apps (Staff, 2013).

Within Zhao and Balugue's (2015) study, definitions are not offered, however it does provide an overview of different lenses used. Zhao and Balugue's (2015) method was to review themes of mobiles app in the three areas of; business objectives, mobile feature and social features. Zhao and Balugue (2015), were keen to critique the use of mobile apps which required consideration on a case-by-case basis, due largely to the importance of sector influence along with the context and stage of business. As this research was conducted within the top 100 apps overall, (i.e. multi-thematic and multi-sector) the need to bring this back to the cycling context will be explored through each stage of the research, responding to the call that such research needs to be applied in specific context.

Critiques of Zhao and Balugue (2015) can be noted as they reviewed only the 100 branded apps, a limitation of sampling selection. However, this is the first stage of academic research into mobile apps following its dramatic growth in practice. When reviewing the 100 mobile branded apps, Zhao and Balugue (2015) argued big brands are best placed to innovate in the adoption of mobile apps, due to the prior marketing knowledge and along with budgets. What is particularly important to draw from Zhao and Balugue (2015) is the need for further research to aid knowledge and understanding about mobile apps. Zhao and Balugue (2015) stressed the conclusion of further research into context and sectors. Thus, cycling is the perfect sector to further explore Zhao and Balugue's (2015) five functions of mobile apps, as the context of further study.

A review of the five functions of mobile apps will provide the remainder of the chapter with its theoretical underpinning. The initial work of Zhao and Balugue (2015) has been utilised at the crux of the literature review on mobile apps and the five functions fit the research objectives of the thesis of understanding how consumer engage with mobile apps. The tool-centric function of mobiles apps adopts the same approach of Zhao and Balugue (2015) as the tool function is informed by features of the mobile phone (e.g. Camera, GPS) being vital to investigate this individual sector basis. The game-centric, social-centric, m-commerce centric and design-centric functions of mobile app are reviewed within the extant literature. This extant literature provides the foundations of the of functions mobile aps, which draws on research in mobile apps.

2.5 Tool-Centric App – Review and Context

When considering tool-centric apps the purpose is to develop apps as tools to provide users with utility (Zhao and Balugue 2015). Whilst not defined within this paper due to the “extremely diverse” nature of tool-centric apps, Zhao and Balugue (2015) go onto explain the purpose of tool-centric apps is to, “identify the motivations and requirements of consumers in using or buying products and to develop services to assist consumers in these processes” (p. 307). If an app is tool-centric the value of it aids the business objectives in the following ways: communicate brand values and products, increase brand image and awareness, make product recommendations and collect user data, (Zhao & Balugue, 2015).

The mobile features with which tool-centric apps engage include: camera: snap and scan, location awareness through GPS, voice sensor and mobile video. However, a critique of Zhao and Balugue (2015) can be that the description of tool-centric apps is extremely vague. For the cycling sector, tool-centric features will typically include GPS for measuring distance and time, map based features for navigation or measuring of data in a virtual world. A good example would be Strava and its ability to measure distance, times and more advanced performance data – which can be seen in Figure 2.8. The social features from Zhao and Balugue (2015) are the ability to share with external social networks e.g. display the performance data of a weekend ride via the Strava app through other social channels. Clearly the importance of this within the cycling sector has seen the launch of service to meet these needs, as smartphones have evolved to include the features to be able to deliver such tool-centric features.

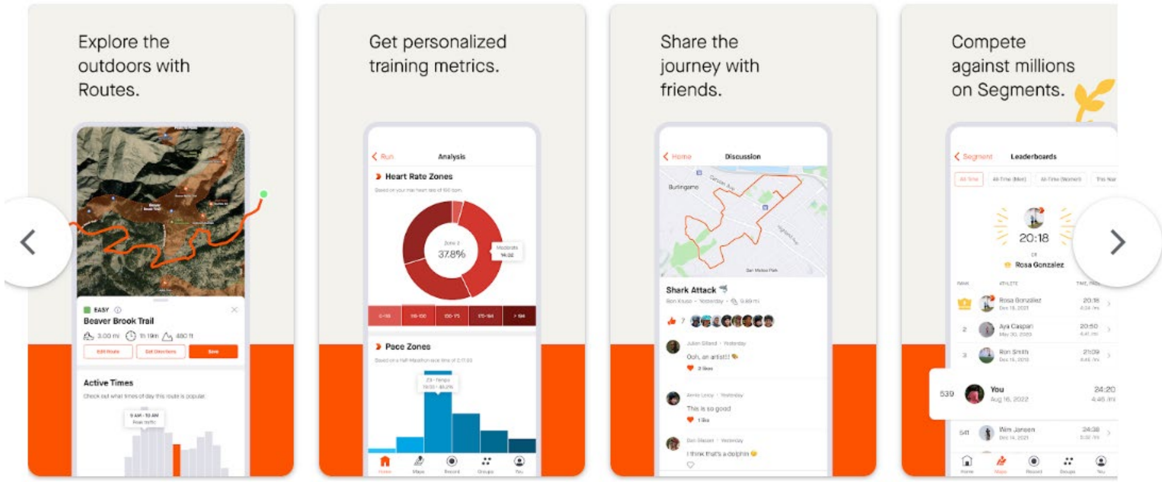


Figure 2.8: *Strava measurement of distance, times and more advanced performance. Source: Google Play.com*

2.5.1 Review of Current Tool-Centric Mobile Apps within Cycling

The heart of the mobile app is the tool, once consumers download an app they either engaged with it or drop out by deleting or not using the app at all. One in every two apps is uninstalled within just 30 days (Business of Apps, 2021). A central element of consumers engaging is the tool-centric functionality or utility of the app, and as such scant academic research has been undertaken to understand how these tools of the mobile apps engage with audiences. After consulting the initial research of Zhao and Balugue (2015), who reviewed the top 100 branded apps, it becomes apparent that the tools often centre upon the features of the mobile phone for example camera: snap and scan, location awareness through GPS, voice sensor and mobile video. Of course, a critique can be levelled upon the evolution and momentum of development of mobile phones and apps which create challenges to wider society (McDaniel, 2019) as discussed above.

Of critical significance was a focus on context, as highlighted by Zhao and Balugue (2015), which also overcomes the challenges of technology developments within mobile phones and apps. For the nature of tool-centric apps, the approach of reviewing mobile apps in the cycling sector has been adopted, as supported by Zhao and Balugue (2015). A review of the mobile apps in the cycling sector which focus on tool-centric functions can be seen in Appendix 1, in order to understand the tools utilised and results in a categories of themes.

The first contribution of the study is a review of mobile apps in cycling for tool-centric functions (see in Appendix 1). Fifty cycling apps were reviewed, which is the time first in the cycling context, aiding our existing knowledge. In reviewing these 50 mobiles for tool-centric functions, patterns of the features emerged falling into five categories: navigation, cycling computer/data on performance, training platform, virtual reality, and a suite of mobile apps. A brief overview of each of these is presented below, before more in-depth analysis which is presented as the next stage of the chapter:

- **Navigation:** as the mobile app adopts the use of GPS to ensure cyclists get from point A to B making it an ideal partner for the mobile phone.
- **Cycling Computer/Data Performance:** measuring the performance as a cyclist through mobile apps such as distance, time, speed or average speed or alternatively review previous performance on the mobile apps such as segment times or kings/queens of mountains.
- **Training Platform**: mobile apps provide access to training plans and performance data and share with coaches (person or virtual) who are able to offer their insights.

- **Virtual Reality:** virtual reality or augmented reality apps, such as Zwift (Figure 2.12) provide virtual reality worlds for users to ride or race with others from around the world.
- **Suite of Mobile Apps**: group of apps that would assist the user in engaging within their interest or pastime (including; weather, the road bike manual, Fill That Hole).

Moving on, the next stage of the literature review chapter will review each of these five categories in further detail. In reviewing each of these categories in depth, Appendix One was drawn upon.

2.5.2 Tool-Centric – Navigation

The use of navigation is seen within the apps of, Bike Hub Cycling Journey Planner, Google Maps and Komoot – which are highlighted as important within the cycling sector (see Figure 2.9). The ideal partner for a mobile app in the cycling sector is navigation as the user needs to get from point A to point B and uses their mobile phone to complete this task. The mobile apps of Komoot, and Bike Hub Cycling Journey Planner allow the mobile app user to define the parameters, whether the mode of bike (road or mountain), types of preference on road or route. Defining these parameters to the individual preference provides a more tailored mobile app experience rather than generic navigation apps such as Google maps.

In the case of Komoot the ability to share their experience following the event is seen with users being able to add pictures and videos of their ride route and of course share these. Also, it is worth noting that such navigation apps offer free restricted access to their service (e.g. via an area or a small number of maps), with additional maps needing to be purchased, with either credits, annual cost or one-off payment. This approach is well utilised, however, it would be interesting to explore how consumers interact with such navigation tools when it comes to the tool-centric approach.

An additional comment is that such navigation apps may be used directly on the user bike via their mobile being attached, or whilst in the home prior to riding. As these navigation apps allow for a connection with GPS units such as Garmin and Wahoo, this may see users engage within these within a different setting and for more route planning than on the go navigation. With such a number and usage of navigation the tool-centric approach is an important focus of the study, to understand how users engage in the use of navigation via their mobile apps.

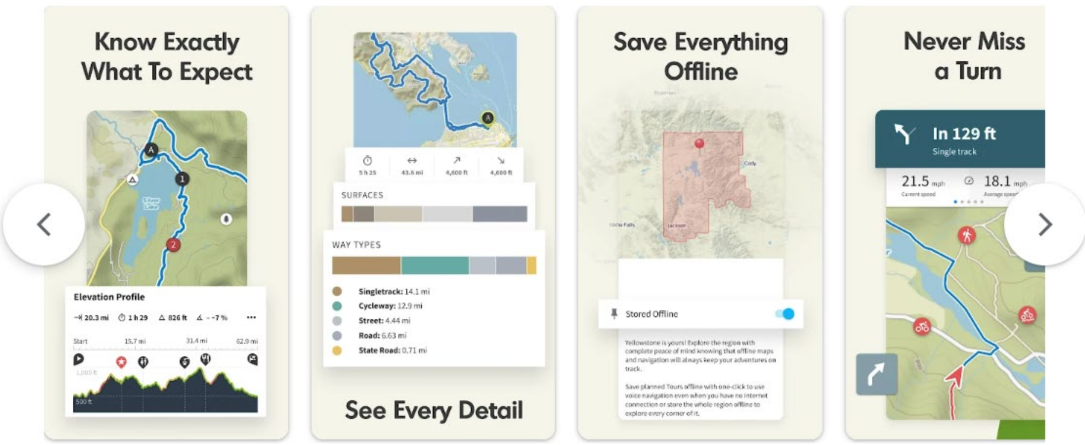


Figure 2.9: *Komoot an example of navigation based. Source: Google Play.com*

2.5.3 Tool-Centric – Cycling Computer/Data Performance

The likes of Strava, Bike Computer, Map my Ride, Garmin Connect (see Figure 2.10) and Wahoo X all offer the ability to measure the cyclist's performance in terms of tools such as distance, time, speed or average speed – in part thanks to the functions of the

GPS within the mobile phone. The ability to have information whilst riding provides the mobile apps with both in-ride information and out-ride information. The in-ride information of speed, distance, time, average speed seems to be a constant offering in terms of tools, such data provides users information in real time. Whereas the out-ride information such as calories burned, elevation ridden and segment times and sharing of route and images, provides functional tools following the ride. Such tools of mobile apps allow users to analyse their performance, both whilst riding and back at home following riding. This allows for comparison with either their own performance in the past or that of others through segment data and leader boards.

Whilst an array of apps provides information as cycling computer or performance, the interaction of the apps into Strava is noted as a common thread. Whether it is Wahoo X or Garmin (whose approach centres on selling separate GPS units) or bike computer (when using the mobile phone as the GPS device) they are all fully integrated with Strava. This shows the importance of not only interaction but the significance of Strava as a platform. Understanding how consumers use their cycling computer along with monitoring their performance is an important focus of the study when exploring the tool-centric approach of mobile apps.

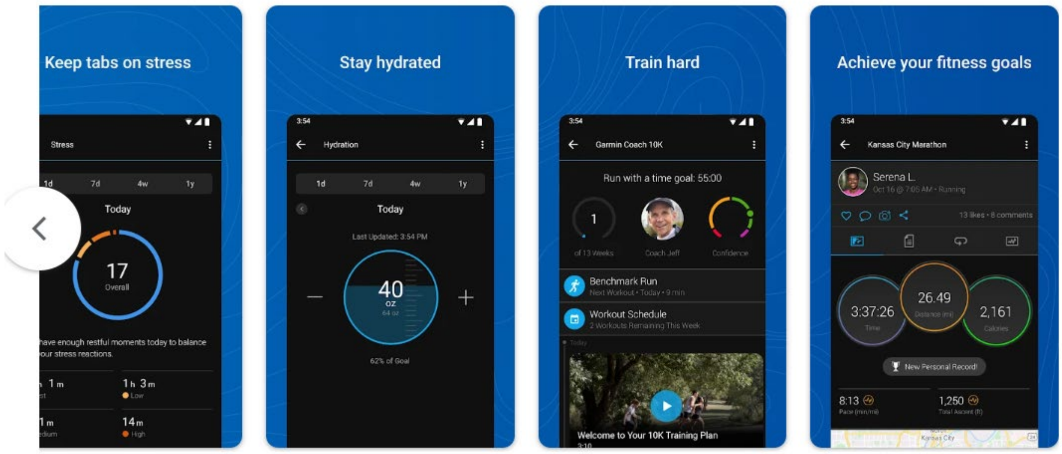


Figure 2.10: Garmin connect an example of cycling computer/data performance based. Source: Google Play.com

2.5.4 Tool-Centric – Training Platforms

The professional nature of the training platforms such as training peaks and trainer road, lends itself to the athlete performance market. Training peaks (Figure 2.11) allows athletes to provide access to their training plans including an array of performance data and thus share these with coaches who are able to offer their insights. However, as such tools are available to a more mass market through various different mobile apps such as Garmin Connect, Wahoo X (Wahoo SYSTM), Strava and Zwift, they allow users to collect information and data upon their training. Such platforms allow users to create training programmes that enable these to be analysed in terms of performance with more advanced measurements such as heart rate, cadence and power.

The features of analysing these training plans provide more detailed insights than the basic cycling computer, as such the functions within the mobile apps provide user ability to create and monitor a structured training plan. In the case of Strava (Summit) this comes though the form of monthly payments on which the user gets access to the additional features. With Zwift this is built into its monthly subscription approach, in which it tailors the training stimulus depending on previous performance. Garmin Connect is based on a manual process of the user creating goals and challenges and combines with hardware of the GPS unit. The importance of integration has been noted when it comes to training platforms as key functions of Ant+ and Bluetooth are commonly used to integrate between the various platforms and provide a seamless experience for the mobile app user for example between Strava and Zwift. Understanding the level of performance data and how consumers engage within training platforms will provide insights on how they utilise these tools within their mobile apps.

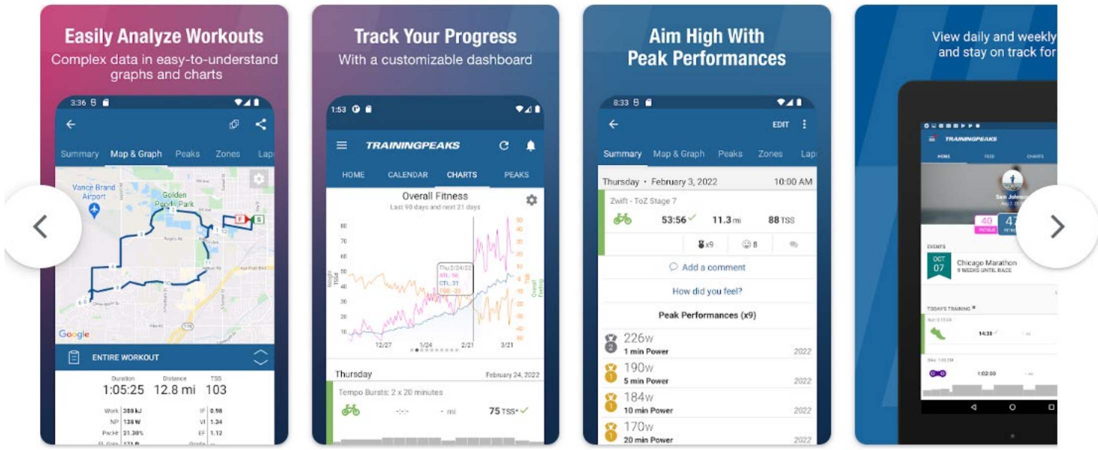


Figure 2.11: *Trainer Peaks: an example of Training Platform. Source: Google Play.com*

2.5.4 Tool-Centric – Virtual Reality

The virtual reality world of mobile apps in the cycling sector has exploded, due to the expansion of Zwift (Forbes, 2021). Mobile apps such as Zwift (Figure 2.12) provide virtual reality worlds for users to ride or race with others from around the world. Mobile apps such as Zwift not only allow training tools and programmes, but also allow for users to engage in virtual or augmented worlds to race against others from around the globe, with an added element of social engagement. This virtual nature is also seen within Zwift's function of My Virtual Mission, in which users can create a goal and then use a virtual journey that each cyclist takes to meet their goal. In addition, the leader boards of Strava provide a virtual world in which users are able to collect segment times and virtual badges of honour. Such virtual reality tools seem to resonate with both the social and motivational approaches of users, and will be explored in further detail as part of understanding the tool-centric functions that engage with different consumers.

Figure 2.12: *Zwift: an example of Virtual Reality App. Source: Google Play.com*

2.5.5 Tool-Centric – The Suite of Mobile Apps

The final group of mobile apps is a group that would assist the user in engaging within their interest or pastime and includes: Weather, Voncrank, first aid, bike gear calculations, the road bike manual, fill that hole. These apps are utilised as a supporting mechanism to the interest/hobby and as such offer utility features that meet the needs of this audience, and due to this are referred to as 'the suite of mobile apps'. These apps such as BBC weather provide information to users when planning routes, whereas the road bike manual provides users with steps, images and videos on completing workshop tasks. Both the first aid and the Voncrank are apps the user might use whilst on the bike. Voncrank connects users with approved mechanism and arranges to meet at a desired location. However, fill that hole is likely to be used following a ride as the user reports holes in the road to local councils through this mobile app. These could be considered a 'suite of mobile apps' that users utilises within their interest in cycling and exploring what combines within this wallet will assist the study in meeting its objectives.

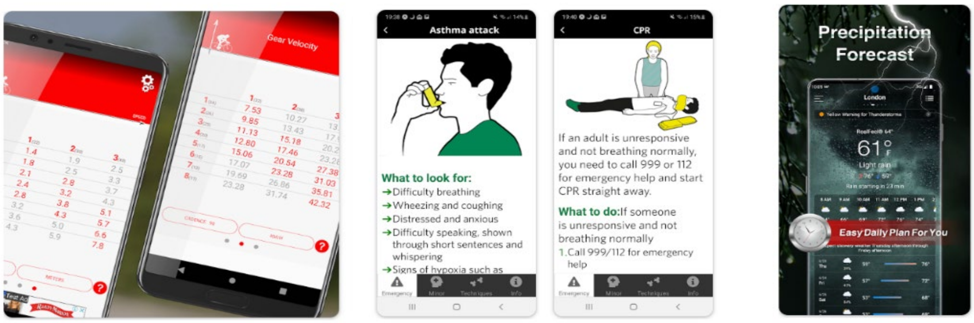


Figure 2.13: *Examples of suite of mobile apps; Voncrank, St John Ambulance First Aid For Cyclists, BBC Weather. Source: Google Play.com*

2.5.6 Positioning a Review of Tool-Centric Apps

Zhao and Balugue (2015) defined tool-centric as the features of utility of mobile apps with examples being: location awareness through GPS, voice sensor, video and image and snap and scan. Within this initial work, Zhao and Balugue (2015) stressed the importance of reviewing apps on a case-by-case bases depending on sector, this has led to the review of 50 apps within the cycling sector, drawing conclusions about the five tool-centric approaches of: navigation, cycling computer/data on performance, training platform, virtual reality or suite of cycling apps. Thus, the study makes a contribution to knowledge, in reviewing tool-centric features of apps in cycling, which is used to conceptualise the framework seen in Figure 2.20

The next stage of this review explores the four remaining functions (tool-centric, social-centric, m-commerce centric and design-centric) of mobile apps and will utilise the extant literature in the field.

2.6 Game-centric apps

The importance of game-centric apps, is demonstrated within the context of cycling given the growth of the two biggest cycling apps of the moment; Strava and Zwift have used this distinct feature to develop their products and services. Both apps align with the premise that companies primarily design game-centric apps due to their high hedonic values (Zhao & Balugue, 2015).

Defining utilitarian and hedonic motivation, Ahtola (1985) stated utilitarian behaviour relates to the usefulness, value, and wiseness of the behaviour as perceived by the consumer, whereas the hedonic aspect relates to the pleasure experienced or anticipated. Parker and Wang (2016), in the review of hedonic and utilitarian motivations for mobile apps, adopted similar definitions adding further justification.

Through a closer examination of the academic literature on utilitarian and hedonic motivations, the concepts are often studied through the lens of gaming – which is particularly poignant for the study's aims with the chapter reviewing game-centric mobile apps. Lin, Wang and Chou, (2012) considered motivations through tennis gaming in the form of physical exercise, finding that individuals play physical games not only for hedonic motivations but also for utilitarian motivations. Additionally, the study of Lin, Wang and Chou, (2012) concluded that perceived exercise utility serves as a critical utilitarian motivation for people to play physical games. This results in the management implication of physical games increasing users' adoption rate of games by emphasising the beneficial effects of playing physical games in terms of exercise and health. (Lin, Wang & Chou, 2012). Whereas the study by Sharma, Tak and Kesharwani, (2020) investigated an empirical study of 201 online games to predict gamers' continual interactions of hedonic and utilitarian motivations on continuing playing online games. The results conclude that hedonic motivations positively impact the continual intention to play online games, whereas utilitarian value does not significantly impact online gaming behavior (Sharma, Tak & Kesharwani, 2020). The study goes on to draw additional conclusions that the higher the perceived risk levels of the online game, the greater hedonic motivations enhance the continued online gameplay. Whereas, in sharp contrast, low-risk levels of online games are impacted by both hedonic and utilitarian motivations and have a significant effect on continual intentions to play online games. (Sharma, Tak & Kesharwani, 2020)

The principles of high hedonic motivations for both Strava and Zwift apps create an immersive environment through which you can expose users to brand moments to enhance brand image and increase brand awareness. In some cases, this allows for the inclusion of a link to an online commerce website to convert toward a sale, or directs the user further into the sales funnel. However, in the context of Strava and Zwift, the mobile app is a central element of the sales funnel, as once the user has signed up or agreed to a free trial, they need to download the app to adopt the use of the services. Thus, the game-centric app is a central element of mobile strategy, allowing for the collection of data, from which companies can develop personalised messages and communications via a customer relationship management function.

When it comes to features of the mobile phone Zhao and Balugue (2015) stated these as: voice sensor, multi-touch gesture, augmented reality (AR) with apps such as Zwift connecting virtual worlds linked to AR, whereas Strava has closer links with gamification due to its leader board-based concepts through Strava Segments. When it comes to social features Zhao and Balugue (2015), suggested the influence on game-centric apps on the following areas: personalised user avatar, invite from external social networks to take part within the game and share with success with external social networks via the game e.g. Strava’s King of the Mountain. A review of gamification literature is essential in meeting the study's objectives and forms the remainder of the next element of the chapter.

When consulting the wider academic literature a causal link between the growth of mobile marketing and the growing interest in gamification is identified (Marchand, André, Hennig-Thurau & Thorsten, 2013; Terlutter, Ralf & Capella, 2013). Clearly any app with a game-centric focus pulls upon the principles of gamification, as defined by Hamari (2015), "gamification refers to a process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation" (p. 25). However, for the purposes of this study the definition offered by Hofacker, De Ruyter, Lurie, Manchanda and Donaldson (2016), which is stipulated within a marketing context is utilised as its draws upon a wider array of research: "gamification as the use of game design elements to enhance non-game goods and services by increasing customer value and encouraging value-creating behaviours such as increased consumption, greater loyalty, engagement, or product advocacy" (p.25).

2.6.1 Review and Context of Gamification

When consulting the academic literature there is debate between the function of gamification as a role to evoke the same psychological experiences as games (generally) or, as Deterding et al. (2011) suggested, a focus on affordance, which in general terms is defined as "actionable properties between an object and an actor" (Gibson 1977, p. 36). As such, Deterding et al. (2011) focused on affordance in terms of motivational affordance leading towards psychological outcomes and resulting in behavioural outcomes. Whilst such debate provides an interesting perspective on motivational vs psychological experiences, the need to consider gamification through a marketing lens rather than behavioural outcomes is essential to meeting the research objectives. When reviewing the literature Hofacker et al.'s (2016) seminal study of gamification and mobile marketing effectiveness is critical, given its looks at gamification in terms of mobile.

Whilst the context of mobile gamification is a recent concept, the principles of non-game use of game-like elements is not new (Blohm & Leimeister, 2013) with origins which can be traced back to the flying loyalty schemes, with air miles being the first versions of gamification (Blohm & Leimeister, 2013). Understanding what makes gamification unique is important, as numerus scholars have concluded the distinguishable characteristic being social and motivational benefits through product usage (Blohm & Leimeister, 2013; Huotari & Hamari, 2012). Whilst mobile technology is well suited to gamification the outcomes are more significant for organisations to develop a well-executed plan. In the creation of the framework seen in Table 2.5 Hofacker et al. (2016) suggests that gamification of mobile platforms has the ability to enhance consumer enjoyment, engagement, purchase, repurchase and retention.

The impact of gamification through mobile allowed for impact all the way through the consumer decision making process (Hofacker et al., 2016). This allowed Hofacker et al. (2016) to generate an eco-system around games, using four elements that interrelate: story, mechanics, aesthetics and technology used to review these four elements as summarised in Table 2.4 to provide further insights into gamification. However, product (product involvement) and consumer involvement in cycling (segmentation and behaviours of cyclist) are considered earlier in the chapter.

Themes	**Meaning**	**Explanation**
Story	Narrative format	Context to a game and adds meaning to the consumption experience.
Game mechanics	Game dynamic in turn	It enable players to know how to

	creates a specific user experience.	manoeuvre through the game and to form an impression of what is expected and rewarded at hierarchical game levels
Asthetic	The look and feel of a game	Games with a sense of purpose and strengthen the development of the storyline. For many games, a focus on visual imagery and presentation is important to creating an immersive experience, although other senses may come into play.
Technology	pertains to how the medium of mobile	How the mobile platform, shapes the game experience. The mobile device is in effect a networked computer creates opportunities for interactivity and dynamic game play.

Table 2.4 *Eco-system of gamification. Adapted from Hofacker et al. (2016)*

2.6.2 Game Mechanism Element

The story element is of significance to the thesis, as the game mechanics are the rules. In other words, exploring how the players achieve goals, along with the rewards players will receive e.g. badges, points, progress bars, and leader boards (Hofacker et al., 2016). Critiques of the literature suggest game mechanism being merely a form of the games feedback, however Deterding et al. (2011), noted the importance of forcing users to make meaningful choices in the pursuit of difficult goals.

In order to effectively design a game, Salen and Zimmerman (2004) stresses the need for clear connections between both player actions and the game outcomes and a rewards scheme that not only motivates players, but also leads to the creation of loyalty and signals a social status. The value of the incentive is widely reviewed within the academic literature, for example through: public vs private incentives; types of incentives – categorical, continuous, symbolic, or monetary incentives; and the role of goal achievement and progression. When it comes to rewards uncertainty seems an important element, as illustrated by Shen, Fishbach and Hsee (2015) who demonstrate uncertainty of the reward increasing motivation when compared to rewards with a known entity. This leads to the concept that motivation being impacted by the uncertainty of receiving the award rather than the outcome of the reward, itself. This links well to the concept of goal gradient hypothesis (Kivetz, Urminsky & Zheng, 2006), as users will increase their effort as the reward approaches (Kivetz, Urminsky & Zheng, 2006) or in the case of virtual words the visual finish line (Cheema & Bagchi, 2011).

In terms of gamification the significance of "badging" must be explored, given its importance and linkages to the cycling perspective focus of the study. Hofacker et al. (2016) draw on older forms of gamification through games such as World of Warcraft to define badging as the contingencies under which visual identifiers are provided, to reflect the merits of a player's accumulated achievements along with the game's social position. What can be drawn from gamification literature is the importance of accumulation of symbolic capital (e.g points or other symbols associated with status) (Hofacker et al., 2016), this is particular strengthened with the proposition of Strava which is based on such badges of honour.

The importance of symbolic capital was stressed by Blohm & Leimeister (2013), badging achievements creates a collection of visual evidence of one's performance, it helps to document progress against personal goals, whilst facilitating social interaction in a community of peers in a competitive environment, and functions as an instrument of social recognition within games. However, the differences in vantage points of in game play vs the marketer's viewpoint are often critiqued as a challenge, with Lin and Sun, (2007) suggesting the challenges of integration is not always in the game's magic circle. This leads to the stipulation of getting the reward–difficulty relationship right as an important issue for gamification design, as it could only lead to positive gamification outcomes but benefit brand attitudes, purchase intention, aid planned and unplanned purchases (Hoffman & Novak, 2009), within the cycling sector this is seen in the business model of Zwift which is monthly subscription based.

The challenges of pursuing the games challenges vs rewards paradigm is essential, to achieve this a level of reward is to be felt; if a game is pitched at too low a level of difficulty it leads to boredom (Csikszentmihalyi, 2014), whereas increased difficulty can lead to game abandonment (Albuquerque & Nevskaya, 2015). This has led to gamification designs attempting to hit the sweet spot (Hofacker et al., 2016) of balance. Hofacker et al. (2016) suggested the differences in the type of skill in gamification; games utilising tacit knowledge e.g. navigation being suited to concretion practice, whereas games utilising written instructions are better suited to space learning sessions. Developing the strength of these within these skills is part of the mechanism of the game to aid consumption, satisfaction, and loyalty (Lakshmanan, Lindsey & Krishnan, 2010; Johnson, Bellman & Lohse, 2003;).

This resulted in Hofacker et al. (2016) suggesting the marketing professionals need to consider reward levels carefully with an eye to how, when, and whether consumers will develop proficiencies of various types. Once a user has developed skills within game, then there are two types of non-monetary value propositions for consumers: the cognitive benefits of skill development, information acquisition, and learning and social value via interactions through appreciation, compliments, and reciprocal exchange (Nambisan & Baron, 2009). This leads Hofacker et al. (2016) to suggest mobile gamification mechanics that encourage social interaction may lead to the creation of an atmosphere of camaraderie, build social bonds, and facilitate future interactions (both brand and other consumers).

2.6.3 Story Element

Story telling is an essential competent of mobile games, often linked to branding, which is often underexplored in literature. As such there is limited understanding of how the story element of mobile games could be utilised for the purpose of marketing (Hofacker et al. 2016).

Hofacker et al. (2016) suggests that storytelling allows players to getlost in the game or story, due to the story's ability to provide relevance and meaning to the player's experience, whilst providing context of the completion of tasks and guide action. Consequently, transporting the user into the story gives the opportunity on a temporary basis to the acceptance of values and beliefs which see a shift away from individual existing beliefs (Slater & Rouner, 2002). The concept of transferring the user into the story is referred to as narrative transportation (Hofacker et al., 2016).

The critical work of Green, Brock and Kaufman, (2004) draws the conclusion that narrative transportation theory is driven by enjoyment from the experience of being immersed in a narrative world, as well as from the consequences of that immersion. Carpenter and Green (2012) recognised the significance of consumers losing themselves in a story with attitudes and intentions evolving to reflect that story. Van Laer et al. (2014) undertook a more recent meta-analysis that positioned the theoretical development of narrative transportation occurring whenever the story receiver experiences a feeling of entering a world evoked by the narrative due to empathy for the story characters and imagination of the story plot, thus, supporting the earlier work of Slater and Rouner, (2002) and the later work of Hofacker et al. (2016). Understanding the narrative story element for mobile apps for gamification is essential as the cycling sector has led the way in the creation of such stories through virtual reality and training apps. However, research to understand how cycling consumers might respond to such narrative story telling is underexplored in the context of marketing (Hofacker et al., 2016).

The literature also shows a theme on orientation of goals impacting the story element in terms of gamification, with Higgins (2006) noting further research should explore the match between the goals of consumers and the goal being pursed in the gamified app. The sense of feeling right impacts both the perceptions of value of experience along with the level of engagement. This led Hofacker et al. (2016) to posit that story mechanism's major contribution is the feeling right experience along with the sense of joy impacting mobile gamification effectively within the context of marketing.

The final influence on story mechanism is the genre of a game, examples of the typical genres of games being: fighter, puzzle, and racer (Marchand & Hennig-Thurau, 2013). However, mobile has reclassified these genres (Hofacker et al., 2016) due to its technology developments. Nowhere more than in health-based apps have you seen the development of new genres as the mobile allows tracking of heart rate, distance covered and generated augmented worlds, as demonstrated by Zwift. This leads Hofacker et al. (2016) to conclude genre impacts consumer involvement and motivation and is the main factor impacting the effectiveness of mobile app gamification. Whilst the conclusion of drawing out genres in cycling links to health-related apps. The research within these field is clearly lagging behind with further opportunities for research into the story's influence on mobile gamification (Hofacker et al., 2016), both in health and fitness and, more significantly, cycling provides the perfect platform (Jang, Kitchen & Kim, 2018).

2.6.4 Aesthetic Element

Aesthetics is an interesting field of gamification and was explained by Hofacker et al.

(2016) as the appearances creating an engaging experience. Hofacker et al. (2016) went on to suggest all of these aesthetic features and character quirks are characteristic of the game. This led Hofacker et al. (2016) to identification of two themes which require further exploration and investigation: narrative vs pictorial representation which is more effective in creating a vision and enhances engagement and finally the snapshot-like design elements of user generated content contributing to brand authenticity. Both were defined as significant opportunities for further research in terms of mobile gamification (Hofacker et al., 2016), however in terms of focus of the research objectives both are explored in greater depth in earlier or later parts of the literature review. Engagement is considered through a breadth of literature in the marketing context (Brodie et al., 2011; Sashi, 2012; Van Doorn, 2010; Vivek et al., 2012), resulting in the adoption for this study of Thakur's (2016) approach whose study on mobiles apps create six motivations (social-facilitation, self-connect, intrinsic enjoyment, time-filler, utilitarian and monetary evaluation experiences) for using mobile apps for customer engagement. The user generated content is considered in the mobile apps' functions and social-centric function of mobile apps in later parts of this chapter.

2.6.5 Technology Element

Hofacker et al. (2016) explained the technology element, simply as the platform of mobile devices. However, what is clear to see when consulting the literature is the consistent evolution of the technology elements, which provides both opportunities and challenges. As such, Hofacker et al. (2016) draws attention to unique characteristics of technology for gamification within the mobile context. As mobile devices offer opportunities for increased personal engagement, the introduction of wearable devices has explored this in more depth (Stern, 2015). In most cases the growth in wearables has been driven from fitness and health, given the smart watches and fitness trackers in cycling such as GPS, HRV, Powermeters which offer ability to track a vast array of personal data. Such data according to Hofacker et al. (2016) is then used as the principles of gamification through either visual clues or threshold targets to drive an increase in engagement and usage.

Hofacker et al. (2016) stresses the importance of marketing professionals needing to consider strategies for both hardware and software. In terms of hardware marketing, professionals need to be mindful of developing hardware that enhances the games like experiences, for example VR and VR games (Hofacker et al., 2016). The importance of personal data was stressed in terms of software as it can be incorporated into the seamless game experiences e.g. measuring heart rate in-game such as Zwift. The significance of gamification and the constant evolution of technology are worth noting e.g. the wearables provide a good example of this and given the context of the study provide highly relevant, but are not the focus of the thesis aims and objectives. However, the importance of considering, both the software and hardware that clusters utilise when cycling. So for example the use of mobile phones and app usage, cycling software usages, GPS, smart watches, and in-door training devices (e.g. smart turbo trainers) is significant to the study to understand attitudes and beliefs of each cluster.

2.6.6 Positioning of Gamification Literature

Having reviewed mobile gamification, the importance of Hofacker, et al. (2016) seminal study of gamification and mobile marketing effectiveness is critical. Both the attributes of Game Mechanism Element and Story Element are essential to this study and thus will be included in pre-testing study (Stage Two) of the survey instrument. The aesthetic elements of gamification are covered in other parts of the literature, most noticeably the customer engagement and social-centric mobile apps. Additionally, the technology element of gamification is on a constant evolution, however, it does not warrant a separate investigation, but instead is included in cluster attitudes towards hardware and software through segmentation.

2.7 Social-Centric Apps

Moving on, this literature review turns to explore social-centric mobiles, with social media being a buzzword, thanks to the growth within the last decade (ElAlfy, Darwish & Weber, 2020). When it comes to social-centric apps Zhao and Balugue (2015), state these are designed from the user perspective to "target socializing for fun" (p. 307). On closer inspection Zhao and Balugue (2015) presents no core definitions of social-centric apps but positions the dimensions of socialising for fun. The example of Japanese apparel retailer UNIQLO is offered in using social media as opportunity to engage with audiences by trying on clothing, other members voting and commenting and weekly winner awarded aiding the engagement through likes and shares. This was further supported by Vazquez (2011), that a social-centric app goes beyond online advertising and UGC to be more about engaging brand advocates and fans into connected communities in sharing content such as styles and models. This led Zhao and Balugue (2015) to state "social-centric apps focus on sharing customized messages" (p. 308-309).

Drawing the importance of user generated content and engaging the community within customised messages (Kaplan, 2012) and business objectives show that social-centric apps aims to achieve several things: increase the sense of intimacy with customers, foster brand engagement by building a community of loyal customers and finally allow customers to communicate positive brand images with their social circles (Zhao & Balugue, 2015). When considering the features of mobile phones, Zhao and Balugue (2015) suggested two camera functions: snap and location awareness. However, some critiques of phone features could be raised as AR surely provides an opportunity to develop social interactions (Dacko, 2017). When consulting Zhao and Balugue (2015) there are a vast array of social features of mobile apps: user-generated content, social annotation, online chat, follow/unfollow people, share via e-mail and share with external social networks. The need to explore the literature from the lenses of user generated content is essential in meeting the study's objectives, as Zhao and Balugue (2015) noted user generated content and co-creation as the theoretical underpinning for the social-centric mobile apps. Whilst consulting the research of Zhao and Balugue (2015) provides a bedrock for the study, it is vital to support the user generated content and co-creation focus for social-centric functions with additional research.

Other studies such as Chen, Tao and Zhou (2019) investigated mobile phones apps and UGC online community through technology acceptance module and concluded that both perceived usefulness and attitudes towards usage impacted on respondents to repost content. The technology development of the shifting use of social media platforms onto the mobile phone devices/apps was the rationale for Roma & Aloini (2019), for the justification of investigating UGC across different social platforms. Additional studies note mobile phones/apps use through social media UGC providing real-time interactions along with the dramatic rise of user participation (Hudson, Huang, Roth & Madden, 2016; Kaplan, 2012; Lamberton & Stephen, 2016; Sterling, 2016; Verhoef et al., 2017). Roma and Aloini (2019) draw conclusions about the need for further research being required into mobile phones/apps and user generated content, which will aid the justification for a focus on UGC for social-centric functions.

Additional research by Rashid, Waseem, Akbar and Azam, (2019) draws conclusions with a systematic literature review that "co-creation and social media has a natural alliance" (p. 779). The research acknowledges the technological development as rationale for expansion of co-creation, with mobile phones/apps and social media starting to develop at nearly the same time (Lamberton & Stephen, 2015). Work by Rashid et al. (2019) draws out the two major themes, firstly consumers motivations and experiences for engaging in co-creation and secondly organisations' ability for sharing knowledge and processing co-creation. As the study aims to understand the motivations of cyclist then focus on the first theme of consumer motivations and experiences of co-creation are vital in meeting the objectives. The development of further research into the field is noted due to businesses already using social media and UGC to gain insights on audiences, which sits alongside the fields of social media and co-creation needing further in-depth quantitative studies to uncover underlying mechanisms and processes (Rashid et al., 2019). Moving on this chapter will review user generated content along with co-creation in order to understand how the social-centric function of the mobile app creates engagement.

2.7.1 The Growth of User Generated Content and Definition

The creation of Web 2.0 is determined as the platform that allowed audiences to create user generated content for the first time, with the BBC first adopting UGC in 2005 through its website. Fast forward to today and marketing has come to terms with the benefits of UGC. The importance of authenticity comes more under the spotlight with 86% of consumers highlighting its significance when making decisions on brands they support (Business Wire, 2017). In fact, research conducted by Business Wire (2017), states 60% of user generated content was the most authentic form of content, whilst also being the most influential when it comes to making purchase decisions. User generated content is defined as “media content created or produced by the general public rather than by paid professionals” (Daugherty et al., 2008, p. 16), with this definition being adopted for the rest of the study.

The nature of looking at user generated content is not only drawn from the themes of Zhao and Balugue (2015) but also from the biggest growing phenomena of mobile apps in the context of the cycling. Within the context of cycling mobile apps such as Strava lead the way with user generated content in creating communities. A recent report from

Strava highlighted an ever-growing community, with 1 million new user per month, often the reason for this growth is attributed to its social interactions and customers' ability to interact with one and another (Strava, 2019). There are some critiques and challenges within the academic literature of definitions of UGC being considered too broad (Daugherty, 2008). This leads towards over-generalisation, lack of consideration of branded vs unbranded content (Poch & Martin, 2015). The discussion within the literature and lack of clarity over user generated content raise two questions: firstly, the pace of evolution in terms of technology and platforms and secondly the challenges of implementing user generated content for marketing professionals (Poch & Martin, 2015).

2.7.2 Themes within the User Generated Content Literature

When consulting the user generated content literature its growth has attracted the attention of researchers across a variety of disciplines including computer science, marketing, management, and journalism (Brabham, 2013; Krishnamurthy & Dou, 2008; von Hippel, 2005). Here, the focus of the literature review chapter will move to focus on user generated content in the context of marketing, which is companies engaging audiences to produce content on their behalf. The growth in terms of user generated content can in part be linked to online product review websites adoption of them, as they allow users to evaluate existing products and share their opinions with fellow users (Chevalier & Mayzlin, 2006; Mayzlin, 2006; Moe & Schweidel, 2012).

On consulting with the literature, Figure 2.14 taken from O'Hern and Kahle (2013) creates typologies for UGC (informing, pioneering, co-communicating and co-creating). Further exploration of the four typologies will be used to explore to aid with the functions of mobile apps, divided into two objectives: why users create content, whether it is product promotion or product innovation. Product promotion resonates with users who generate content that mentions either strengths/weaknesses associated with products or brands, designed to stimulate further word-of-mouth activity (Chevalier & Mayzlin, 2006; Mayzlin, 2006). Whereas, in sharp contrast, product innovation users are interested in improving an existing product or developing a new product of their own origins (O'Hern & Kahle, 2013).

The horizontal axis in Figure 2.14 considers the knowledge flows that result from the UGC process; C2C knowledge where the primary target is other users (e.g. social media and product reviews) and secondly C2B knowledge with the primary target audience being the organisation. On further inspection this leads O'Hern and Kahle (2013) to define four distinct types of user generated content (informing, pioneering, co-communicating and co-creating), and allow for further understanding within a mobile context on the rewards, motivations and challenges of each group, whilst further aiding the functionality of each typology.

		User Contribution Objective	
		Product Promotion	Product Innovation
Direction of UGC Knowledge Flows	C2C Knowledge Row	**Informing**	**Pioneering**
	C2B Knowledge Row	**Co-Communicating**	**Co-Creating**

Figure 1. A typology of user-generated content.

Figure 2.14: *Typologies of user-generated content Source O'Hern and Kahle (2013).*

2.7.3 Informing

When it comes to the concept of informing it is often referred to in the academic literature as an umbrella term, due it its wide nature of encapsulating a large spectrum of activity. However, with deeper consultation of the literature it becomes clear informing differs from the three typologies, with the key being understanding the goals of users when sharing their opinions with their peers, along with the effect the contribution will have on fellow users (O'Hern & Kahle, 2013). An example is the cosmetic brand Dove which used it Real Beauty Productions platform to encourage women to share their stories through images/photos to other consumers through an open platform to challenge the stereotypes of beauty.

The literature often focuses on product reviews and the impact of customer word of mouth, (Chevalier & Mayzlin, 2006; Liu, 2006; Li & Hitt, 2008; Moe & Schweidel, 2012) which provides some interesting context. Studies often highlight the positive role that Electronic Word of Mouth (eWOM) plays in stimulating subsequent market response, in particular new product offerings (Chevalier & Mayzlin, 2006). However, as user generated content evolves and grows it plays a significant role, partly due to the rise of social media platforms, brands have faced challenges on scale of independent UGC and this regularly occurs outwith the 'walled garden' of the company's website/social media pages (Bernoff & Li, 2008). This has led to the stipulation that informing has a major impact either positively or negatively upon a company's reputation, and thus their success in the marketplace (Boush & Kahle, 2001: 2005; Kahle & Valette-Florence, 2012). The significance of the challenge in responding to the positives and negatives of user generated content through eWOM is down to a key attribute of motivation and the need to understand an extremely diverse and difficult to ascertain set of motivations (Minton et al., 2012).

This is of particular interest to the research in understanding the motives of consumer engagement, with UGC and Poch and Martin (2015) using both intrinsic and extrinsic motivation within their work. The aforementioned study of Poch and Martin (2015) concluded that altruism (individual difference) has a significant positive effect on the likelihood of creating positive eWOM. The relationship between altruistic consumers and content was drawn as the importance of appealing to their desire to help others (partnering with local not-for-profit cycling organisations or best routes in a local area) was highlighted as an area of significance for marketing practitioners to target consumers most likely to engage in positive user generated content through eWOM (Poch & Martin, 2015).

2.7.4 Co-Communicating

O'Hern and Kahle (2013) defined "co-communicating as a process that occurs when users create their own novel marketing materials (promotion focused user activity) and share them directly with a firm (C2B knowledge flow) to enhance the firm's marketing communications" (p.23). This led to a link between co-communicating and user generated advertising which is any public message from a consumer involving a brand. (Campbell, Pitt, Parent & Berthon, 2011).

The distinction within O'Hern and Kahle (2013) of co-communicating as opposed to user generated advertising centres on the whether UGC involves C2B or C2C, with co-communicating being promotional content directed at firms. In essence, co-communicating may provide stimulation of promotional materials a company can use, it is down to the organisation to decide on which marketing materials to utilise and level of engagement with the user, for example in its simplest form sharing ideas to submission of final ideas. An example is Starbucks Stories, which uses a platform to collect stories on consumers that inspire the world. Within this example, Starbucks select the stories from the consumers that are to be published on the platform.

Engaging consumers in the creative process via co-communicating is considered to generate benefits of cost effectiveness of user generated advertisements, creating new creative directions and ideas (Winer, 2009), along with a selection of advertisements that appeal to audiences due to detailed consumer input and monitoring consumer tastes (O'Hern and Kahle, 2013). However, the cost effectiveness of this marketing approach is called in to question by Story, (2007) who questions the high level of investment needed on the front-end to communicate with participants involved in the creation of the campaign.

Likewise, other criticism was noted by O'Hern and Kahle (2013) questioning the concerns of the quality of user-created advertisements, along with portraying the brand in not such a positive light or inability to resonate with an audience. This led O'Hern and Kahle (2013) to note organisations can overestimate engagement in their brand which can result in the creation of negative impact as images could be low or submission could be negative towards brand equity, due to a lack of fit.

Understanding the social-centric tool of user generated content and its ability to co-communicate offers potential in the cycling sector, as currently the author is not aware of any brands using co-communicating to stimulate promotional materials. The thesis will explore the potential of the co-commutating functionality in terms of mobile apps, and the how the consumer will engage and respond.

2.7.5 Co-Creating

Co-creation is a term used to describe the propensity of the user to engage in the creation of their own innovative product design, being shared with the organisations (O'Hern & Kahle, 2013). An example is Unilever Innovate hub, which looks to new product innovations from designers and academics to respond to UN global challenges. New product innovations are shortlisted by Unilever's partner agency with feedback provided to those not shortlisted.

The growth of co-creation is evidenced by research which reviews the various activities (Piller, Ihl & Vossen, 2010; Hoyer et al., 2010; O'Hern & Rindfleisch, 2010). For example, O'Hern and Rindfleisch's (2010) research led to the creation of two dimensions: empowerment of new product designs and empowerment of marketing the new product. This is supported by research by Ogawa and Piller (2006), with benefits of granting power to consumers within the new product development through co-creation reducing the commercial failure. Whilst O'Hern and Kahle (2013) noted the benefit of gaining access to highly innovative user generated content and enhance new product development, in addition Ogawa and Piller (2006) noted producing NPD engages the greatest positive response from consumers.

Whilst the concept of co-creation seems logical it does present some questions and challenges identified by O'Hern & Hahle (2013), firstly attracting enough high-quality product designs, creation of communities with high enough engagement and competition using this asa source of new ideas, and secondly managing co-creation communities' notes as an area of conflict, as creators and selectors have a vast array of different motivations for taking part in co-creation. The variances within motivations ensure that further research of co-creating within a cycling context could be undertaken to contribute towards developing knowledge. Current knowledge is limited in this context of understanding whether user generated content through the power of designing new products engages with the audience.

2.7.6 Pioneering

O'Hern and Kahle (2013) devised the final variant of UGC as pioneering with the focus on innovative new product ideas, which are shared by consumer to consumer. An example often comes from Kickstarter, and the cycling sector which in 2014 had 1,738 Kickstarter projects worldwide with a bike focus raising over $32 million and within the UK 136 projects raising over £1.6 million (Bikebiz, 2015).

The premise of pioneering is that consumers have the potential to develop new ideas through a creative process named "lead users". Franke and Shah (2003) and Lüthje and von Hippel (2005) both noted the lead user as being those individuals who are able to provide specialised needs, provide skills and insights along with vision to develop unique solutions to satisfy needs. Research conducted by von Hippel, de Jong and Flowers (2012) shows that leading users generate new product ideas which are extremely novel, across a wide spectrum of sectors: extreme sports, medical devices, and computer gaming (Füller & Matzler, 2007; Haefliger, Jäger & von Krogh, 2010; Lüthje, Herstatt & von Hippel, 2005). Additional benefits of lead users are they devise prototypes of their inventions and share these within communities long before commercial versions, hence the user contribution being given the typology of pioneering (O'Hern & Kahle, 2013).

Pioneering has the opportunity to create innovation in most sectors, however the pioneers may lack affinity with the brand (O'Hern & Kahl, 2013). In terms of cycling the concept of the pioneer lends itself to extremely exclusive and thus niche end of the market, for example custom design cycling shoes by Cailting Feilder or Michal Bačák one-of-a-kind masterpiece (See Figures 2.15 & 2.16). In sharp contrast is the mass cycling market, which has involved limited use of lead user, in part due to lack of innovation from the bigger brands. This has seen some extremely successful crowd funding campaigns, for example Clug which is now sold in over 40 countries, which has led the Guardian (2012) to stipulate that cycling and crowd funding are a natural combination. The thesis will explore the potential of the pioneers and, more significantly, leader users through user generated content, and how these impact the functionality of mobile apps resulting in further knowledge of mobile app engagement that resonates with consumers.

Image 2.15: *Example of Pioneering, custom design by Caitlin Fielder*

Figure 2.16 *Example of Pioneering, Michal Bačák one-of-a-kind bike*

2.7.7 User Generated Content in Mobile and Positioning

When reviewing user generated content, a sea of change is apparent, as organisations note a shift from centralised marketing control towards creative consumers from around the world who are able to show their interests; sharing their opinions, inventions, and insight results in a shift within power (O'Hern & Kahle, 2013). As the mobile phone and mobile apps are the central hub of all these forms of UGC (Dube, 2012; Hudson, Huang, Roth & Madden, 2016; Kaplan, 2012; Kulkarni, 2017; Lamberton & Stephen, 2016; Lamberton & Stephen, 2015; Rashid et al., 2019; Roma, & Aloini 2019; Sterling, 2016; Verhoef et al., 2017), further investigation is essential to aid knowledge. This provides opportunities and challenges for organisations and elevates the importance of O'Hern and Kahle's (2013) four typologies (informing, co-communicating, co-creating and pioneering), providing the theoretical framework to further explore in a mobile apps context. This thesis will focus on the investigation of these four typologies of user generated content to investigate the typologies that engage consumers in the cycling sector, along with furthering the academic contribution to knowledge on the social-centric approach of mobile apps.

2.8 M-Commerce app

This chapter will now investigate the extant literature into mobile commerce of apps. The biggest online retailers in the UK, Wiggle and Chain Reaction, have adopted this approach for their mobile app and stresses the important to the sector (Fernie, Fernie & McKinnon, 2018). Quite simply the goal of m-commerce apps is to sell products (Zhao & Balugue, 2015), and hence is of importance to both online retailers within cycling. The business objectives are simply to collect data on the user in order to personalise, during the purchasing process and product customisation (Sutanto, Palme, Tan & Phang 2013; Tong, Luo & Xu, 2020). When it comes to the social features Zhao and Balugue (2015) notes the importance of: product personalisation along with ability to share with external social networks.

This is supported by other studies such as Sutanto et al. (2013) and Farrag & Nasr (2017), who stress the significance of mobile apps in commerce, providing the ability to personalise product offers along with consumers sharing their experiences on social media. With such a strong emphasis on personalisation with mobile apps commerce, the results in Zhao and Balugue's (2015) review of 100 branded apps identified the following mechanism for personalisation through m-commerce: camera: scan barcode/QR code, location awareness, augmented reality (AR), virtual mirror and mobile payments. Wen, Wang, Fang and Huang (2022) adds further justification of personalisation as the study investigates the motivations of users of mobile commerce apps, and multiple dimensions of extrinsic value, social value and intrinsic value influencing the satisfaction. The themes of scan barcode/QR code, location awareness, augmented reality (AR), virtual mirror and mobile payment will be reviewed for the remainder of the M-commerce app, in order to aid further understanding and draw conclusions to meet the study's aims.

2.8.1 Scan Barcode/QR Code/Vouchers and Coupons

Combining both areas of scan barcodes/QR and Vouchers/ Coupons, allows us to both draw comparisons and differences that exist,on consumer motivation for engaging. A common theme of engagement between retailer and consumer is the practice of sending coupons and vouchers via the mobile (Skleton, 2014). The advantages of mobile coupons are that they provide convenience and direct actions from consumers (Lawry & Bhappu, 2021). This is due to transactional apps and mobile apps, which have led mobile vouchers and coupons to become the stablemates of how the retailers not only generate new revenues by driving traffic but also service their customers (Skleton, 2014; Lawry & Bhappu, 2021; Liao, Wu, Truong & Do, 2022). Often the literature highlights the need for further insights into the effectiveness of mobile coupons and vouchers and in particular the extent to which consumers perceive coupons as relevant (Grewal et al., 2011; Achadinha, Jama & Nel, 2014 Liu; Liu & Jiang 2022).

Khajehzadeh, Oppewal & Tojib (2014) noted differences depending on motivation of shopping as utilitarian shoppers perceive regulatory fit when an offer is compatible with their shopping motivation, as mobile coupon offers do not divert the shopper away from their focal shopping motivation. Conversely, hedonic shoppers perceive no difference in regulatory fit when an offer attempts to divert them from their shopping motivation, leading Khajehzadeh, Oppewal & Tojib (2014) to draw the conclusion hedonic shoppers redeem a wider variety of offers, whereas utilitarian shoppers require more personalisation to redeem coupons and vouchers. Understanding the motivations for consumers engaging in vouchers and coupons (Khajehzadeh, Oppewal & Tojib, 2014) through mobile apps is important for this thesis to aid the understanding of cyclist segmentation.

The integration of bar code scanners and QR for retailers allows the development of comparison within store/online, video demonstration of products, when delivery arrives, ability to drive the conversation/instructions/review online, delivery details and tracking provide aftercare service for product or service and even making payment (Skleton, 2014). Using the camera function via the mobile phone, allows both bar code scanners and QR to generate a greater level of convenience as it makes life easier for consumers (Ashford, 2010; Chang, Chen, Xu & Xiong, 2021). This leads Watson, McCarthy and Rowley (2013) to define QR codes as a pull technology along with splitting audiences into two groups: users and non-users. Watson, McCarthy and Rowley (2013) notes the characteristics of QR code users as positive about their use, stressing the importance of ease of use, the significance of information/content and discounts and finally users being motivated by the benefits that they perceive of scanning. Similarities of the non-user were noted by Watson, McCarthy and Rowley (2013) in them stressing the value of information, content and incentives for not engaging. However, the non-users face barriers for not adopting QR codes, due to older technology, lack of familiarity and understanding with QR codes and thus missing out on their potential benefits (Watson, McCarthy & Rowley, 2013).

The study by Wen et al. (2022) concluded that when using mobile apps for commerce extrinsic value (e.g. convenience) positively affects utilitarian users, whereas intrinsic motivation (value motivation) positively impacted by both the hedonic expectations and social value (e.g. subjective norms) for both utilitarian and hedonic users. Whilst the Wen et al. (2022) study is interesting to note, it is not without raising questions with a small sample size (292) along with sampling approach resulting in 70% of participants being aged between 19 and 36 and only 4% above 55. Considering the advantages (Watson, McCarthy & Rowley, 2013) of such a simplistic approach of motivations of user and non-user, this is selected as the approach to adopt for the need of meeting the objectives of the study.

2.8.2 Location Awareness

Location has long been defined as the distinguisher of mobile phone (Skleton, 2014; Rotman & Shalev, 2022), however the iPhone transformed this. As the network can now triangulate the location of the phone, this service has become the key used by the mobile to add value around old propositions (Skleton, 2014), not only are retailers able to utilise location in proximity to the service and their nearest store, but new services such as Near Me allow user to search for bars, restaurants, shops and taxi firms, all under one mobile app.

There are several reasons customers choose to share location via a mobile app: relevant offers in real time, personalised experiences, better navigation and virtual tour, shopping and search suggestions and promotions and precise services (Parise, Guinan & Kafka, 2016). This leads towards the use of location-based apps not only for directions (which are significant for mobile apps in the cycling sector) but also for play (i.e., geocaching) and social networking (i.e., locative mobile social networking (LMSN) application (Wang, 2021).

Research on mobile locations has often focused on mobile games, the arts or mobile social networks (De Souza e Silva, 2009; Galloway & Ward, 2006; Humphreys & Liao, 2011; Wang, 2021) and some conclusion can be drawn as to the motivations. In order to understand this, Humphreys (2007) reviewed the motivations for using location based mobile app dodgeball and facilitate gatherings, to document a location, to brand a person's identity, or to mark a particular location. Similarities are drawn from a study looking at location on a platform called Socialite, in which conclusion of document location assists in the user telling stories about a location (Humphreys & Liao, 2011).

Additional themes of motivation of consumers to engage in location-based mobile apps are drawn from Schmitz and Weiss (2013) and benefits noted of significance of mobility, location, accessibility and convenience being the key attributes in the adoption of the mobile device and location services. The study will use attributes of mobility, location, accessibility and convenience from Schmitz and Weiss (2013) to investigate cyclist segment's views on the adoption location when it comes to mobile commerce apps.

2.8.3 Augmented Reality and Virtual Mirror

Augmented Reality (AR) is defined as "overlaying of digital information onto the real world" (Skeldon, 2011 p. 98). AR often uses technology such as cameras, GP and compasses which are built within the mobile phones and brings together location, orientation and context to provide an immersive user experience (Skeldon, 2011). AR often results in uses such as virtual content (e.g. new riding kit) in a real environment (placed upon the consumer's). Historically, large devices hindered the adoption of augmented reality, however due to increased adoption of the mobile phone and the ideal platform of mobile apps, interest from companies in augmented reality has significantly increased (Rese, Baier, Geyer-Schulz & Schreiber, 2017).

As AR has moved from test platforms to the consumer marketplace (Daponte et al., 2014) retailer sectors have adopted one of its front runner, with smart or virtual mirrors aiding the customer experience (Demirkan & Spohrer, 2014; Pantano & Naccarato, 2010; Pantano, 2014).

A virtual mirror (smart mirror), as seen within Figure 2.17, is a device that displays a user's own image on a screen as if that screen were a mirror, it is available within mobile apps and allows users to modify their appearance or try on clothing.

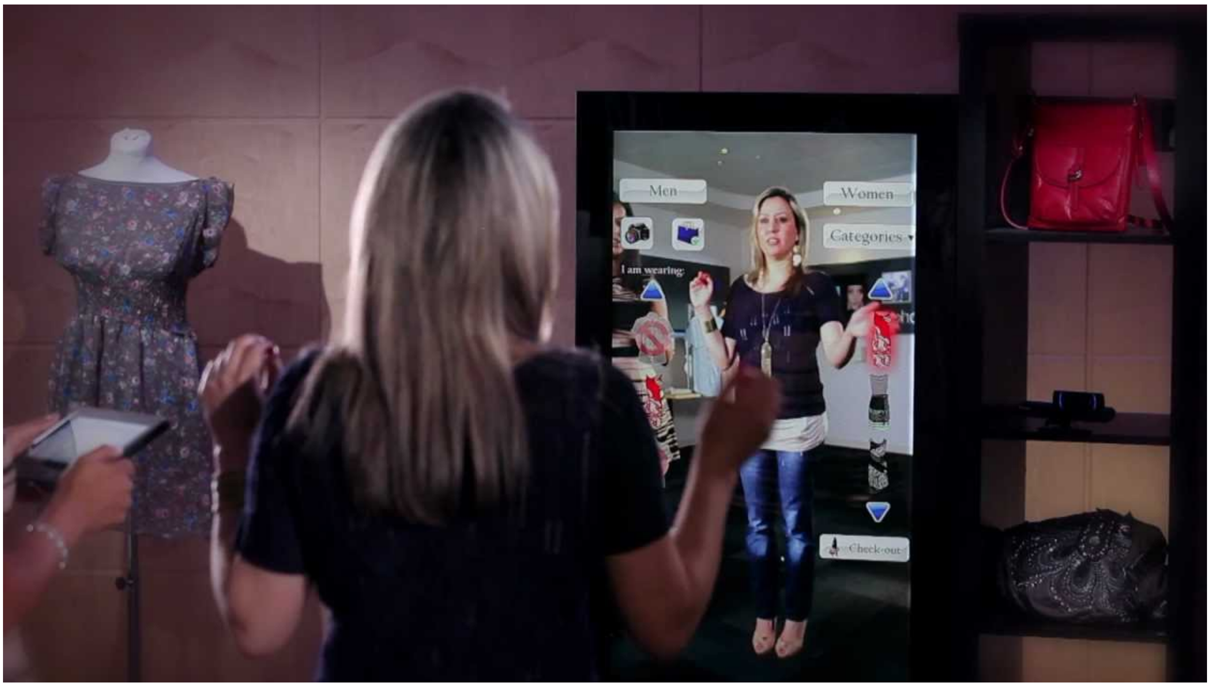


Figure 2.17 *StyleMe Virtual Fashion Mirror. Source: Cisco*

A key component of AR is how it utilises 3D virtual objects in the environment of the user, which generates a sensorial perception of the person (Daponte et al., 2014; Sala, 2021) but does not replace the real world environment but instead uses this environment as the background. Whilst AR can be utilised within variety of areas from entertainment and games such as Zwift, through to education and training, its marketing has been identified as a potential application field with the largest opportunity (Adhani & Rambli, 2012; Gervautz & Schmalstieg, 2012; Mekni & Lemieux, 2014; Gervautz & Schmalstieg, 2012).

When it comes to retailing through mobile commerce AR can engage with audiences through virtual trial and product education. Blazquez (2014) highlighted the ability of the user to utilise their own image to interact with product as aiding the interaction. It results in the ability to present additional product information in terms of virtual content and thus the augmented reality app can support consumers in their product decision (Adhani & Rambli, 2012).

The rationale for such an impact is due to interactivity of AR mobile apps (Gervautz & Schmalstieg, 2012). In addition, AR sees gamification enhancing the customer experience (Baier, Rese & Schreiber, 2015), which is significant given the focus of research in social-centric mobile apps. In-game play again allows users to interact with additional product information in terms of virtual content. Considering AR of handheld devices is often an unexplored area of study particularly from the consumer vantage point (Bulearca & Tamarjan, 2010; Dey & Sandor, 2014), thus offering opportunity to explore the attribute that engages audiences within mobile commerce. In order to aid knowledge upon each cycling segment's views on AR/VR, the study will investigate attitudes towards AR and VR in mobile apps within the pre-testing of the study.

2.8.4 Mobile Payments

Early adopters of mobile apps decided not to offer payment channels in part due to complexities (Skeldon, 2011). However, due to the likes of Amazon leading the way of including payments methods into mobile apps, the consumer is driving the need for mobile payments (Chakraborty et al., 2022). As Skeldon (2011) notes, if mobile payments are not offered to consumers through mobile apps, due to demand for convenience then they will vote with their feet and use alternatives. This was further supported by Slade, Dwivedi, Piercy and Williams (2015), who noted payment systems and mobile devices and services are essential to the way in which we live in the 21st century. As we strive to move to the digital wallet, the introduction of Apple Pay and Google Pay alongside the older models of Paypal see the infrastructure moving towards consumers being able to use mobile as a payment tool. As the mobile payment takes away the need to use physical cash (Pham & Ho, 2015), it is defined as offering convenience and speed for consumers (Teo, Tan, Ooi, Hew & Yew, 2015) and performing transfer of secure information between devices. The adoption of mobile payments lends itself to the environment with high volume of payments, such as restaurants or large retailers (Leong et al., 2013). Of interest to this thesis is the adoption of mobile payments in large retail environments, as the biggest online retailers in cycling have utilised mobile payments successfully.

Mobile payment is regarded as a new area of research, which is therefore under explored when compared to related areas of research such as commerce, leading some authors to regard mobile payment adoption research as still in its infancy (Slade et al., 2013). The importance of understanding the adoption of mobile payments is often explored and draws the importance of further clarity required in understanding determinates of mobile payment adoption (Leong et al., 2013; Slade et al., 2014; Tan et al., 2014).

Research by Lai and Chuah (2010) noted that value of mobile payment differs between consumer and merchant and the need to create a notable distinction between these motives. This is contrasted by other research including Chang, Chen and Zhou (2009), who noted the widespread adoption of mobile payment services from both consumers and merchants being dependent on a secure and reliable payment system which is convenient and easy to use, and thus stress the importance of security on adoption. The study aims to investigate to what extent the mobile payments are adopted by different cyclist segments and whether these are influenced by security and reliability, convenience, and finally ease of use (Chang, Chen & Zhou, 2009),

2.8.6 Positioning of Mobile Commerce for Apps

When reviewing M-Commerce-centric apps, Zhao and Balugue (2015) defined their goal as to sell products. The importance to the cycling sector is seen with the two biggest online retailers, Wriggle and Chain Reaction, adopting an m-commerce based approach to their apps. However, this is only part of the equation with Zhao and Balugue (2015) and Skeldon (2011), noting the characteristic for m-commerce apps including: scan barcode/QR code, location awareness, augmented reality/virtual mirror, and mobile payments. The move from m-commerce into the world of apps, aids the understanding of the consumers' motivations and thus allows an additional lens to segment cycling audiences. The pre-testing study will investigate m-commerce in apps, using the following factors of Khajehzadeh, Oppewal & Tojib (2014) when it comes vouchers and coupons; Watson, McCarthy & Rowley, (2013) for scan barcode/QR code (motivations for user and non-user); Schmitz Weiss (2013) for location (mobility, location, accessibility, and convenience); Blazquez, (2014) attitudes towards AR and VR; Chang, Chen and Zhou, (2009) for mobile payments (secure, reliable, convenient and easy to use).

2.9 Design-centric App

The design-centric functions of mobile apps will be reviewed though literature review into areas such as m-branding. Zhao and Balugue (2015) stated that some brands develop creative and imaginative design-centric apps. As the design-centric app is open ended, the work of Zhao and Balugue (2015) requires exploration to draw out the meaning before using additional academic research to support and justify. A particular critique of Zhao and Balugue's (2015) work is the early stages of design-centric apps as the focus centres on brand consistency across a suite of interconnect apps. Whilst drawing on the original work to infer meaning for design-centric apps there is a lack of clarity beyond brand consistency. This resulted in a wider review of the literature with a focus on m-branding being particularly significant and poignant for the study. (McGrath and McCormick, 2012)

Zhao and Balugue's (2015) exploration of design-centric apps uses examples, each drawing upon the creative brands philosophy, for example Camper, which is not a specific shoe, but rather a style, a philosophy of life. Zhao and Balugue (2015) did suggest larger brands create a selection of mobiles apps to meet different purposes/objectives for example tool centric vs game-centric, and brands can also implement a series of interconnected apps using a design-centric approach. With this in mind the business objectives are to communicate consistency across brand values whilst increasing brand image (Zhao & Balugue, 2015). Accordingly, Zhao and Balugue (2015) stated design-centric apps do not offer any unique mobile features, instead allowing for sharing a consistent brand image with external social networks.

The focus on design-centric apps, stresses implementatng a series of interconnected apps, with the objective of consistent brand values to increase brand image from Zhao and Balugue (2015) it lacks clarity beyond brand consistency, requiring delving into additional research of m-branding. McGrath and McCormick (2012) did suggest there was lack of research on aspects of branding when it comes to mobile design. Bauer et al. (2005) was even stronger in stipulating the implications of the mobile commerce and branding not being understood within academic research.

Moving forward, the remainder of the chapter will investigate the scholarly approaches to branding and mobile design to aid the outline provided by Zhao and Balugue (2015), using McGrath and McCormick's (2012) m-branding.

2.9.1 Reviewing Literature and Defining M-Branding

When consulting with academic literature, a large array of definitions and frameworks of branding are often linked to the world of design, with the brand persona being the focus and widely regarded as sign, symbol and design, in order for the brand to be identified from others (American Marketing Association, 1960; Dibb et al., 1997; Kotler et al., 2002; Keller, 2003). The holy grail of using such design features is to develop an improved brand image (Karjalainen, 2007), and thus in turn improve brand loyalty. This would allow the introduction of new successful products and effectively create a point of difference in the market (Aurand et al., 2005). The development of brand image and loyalty drives benefits to consumers as it makes the decision-making process simpler for the consumer and can reduce consumer risk and develop consumer expectations (Davis, 2000).

In terms of the design elements when researched within online channels, some elements not only induce purchase intentions, but go beyond and develop trust and provide entertainment value, thus, most significantly, leading to consumer satisfaction and loyalty (Chung & Shin, 2010; Cyr et al., 2009; Yeh & Li, 2009). There seems a contrasting body of views when it comes to branding theory and concepts transferring into the mobile context with the purest suggested similarities of online and mobile environments.

Bauer et al. (2005) argues the implications of the mobile commerce environment have yet to be fully explored for branding with McGrath and McCormick (2012) stipulating the lack of academic research upon the branding aspect of the mobile design and business strategy leading to the creation of a holistic framework of m-branding design. Consulting mobile branding theme and through practical literature, similarities can be drawn between McGrath and McCormick's (2012) m-branding design and challenges that exist within practice.

McGrath and McCormick (2012) define m-branding design as relating “to the visual branding elements utilised within a mobile” (p. 104). The visual elements of m-branding are; name (Wood, 2000: Kolter et al., 2002), logo (An & Harvey, 2019), brand design (Yi, Ruddock & Kim, 2015), brand content (An & Harvey, 2019) which allow the consumer to distinguish a unique identity to the brand (McGrath & McCormick. 2012). Reviewing these four themes of mobile branding will aid the theoretical underpinning for design-centric apps. The m-Branding framework of McGrath and McCormick (2012) is seen in Figure 2.18, the remainder of chapter will use this theory to review name, logo, brand design and brand content.

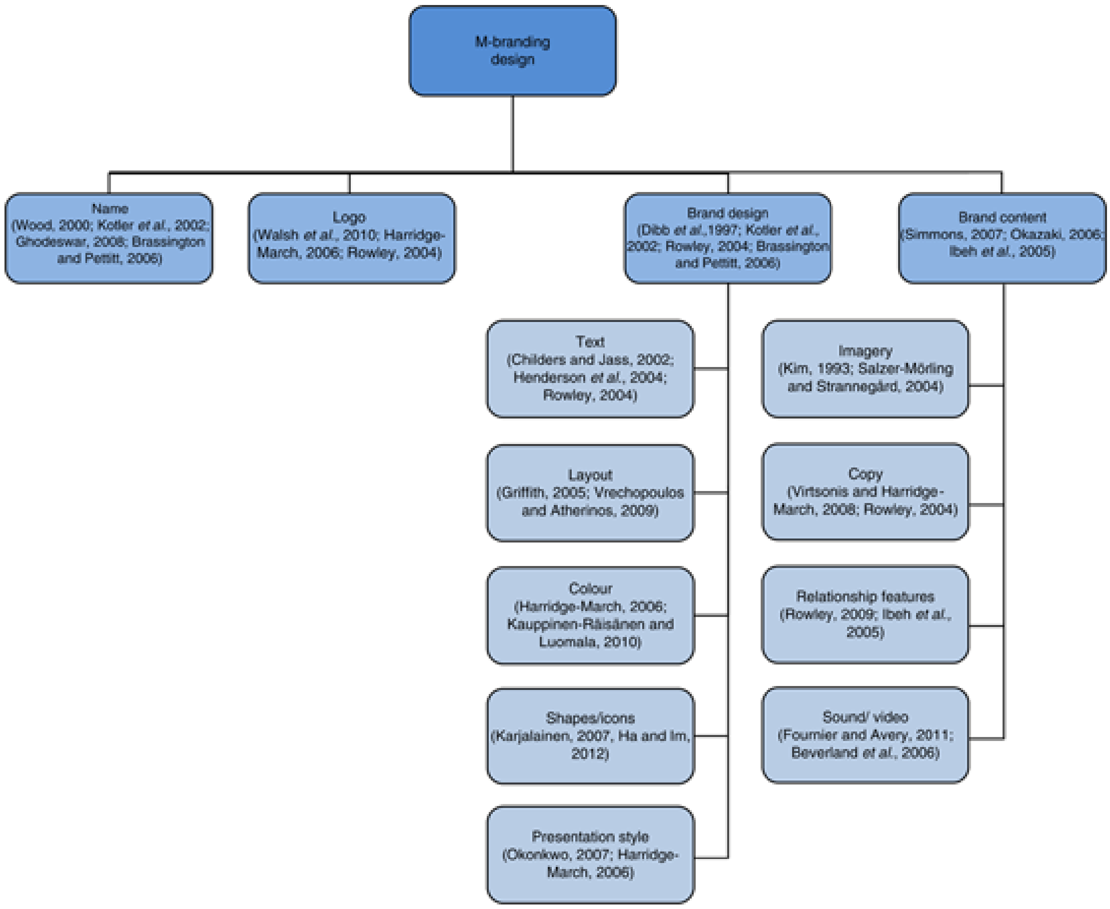


Figure 2.18: *M-branding design McGrath and McCormick (2012)*

2.9.2 Brand Name

The brand name is the principal way for consumers to identify a brand (Belén del Río et al., 2001), particularly in verbal communication as it provides recognisable cues for consumers, and thus leads towards the evaluation of products, stores and other assets related to the brand (Park & Lennon, 2009). Not only is the brand name essential for brand recall and awareness (Belén del Río et al., 2001), but also of significance in promoting the brand benefitting status, guarantee and significance to social and personal consumer identification.

Whilst brand name is included in the theme of brand design (McGrath & McCormick, 2012) numerous studies have created the notion that brand name works in sync with both symbol and design (Dibb et al., 1997; Kotler et al., 2002; Keller, 2003; Brassington & Pettitt, 2006), as this generates brand identity and market differentiation (Dibb et al., 1997; Karjalainen, 2007). This differentiation comes in the form of consumers identifying differences between organisations (Elliott & Percy, 2007), and results in a positive brand image and leads towards the simulation of repeat purchases (Park & Lennon, 2009). This notion was further supported by Round and Roper (2012) as brand image creates differentiation to the consumer and thus provides identification, risk reduction and signals quality.

With such a crowded marketplace the importance of brand name has long been debated within academic settings, as consumers searching for branded apps require instant recognisability (McGrath & McCormick, 2012). This led McGrath and McCormick (2012) to conclude the brand name association through a mobile app not only provides recognisability but also positivity, trust and awareness.

2.9.3 Brand Logo

Brand has long been considered as the graphic representation of the brand as seen within Figure 2.18, with the goal of triggering memories and associations (Walsh et al., 2010). The brand logo aids consumers in both shopping and social situations as it acts as a visual reminder that provides a stimulus of statutus to the brand name, which aids both brand recall and brand identification (Kapferer, 2008). Importantly singled out within the academic literature is the gravitas the brand logo has upon the visual brand recognition (Ewing, 2006; Karjalainen, 2007) as it is critical to the brand's aesthetics (Walsh et al., 2010) and is essential to the organisation's success (Mcgrath & McCormick, 2012). The brand logo is part of the pillar of information for consumers including the visual brand identity (Abratt & Kleyn, 2012; Ewing, 2006) and accompanying sign or symbol (Brassington & Pettitt, 2006; Mulyono & Pasaribu, 2021) which represents the brand name and company. The visual elements of brand logo are argued to affect both the consumers' response and brand commitment (McGrath & McCormick, 2012; Rathnayake, 2021). However, as both brand name and logo combine as the pillars of information, they aid the consumer in recognising both online media and brand values (Da Silva & Alwi, 2008). As the logo is packaged with the mobile app it supports authenticity (Rowley, 2004) and develops the building of customer trust (McGrath & McCormick, 2012).

2.9.4 Brand Design Includes Typeface, Layout, Colour, Stimuli: Shapes/Icons

Visual identity is described as the visual methods utilised by a brand to communicate and articulate the organisation's identity (Abratt & Kleyn, 2012). It includes the brand's name and logo in addition to: colours, symbols "anything else that is related to graphic design" (Abratt & Kleyn, 2012, p. 6). The aforementioned criterion of visual identity is supported by Melewar and Saunders (1998) and Jun and Lee (2007) whose studies both added typography. Within a digital context, Rowley (2009) reviewed online branding strategies of retailers to draw the conclusion and re-termed the visual identity as "brand design".

The criteria of brand design including colour, typography, symbols (Abratt & Kleyn, 2012; Jun & Lee, 2007; Melewar & Saunders, 1998; Rowley, 2009) are well supported in mobile apps. Some challenges of brand visual identity in the mobile environment (Rowley, 2004; Okonkwo, 2007; Harridge-March, 2006) require the inclusion of layout and presentation style (McGrath & McCormick 2012; Stocchi et al., 2021). The challenges of brand design through the medium of mobile apps are more demanding (Rowley, 2004) such as variance in screen size, speed and accessibility (McGrath & McCormick, 2012), leading Li and Yeh (2010) to stipulate the need for further research into effective branding design (typefaces, colours, shapes, layout and the presentation style) within the context of mobile apps.

Understanding the importance of mobile aesthetic design is stressed through Li and Yeh (2010), as its mechanism is not only to build trust with consumers, but also essential to generate purchase intentions. Both the brand message and values are shared with the consumers through design elements (Rowley, 2004; Karjalainen, 2007). The way in which the fonts, colours and images are presentated within a page was noted as an ability to impact both pleasure and arousal, and most significantly creating a positive impact for the consumer (Oh, Fiorito, Cho & Hofacker, 2008). Reviewing each of these each brand design elements, typeface, layout, colour, stimuli: shape/icons, will aid the research in meeting its objectives.

2.9.4.1 Brand Design Typeface

Typeface is simply the style or font used (Ha, Kwon & Lennon, 2007) via the written communication formats (Rowley, 2004). Consistency is argued across all channels for the purpose of brand personality (Rowley, 2004) and as well as impacting the overall presentation it also represents authenticity and originality (Harris & Goode, 2010). Both practical and academic worlds have long argued its significance, due in part tothe importance of developing a branding strategy of a company, as font affects the consumer's perception of the brand, memorability and influences its legibility (Childers & Jass, 2002), thus impacting a consumer's response (Henderson et al., 2004).

2.9.4.2 Brand Design Layout

Layout is the outline and arrangement of the images, text, headers and graphics (Rowley, 2004; Harris & Goode, 2010). Harris and Goode (2010) noted that within online platforms this includes not only the placing of elements, but also their functionality along with the usage of navigation buttons. Again, consistency is argued for layout to be important from different digital platforms and apps. The layout goal is to provide consumers with format information easily and pleasurably with the objective of therefore affecting consumer satisfaction (Chung & Shin, 2010). Furthermore, research suggests that layout can have impact on the behaviours of consumers and their disposition to shop online (Vrechopoulos & Atherinos, 2009).

2.9.4.3 Brand Design Colour

Colours come in the form of fonts and background colours within a site and app (Ha & Im, 2012). The purpose of using colour is to create an identifiable entity (Okonkwo, 2007), with a distinctive brand through text, backgrounds, menus, and images (Rowley, 2009). This creates a colour palette for the brand which is referred to as the “brand norm” (Harridge-March, 2006; Lee, 2018), which should offer consistency across all channels (Rowley, 2009). Colour then delivers associated messages to the consumers in line with a brand's overarching strategy (Rowley, 2004) with the role embodying the brand's personality and associating the brand's character (De Chernatony & McDonald, 2003).

2.9.4.4 Brand Design Stimuli: Shapes/Icons

The utilisation of both shapes and icons is to combine other brand design elements (colours, typeface) with an overall influence on the presentation. In the digital context shapes are described as including graphical buttons, the shapes of pictures, menu boxes, or the whole shape of overarching layout (Rowley, 2004). Of course these must be considered in line with brand design for consistency (Rowley, 2009), however in addition there is the significance of delivering an exciting experience through the digital context (Wu et al., 2008).

2.9.4.5 Brand Design Presentation

Presentation combines the holistic attributes of the branded design (layout, typeface, shapes and colours) into a brand image (Okonkwo, 2007). It is the whole of the parts, as not only the brand image of logo generates brand recognition but the overreaching styling of the mobile app (Mcgrath & McCormick, 2012). The second stage of data collection (pre-testing stage) along with the pilot study (stage three) provides the ideal platform to investigate each of the four elements of McGrath and McCormick (2012) for brand design. In both stages two and three the survey instrument will look to statistical validation of the four brand design factors of typeface, layout, colour, stimuli: shapes/icons.

2.9.5 Brand Content Includes Imagery, Copy, Relationship Features, Sound/Video

Brand content includes: imagery, copy, relationship features and sound/video features (McGrath & McCormick, 2012). Brand design and brand content straddle a line that offers similarities (Rowley, 2004) with the key distinguisher being that brand design remains static and looks for consistency, whereas brand content is dynamic and changeable (McGrath & McCormick, 2012) in today's digital complex world. Brand content does not form the brand's corporate identity, however it expands its identity through the vehicles of digital mediums building further the brand personality by pushing the brand's message which thus generates a brand-consumer relationship (Okazaki, 2006; Ibeh et al., 2005).

Content has long been argued as being important for consumers in terms of branding (Ibeh et al., 2005) as it adds value (Rowley, 2004). Simmons (2007) created the four pillars of internet branding in which content is identified as a key strand, this was the catalyst for the four themes of branded content which includes imagery, copy (Simmons et al., 2010), relationship features (Rowley, 2004) and videos (Simmons et al., 2010; Chang, 2011). The expansion of content is seen within a recent report by the content marketing institute (2022) with 80% of consumer brands having a strategy for content marketing. The expansion and interest in content marketing is attributed to the significance of developing brands in today's digital world (Simmons, 2007; Simmons et al., 2010; Simmons et al., 2010; Chang, 2011; Rowley, 2004) and how it supports the delivery of the brand personality (Okazaki, 2006).

2.9.5.1 Brand Content – Imagery

Image includes the graphics, pictures, headers and background images (McGrath and McCormick 2012), with the purpose of visually representing the brand values and image (Rowley, 2004; Kim & Lim, 2019). Images a: 1) provide enjoyable and attractive experience (Chen & Dibb, 2010), 2) provide interactive experience, 3) act as a link to other pages or apps (Heeter, 2000; Page & Lepkowska-White, 2002). Most significantly for the purpose of the thesis, they creates the overall feeling of a platform and provide evidence about the brand (Eroglu et al., 2003; Chen & Dibb, 2010; Peter & Dalla Vecchia, 2021). Research concludes the importance of relevancy, consistency and the need for up-to-date imagery to aid trust (Chen & Dibb, 2010). Such trust is seen to increase credibility whilst heightening the user experience (Page & Lepkowska-White, 2002; Heeter, 2000; Chen & Dibb, 2010).

2.9.5.2 Brand Content Copy

Copy is defined as purely the words that are used to communicate with consumers (Rowley 2004) and examples include overview mobile app and home page. Thus, the purpose of copy is to provide textual information about the brand (McGrath and McCormick, 2012). The long-aged debate on tone of voice has been raised in both academic and practical settings. The tone of voice should resonate with the brand's values along with offering consistency for both the brand's personality and message (Chaffey & Smith, 2008; Rowley, 2004) in order establish brand relationships (McGrath & McCormick, 2012).

As copy is an asset that can be changed, it should utilise brand design to ensure consistency across channels. However, due to the challenges of mobile apps, in particular size limitations of screens, this requires information to be condensed, whilst still delivering an organised, visual and enjoyable experience (McGrath & McCormick, 2012). This makes copy of particular significance when it comes to developing a brand through a mobile app (Bala & Verma, 2018), whether in the branded apps or app store.

2.9.5.3 Brand Content Relationship Features

Rowley (2004) described relationship features as going above and beyond the expected (for example customisation of platforms, personalisation of communication through social) with the purpose of adding value to the consumer experience. This stresses the importance of navigation features, load speeds, ease of communication (Rowley, 2004) along with the customisation of a platform (Ha & Im, 2012). Customer value is generated by the interpretation and satisfaction of interactions with a platform such as a mobile app, thus impacting the overall brand (Okonkwo, 2007).

The growth in social media channels has seen the increase in quick links within mobile apps (Ha & Im, 2012; Kapoor & Vij, 2018), but more significantly the development of consumer interaction through personal communication (McGrath & McCormick, 2012). Such personal communications studies have shown the development of brand-consumer relationships, which further enhances brand satisfaction and loyalty (Yeh & Li, 2009; Ward & Dagger, 2007; Tran, Mai & Taylor, 2021; Tran, Taylor & Wen, 2022).

2.9.5.4 Brand Content Sound/Video

Sound within website/apps has long been a thorny issue as consumers make decision to mute sound as they find it unsatisfying (Abdinnour-Helm et al., 2005). This has transferred across to mobile, in part due to similar frustrations, but also due the personal nature of the mobile phone and at times the public nature of mobile phone usage (McGrath & McCormick, 2012). However, the growing prevalence of video shows no signs of slowing down, with 92% of marketing professionals noting the significance of video within marketing strategies (SMART Insights, 2020).

Brands utilise videos within mobile apps to either provide entertainment or express their personality with the objective of building brand relationships (McGrath & McCormick 2012). This leads to Kim et al. (2011) noting embedding video within mobile platforms not only reduces the consumers' perceived risks, but also improves their shopping entertainment, and importantly their purchase intention. Due to the nature of growth of video, and increased significance of usage in the marketing professional toolkit (SMART Insights, 2020), which is also supported as video aids purchase intention (Kim et al., 2011), video rather than sound will form the focus of the research.

2.9.7 Positioning of Design-Centric Mobile Apps

As Zhao and Balugue (2015) noted design centric mobile apps consider the branding approach as consumers will use multiple different apps to meet their requirements whether game-centric or social-centric. Ensuring a consistent brand experience is at the heart of design-centric design as consumers use interchangeable apps from the same brand or company. On closer inspection of Zhao and Balugue (2015), a critique is that the very early stages of design-centric apps result in lack of empirical findings to base the function upon. With a review of the literature the need to look at the concept of mobile app branding through a different lens becomes apparent, due to its unique characteristics (Chen, Lu & Tang, 2019).

The theory of M-Branding was created by McGrath and McCormick (2012) who compare and contrast the difference of branding theories through online and mobile. The creation of the framework, as seen in Table 2.19, identifies the four themes of brand name, brand logo, brand design and brand content. These four themes are of significance to the thesis and the study’s objectives as they provide the theoretical underpinning to explore consumer’s attitudes and motivations towards design-centric apps.

Brand category	Brand consistency	Purpose	Examples from literature: consumer effects
Brand name	Consistent	Verbal and visual communication and identification of the brand (Belén del Río *et al.*, 2001; Round and Roper, 2012)	Repeat purchases (Park and Lennon, 2009) Brand equity (Belén del Río *et al.*, 2001) Decision making (Jiang, 2004) Association and experience retrieval (Keller, 1993) Quality cue (Jiang, 2004)
Brand logo	Consistent	Graphic representation of the brand name utilised for identification and recognition (Walsh *et al.*, 2010; Kapferer, 2008)	Visual brand recognition (Karjalainen, 2007) Brand loyalty (Ewing, 2006) Brand commitment (Walsh *et al.*, 2011)
Brand design	Consistent	Creation of the corporate visual identity/design (Jun and Lee, 2007; Abratt and Kleyn, 2012; Melewar *et al.*, 2012)	Trust (Li and Yeh, 2010) Positivity (Oh *et al.*, 2008) Willingness to shop (Vrechopoulos and Atherinos, 2009) Consumer satisfaction (Chung and Shin, 2010) Pleasure (Wu *et al.*, 2008)
Brand content	Changeable	Delivery and enhancement of the corporate brand image (Okazaki, 2006; Simmons *et al.*, 2010), brand personality and brand message (Okazaki, 2006; Ibeh *et al.*, 2005)	Brand-consumer relationships (Okazaki, 2006) Brand experience (Rowley, 2004) Enjoyment and interaction (Heeter, 2000; Oh *et al.*, 2008) Trust (Chen and Dibb, 2010)

Figure 2.19: *M-branding design categories Mcgrath and McCormick (2012)*

Whilst the study by Zhao and Balugue (2015) provides a starting point, the lack of clarity beyond interconnected branded apps for consistency requires a delve into further literature. The focus on research surrounding M-Branding for this thesis will draw on: brand name positive impact on trust and awareness (McGrath and McCormick, 2012), logo within mobile app supporting authenticity (Rowley, 2004), brand design and the importance of “brand norm” (Harridge-March, 2006) in creating consistency across all channels (Rowley, 2009), brand content supporting the delivery of the brand personality (Okazaki, 2006) along with video content aiding purchase intention (Kim et al., 2011).

2.10 Positioning of the Research Gaps and Scope of Further Research in Both Theory and Practical Terms

The literature review has evaluated a wide number of fields: consumer involvement, segmentation and SDT in cycling, customer engagement for mobile Apps, and finally the five functions of mobile apps drawing on research undertaken by Zhao and Balugue (2015), bridging some of the gaps in the literature, in particular the review the of top 100 branded mobile apps generates an outline of the concepts of the five functions of tool-centric, game-centric, social-centric, design-centric, and m-commerce-centric. However, what becomes apparent is the lack of research on mobile apps in the context of cycling (Nikolaeva, Te Brömmelstroet, Raven & Ranson, 2019).

Zhao and Balugue (2015) stressed the importance of these mobile app functions being the context of the organisation/sector with the following quote "features that they apply to their own business strategies wisely; furthermore, the features included in app designs should be chosen on a case-by-case basis" (p. 313). This statement demonstrates the need to consider the functions of mobile apps in the context-specific focus, as specifically for this thesis the context of cycling. No research paper has previously defined the factors of the five functions of mobile apps for cycling. The aims of this study are for the first time to conceptualise (seen in Figure 2.20) and then develop a testable framework of the five functions of mobile apps for cycling.

The impact of mobile apps in cycling is demonstrable, this sector has quite simply widely embraced mobile apps, with Strava having 95 million active users (Business of Apps, 2022d). This is often due to the existing fitness technology companies such as Garmin, alongside those digital disruptors such as Strava and Zwift who have utilised subscription-based models. The approach of Zhao and Balugue (2015) was used to review the 50 mobile apps in cycling within the chapter (see Appendix 1). In reviewing the tool-centric apps the navigation, cycling computer/data performance, training platforms, virtual reality, and suite of mobile apps, were identified.

Of particular significance is the influence of two ground breaking apps in the cycling sector: Strava and Zwift. These mobile apps are at different ends of the spectrum. Strava uses navigation, data performance, and training platforms to stimulate the sharing with peers through the mechanism of leader boards, badges, and kudos, whereas Zwift transports users into a virtual world through AR through the mechanism of personalised user avatars and builds community through gamification. Whilst similar apps exist that include comparable functions, the penetration of both these apps results in their usage being a prerequisite of being identified as a cyclist.

A review of the extant literature on the five functions of mobile apps leads to the identification of gaps in empirical research surrounding the conceptualisation of this model. The aim of this thesis is to further explore the significance of existing conceptualisations to design and test a model of the five functions of mobile apps for the cycling sector. Whilst a number of theoretical concepts such as Hofacker et al. (2016) for game-centric, O'Hern and Kahle's (2013) four typologies for social-centric, M-Branding for design-centric (McGrath & McCormick, 2012), and for M-Commerce-centric taking a range of theories from vouchers and coupons (Khajehzadeh, Oppewal & Tojib 2014), scan barcode/QR code, (Watson, McCarthy & Rowley, 2013) location (Schmitz & Weiss, 2013), AR and VR (Blazquez, 2014), mobile payments (Chang, Chen, & Zhou, 2009).

The theories include numerous conceptualisations of factors in other fields of study, however they lack empirical findings when it comes to the context of mobile apps. The aims of the research are to draw upon these other fields of research to develop a measurement tool for the five functions of mobile apps which are empirically tested and supported.

The study will now turn its attention to using these five functions of mobile apps to develop a greater understanding of cyclists by segmenting audiences on the key factors of cycling-based apps. To the best of the author's awareness, this study will be the first of its kind to use mobile apps to segment audiences – not only in the cycling sector but in the wider, academic research area of sports management.

On consulting with wider literature on the areas of consumer involvement, segmentation and SDT in cycling, and finally customer engagement allows for the adoption of existing models to further understand each of the cycling segments (Lamont, 2013; Pelletier, et al., 1995; Thakur, 2016). This is of particular significance as Zhao and Balugue (2015) stressed the importance of user motivations through the quote: "Good mobile apps are aligned with different levels of user motivations and should engage them passionately" (p. 313). Both intrinsic motivation (entertainment, functionality, information, socialisation, intellectual stimulation, following a trend, and learning) and extrinsic motivation (symbolic, monetary benefits) are presented through a review of the 100 branded apps.

However, there is a lack of conceptualisation of user motivations within Zhao and Balugue's (2015) research. The existing research in the fields of consumer involvement, segmentation and SDT in cycling and customer engagement provide the perfectly tested models to further investigate the user motivations for involvement in cycling and user motivations for using mobile apps in the wider context, thus responding to Zhao and Balugue's (2015) call for "user attitudes toward branded apps need to be studied further to guide marketers on how to build better apps" (p. 313).

This study, therefore, is the first to empirically investigate the appropriateness of the conceptual framework of the five functions of mobile apps, which will be empirically tested and supported. It moves to use this empirically tested model in a cycling context to segment audiences, before finally using established models to understand user motivations for cycling and user motivations for using mobile apps.

2.11 Conceptualisation of Five Functions of Mobile Apps

Figure 2.20 builds on the research map which was presented by Zhao and Balugue (2015). This is overlayed with research into cycling involvement by Lamont and Jenkins (2013), sport management by Pelletier et al. (1995) and customer engagement for mobile apps by Thakur (2016).

Mobile Apps Tool-Centric	Mobile Apps Game - Centric	Mobile Apps Social-Centric	Mobile Apps M-Commerce-Centric	Mobile Apps Design-Centric
• Navigation • Cycling Computer/Data Performance • Training Platform • Virtual Reality • Suite of Mobile apps	• Game Mechanism Element • Story Element • Aesthetic Element	• Informing • Pioneering • Co-Communicating • Co-creating	• Scan/QR/Vouchers • Location • Argument reality and virtual mirrors • Mobile payment	• Brand Name • Brand Logo • Brand Design • Brand Content

Figure 2.20: Conceptualised model of the five functions of Mobile Apps

The five functions of mobiles	Themes used in the cycling mobile apps	Overview
Tool Centric	Navigation Cycling Computer/Data on performance Training platform Virtual reality Wallet of cycling	“features included in app designs should be chosen on a case-by-case basis.” (Zhao and Balugue, 2015, p. 313) Review of 50 mobile apps in cycling; 1) apps characterized into features of: navigation, cycling Computer/Data on

	apps	performance, training platform, virtual reality, wallet of cycling apps 2) Significance of two apps Strava and Zwift.
	Game Mechanism Element	Hofacker et al. (2016) gamification of mobile platforms enhances; consumer enjoyment, engagement, purchase, repurchase and retention. “badging”, is contingencies provides visual identifiers Hofacker et al. (2016) Non-monetary value propositions for consumers vs social value via interactions (Nambisan & Baron 2009) Conclusion of the significance of social interaction as it: creates an atmosphere of camaraderie, builds social bonds, and facilitates future interactions. (Hijacker et al., 2016)
Game-Centric	Story Element	Sense of joy impacting (Hofacker et al. (2016), transporting into new world acceptance of values and beliefs (Slater & Rouner 2002). Mobile as reclassified (Hofacker et al 2016), able to track heart rate, distance covered, and generated argument worlds (Review 50 mobile apps in chapter 2)
Game-Centric	Aesthetic Element	The pictorial representation is more effective as it enhances engagement (Hofacker et al., 2016) Engagement is considered through a breadth of literature in (Brodie et al., 2011; Sashi, 2012; Van Doorn et al., 2010; Vivek et al., 2012) and results in the adoption of study of Thakur’s (2016) model of CE shopping on mobile.
Game-Centric	Technology Element	Mobile devices and apps, increased personalisation, and move towards wearable devices (Stern 2015). Hardware enhances the games’ experiences, and software through personal data is incorporated to personalise. (Hofacker et al., 2016) Nonstand-alone item, hardware, and software investigated cluster attitudes towards hardware and software through segmentation.
Social-Centric	Theme of informing. Theme of Co-communicating Theme of co-	Vazquez (2011), a social-centric app engaging brand advocates/fans to connect communities to share content. Zhao and Balugue (2015) user-generated content and co-reaction as the theoretical

	creating Pioneering	underpinning of social-centric. Mobile apps central hub of all these forms of UGC/co-creation (Dube, 2012; Hudson, Huang, Roth, & Madden, 2016; Kaplan, 2012; Kulkarni, 2017; Lamberton & Stephen, 2016; Lamberton and Stephen, 2015; Rashid et al., 2019; Roma, & Aloini 2019; Sterling, 2016 Creative consumers show interest, by sharing opinions, inventions, and insights (O'Hern & Kahl 2013). O'Hern and Kahl (2013) four typologies (informing, co-communicating, co-creating and pioneering) provide the framework.
M-Commerce Centric	Scan barcode/QR code/Vouchers and Coupons Location Awareness Augmented reality and Virtual Mirror Mobile payments	M-commerce goal is to sell products (Zhao and Balugue 2015), able to personalize at purchasing process (Sutanto, Palme, Tan, & Phang 2013; Tong, Luo & Xu, 2020) Zhao and Balugue (2015), Skeldon (2011), M-commerce apps include: scan barcode/QR code, location awareness, augmented reality/virtual mirror & mobile payments. Khajehzadeh, Oppewal, & Tojib. (2014) hedonic shoppers (offers) vs utilitarian shoppers (personalization) of vouchers. McCarthy & Rowley (2013) users vs none-user affected by attitudes to; positive about use, ease of use, information/content, benefits of scanning. Motivations for engaging in location (Humphreys 2007; Humphreys and Liao 2011). Understanding the motivations of consumers engaging in location-based of mobile Schmitz & Weiss (2013) concluded with benefits of; significance of mobility, location, accessibility, and convenience AR apps support consumers in product decisions (Adhani & Rambli, 2012), the importance of using own image to interact with a product (Blazquez, 2014) Chang, Chen, & Zhou, (2009), of mobile payment adoption dependent on a secure, reliable payment system alongside convenient and easy to use.
Design Centric	Theme of brand name Theme of Brand design Theme of Branded	Sharing a consistent brand image with objectives of consistent brand values and increasing brand image (Zhao and Balugue (2015) Lack of research on branding and mobile design, McGrath and McCormick validated the m-

	Logo Theme of Brand content	branding framework includes name, design, logo, and content (2012) Trust and awareness positive impact on the brand name. McGrath and McCormick (2012) Consistency of message is important for (Rowley, 2009) creating a “brand norm” for brand design (Harridge-March, 2006) and delivering brand personality for branded content (Okazaki, 2006) Growing reliance on video content for mobiles apps, aids the purchase intention (Kim et al., 2011)

Table 2.5: *Theoretical concepts of the five functions of mobile apps*

Through a critical literature review, the research has informed and generated predictors and the anticipated outcomes, as seen in Table 2.6. These predictors and outcomes, these will be revisited in chapter 4 findings and analysis (see 4.8 chapter review).

Business research methods commonly adopt predictors in studies as they investigate how the future might look and uses the early stages of existing theoretical research to support the predictions. (Blumberg, Cooper, & Schindler, 2014). Further justification for the adoption of predictors is offered when conducting a Google scholar search in July 2023, when searching the term ‘predictors segmentation’, yielding 666,000 papers and further 2,990,000 research papers when searching for the term ‘predictors cluster analyses. The study has deliberately not set hypotheses tests as that is beyond the scope of the thesis. The early stages of academic research in mobile apps (Zhao & Balugue, 2015) ensure predictions are best positioned to take embryonic theory to support predictions (Blumberg, Cooper, & Schindler, 2014). Other studies in the early stages of research, such as Lamont & Jenkins, (2013) investigated segments of cyclists using a two-step cluster analysis and adopted predictions, further aiding the justification for the study to use predictors.

Predictor	Proposed outcome
The increasing significance of mobile apps, and the growth, and expansion of fitness apps as transferred across into cycling.	Strava and Zwift are the two most influential mobile apps in cycling which are influencing consumer attitudes toward technology (Van Doorn et al. 2010; Thakur, 2016; Pansari & Kumar, 2017)
Cycling adopts a hobby-like state, which leads toward the creation of an identity as a cyclist.	The level of involvement in cycling will be high, due to the hobby-like nature (Bloch & Bruce, 1984; Lamont & Jenkins, 2013).
Indoor cycling has seen a significant increase, due to the development of Zwift and the creation of immersing new VR worlds.	Indoor cycling will be linked to the adoption of virtual worlds (Zwift), with links to the story element of gamification (Hofacker et al. 2016; Slater & Rouner 2002).
With cycling being primed for the development of co-creation, investigate the impact of cluster propensity to engage in co-creation.	Predicted a small percentage of clusters will resonate with co-creation (O'Hern & Kahle, 2013; Sarmah, Kamboj & Rahman, 2017).
Mobile apps in cycling are influenced by gamification. As the two most influential apps of Strava and Zwift are being adopted by consumers due to gamification. As Strava and Zwift are the platforms cycling audiences are using to engage and connect with the cycling community.	Clusters are predicted to respond to the gamification of mobile apps with the strongest relationships (Hofacker et al 2016). The prediction of cycling clusters being separated on the relationship between the mobile apps of Strava and Zwift, with clusters having strong to weak relationships with Strava (Badge of Honour) and Zwift (World of Rules) (Hofacker et al. 2016).
The creation of a testable framework of five functions of mobile apps in multiple stages of data collection to develop.	With such early and embryonic development of the five functions of mobile apps Zhao and Balugue (2015), in order to create a testable model predicted this will require multiple stages of data collection and analysis.

Table 2.6: *Predictors and outcomes as informed by a critical review of the extant literature.*

Table 2.5 demonstrates the context of the research, which has been drawn from the literature review presented throughout this chapter. The approach to primary data collection along with the analysis will follow a four-stage process. Stage One will review 50 mobile apps in the cycling sector; Stage Two will adopt a pre-testing stage to conceptualise the instrument; Stage Three will be a pilot study to empirically test the perceptions of five functions of mobile apps and finally Stage Four will be a full scale study to further empirically test the proposed research instrument and analysis clusters. This next chapter will discuss the research methodology and methods. The chapter will justify the research methodology, research design and methods adopted to collect primary data.

Chapter Three: Research Methodology and Methods

3.0 Introduction

This chapter explores the methodological approach underpinning this thesis. As such it provides insights into the approach and methods adopted for data collection and analysis. At the forefront of the methodological choices is responding to the research aim of: ***identify and develop a testable method to cluster cycling audiences based on their engagement in the functions of mobile apps and additionally their attitudes and behaviours.*** Therefore, the aim of this chapter is to illustrate the multiple-stage approach used in order to aid the robustness of the final survey instrument that extracts the motivations of cyclists and their engagements within mobile applications.

The chapter is structured in the following way. The initial section will discuss the major elements of the research project and as such will include: developing a rigourous epistemology, theoretical perspective, methodology, and methods used for data collection. After this the four stages of the construction of the research instrument are discussed and justified. And finally, a consideration of the ethical issues of the thesis, after which a review of the limitations of the study follow.

3.1 Epistemology

Research has long been underpinned by philosophies, which is often referred to as the framework of reference, guiding ideas and confirming a research strategy (Ormston Spencer, Barnard & Snape, 2014). Epistemology describes the way in which people see the world and includes important assumptions (Saunders, Lewis & Thornhill, 2009); understanding the researchers' epistemology is important to understand the stance in which the research has been approached and undertaken.

Within the context of social research, Crotty (1998) provides a philosophical foundation for the methodology embedded within a research project. As such the spectrum of positivism to interpretivism is typically offered as extremes with later the introduction and popularity of pragmatism and realism (Saunders, Lewis & Thornhill, 2009). When reviewing the concepts, it becomes clear the approach of positivism, is most suited to the author's approach to viewing the world. Furthermore, adopting a positivist approach aligns with other studies within the fields of mobile apps, many of which have used a positivist approach (Lamsfus, Xiang, Alzua-Sorzabal & Martín, 2013: Maghnati & Ling, 2013; Barriage & Hicks, 2020). Further justification for a positivist approach is presented by Maghnati and Ling (2013), and the current stages of research into mobile apps with the recommendations, "summarising and generalising the hypotheses tested that derived from the theory" (p.4).

Positivism can be defined as the truth coming from the origins of 'things' and thus refutes that knowledge is created subjectively (Crotty, 1998). This leads to the idea that the truth is the truth or as the philosopher Galileo noted that the primary attributes are those that are posited and can only be measured or quantified, meaning often knowledge is constructed numerically. Such an approach is seen within the study in the utilisation of data being collected through both approaches: reviewing the top 50 apps in the cycling marketplace and a survey instrument of cyclists. Reviewing the 50 mobile apps aids the context of the cycling sector along with considering the social facts as offered by Durkheim, (1982: 1895) as "every way of acting which is general throughout a given society, while at the same time existing in its own right independent of its individual manifestations" (p. 147)

The term positivism was first used in a scientific context in the 19th Century by Auguste

Comte and led Crotty (1998) to review the premises of positivism research being based upon laws that are scientifically established along with methods that allow the truth to be not only observed but experiments allow for comparisons. Of particular significance to the thesis is that the approach of Comte's positivism is drawn in other physical science studies (May & Williams, 1996) as the application of the scientific method to social contexts (Alharahsheh, & Pius, 2020). Positivism is derived from the physical sciences, viewing knowledge as being arrived at not through speculation, but rather significantly grounded and attributed to something that is given (Crotty, 1998; Della Porta & Keating, 2008). This leads to the notion that social actors are able to discover knowledge through experiences in which they are directly involved and take away speculation.

Approaches of positivism are witnessed within other epistemological approaches including logical and post-positivism, such as critical realism. Critical realism is often critiqued as being difficult to follow and time-demanding (Pratt, 1995) due to being a meta-theory that does not follow a procedure for conducting social research (Hesketh & Fleetwood, 2006; Hartwig, 2015), and as such not deemed as appropriate for this study. Whilst post-positivism provide interest to the thesis, one of the key attributes of Comte's positivism is the only approach to discovering scientific knowledge that is both accurate and certain (Crotty, 1998). As such this approach is significant given the methods utilised within the thesis, as Comte argued that social facts do not have scientific meaning until a connection exists with other social facts and until the connection is made then knowledge remains merely a narrative involving no rational utility (cited by Crotty, 1998).

A short review is presented within the context of the thesis, before drawing the epistemology to a conclusion. One of the key attributes to maintaining and accepting a positivist epistemology is the ability to adequately describe and explain a phenomenon, including a representation of the entire cyclist population (Anderson & Bennett, 2003;

Freeman, 2011), and the sampling approach of the study to ensure a representative sample is obtained (Cohen, Manion & Morrison, 2005). The resulting reliability test is utilised to understand the degree of generalisability associated with the data (Moore, 2011). A definition of generalisability is offered by Johnson (1997): "refers to the extent to which research findings can be applied across, and are considered relevant to, different persons, settings and times" (p.191). The conducting of the multi-stages approach within the data collection and process within this thesis will assist with analysis and generalisability within the data, using approaches such as Cronbach's Alpha and Spearman's Correlation to validate the scales of mobile applications within the context of cycling, to knowledge.

Zhao and Balugue (2015) positioned the five functions of the top 100 mobile apps as a social fact, the need to support and connect with mobile app functions in the cycling sector is essential to attribute knowledge. Once the five functions of mobile apps were supported with a review of 50 mobile cycling apps, and then added in pre-testing with stage two and piloting in stage three (see Figure 3.1) it further connected the social fact with knowledge. When reviewing the extant mobile applications, it becomes apparent a positivist epistemology is undertaken for a scientific understanding of the attributes (Lamsfus, Xiang, Alzua-Sorzabal & Martín, 2013; Maghnati & Ling, 2013; Barriage, & Hicks, 2020). The attributes explored within this study are motivations to undertake sports, mobile applications motivations, and mobile application usage in the context of cycling. Therefore, in order to attribute scientific knowledge to the functions of mobile apps (Zhao & Balugue, 2015) as previous studies in the field (Lamsfus, Xiang, Alzua-Sorzabal & Martín, 2013: Maghnati & Ling, 2013; Barriage & Hicks, 2020) have undertaken a positivist epistemology, this research adopts a positivist approach to discovering knowledge.

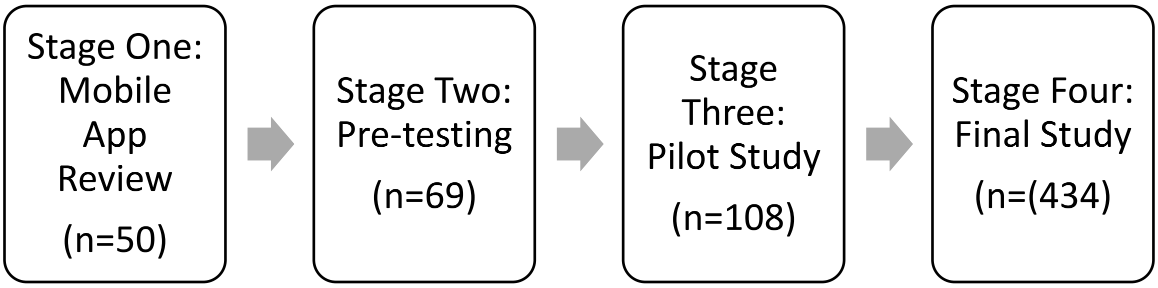
This research adopts a positivist approach based on research being grounded and attributed to something that is given (Crotty, 1998; Della Porta & Keating, 2008). Additionally as Comte's view of positivism is drawn in other physical science studies (May & Williams, 1996) the application of the scientific method to other social contexts (Alharahsheh & Pius, 2020).

Zhao and Balugue (2015) positioned the five functions of the top 100 mobile apps as a social fact, the need to support and connect with mobile app functions in the cycling sector is essential to attribute knowledge. Once the five functions of mobile apps were supported with a review of 50 mobile cycling apps, and then added with pre-testing with stage two and piloting three in stage three (see Figure 4.1) further connected the social fact with knowledge.

3.2 The Process of Data Collection

This study undertook a detailed literature review; to draw out the factors and insights that exist within the extant research. The literature review draws upon academic literature in the fields of marketing, mobile apps, and sports management. Additionally, the literature review considered principles of product and customer involvement theory, motivation to undertake sport, and self-determination theory (SDT) in cycling, mobile technology acceptance, customer engagement in apps, and finally mobile apps with a focus on five functions of mobile apps.

After conducting the literature review the need to conduct multiple data collection approaches, in order to investigate the study's objectives was apparent. A seminal study by Thakur (2016) exploring customer engagement in mobile app shopping was of particular interest and supports the multiple stages of data collection model development adapted in this study. Thakur, (2016) undertook three stages of research, firstly 10 interviews with mobile retailers, secondly screening with CE stakeholder panels and finally a survey, indicating that multiple stages of research are important when conceptualising and testing models in mobile apps. This resulted in the following stages of data collection as illustrated in Figure 3.1 below:



Aim of stage one: Establish the tool-centric functions of mobile apps that exist in current cycling apps.

Aim of stage two: Test the five functions of mobile apps for cycling.

Aim of stage three: Test the factors/items of five functions of mobile apps.

Aim of stage four: Test the five functions of mobile apps, and then adapt the framework to cluster solutions based on apps.

Figure 3.1: *The four stages of data collection*

3.3 Stage One – Mobile Application Review

The extant literature review confirmed the apparent need to consider context within research, hence this study focusing on the mobile apps in the context of the cycling sector. In the initial paper Zhao and Balugue (2015) stated the need for further research on mobile apps pertaining to a review of apps in an individual sector suggesting that "features included in app designs should be chosen on a case-by-case basis" (p. 313). The review of literature showed research needed to conceptualise the five functions of mobile apps, as no prior study had understood the functions; tool-centric, social-centric, game-centric, m-commerce-centric, and design-centric. This resulted in the need to review the existing 50 mobile apps in the cycling sector, as being considered crucial for the context of mobile apps being used in this sector (Zhao & Balugue, 2015).

A systematic approach was adopted to review the mobile apps, using a process as seen in a review of medical apps study (Eng & Lee, 2013). This included reviewing the mobile app within the chosen app store, consumers' reviews of the apps, and then downloading the apps to investigate the functions that could be seen with each mobile. Exploration of the existing mobile apps was undertaken using the following criteria: reviewing the number of downloads of mobile apps, reviewing forums, blogs and social media, and media outlets. This resulted in the creation of a list of mobile apps covering a variety of features from social, virtual reality, and wallet of mobiles to support cycling. A sample size of 50 mobile apps was selected in order to obtain the balance between the breadth along with the diversity of cycling mobile apps currently within app stores. At this point, saturation is expected to be achieved with apps repeating the same mobile functions.

The outcome of this review was documented using tables seen in academic literature introducing the themes of tool-centric functions. Additional game-centric, social-centric, m-commerce-centric and design-centric functions were drawn from the extant literature as discussed previously in Chapter Two. Table 3.1 illustrates this as a novel method of collecting mobile apps was vital to developing the work of Zhao and Balugue (2015). As such, this thesis is considered to have assisted in developing key attributes of each of the five functions which were already in use with mobile apps in the cycling sector and were used to generate questions within the survey instrument on the five functions of mobile apps.

Function	Themes used in the cycling mobile apps	Evidence supporting
Tool-Centric	Navigation Cycling Computer/Data on performance Training platform Virtual reality Wallet of cycling apps	"features included in app designs should be chosen on a case-by-case basis." (Zhao & Balugue, 2015, p. 313) Review of 50 mobile apps in cycling; 1) apps characterized into features of: navigation, cycling Computer/Data on performance, training platform, virtual reality, wallet of cycling apps 2) Significance of two apps Strava and Zwift.
Game-Centric	Game Mechanism Element	Hofacker et al. (2016) gamification of mobile platforms enhances; consumer enjoyment, engagement, purchase, repurchase and retention. "badging", is contingency that provides visual identifiers Hofacker et al. (2016) non-monetary value propositions for consumers vs social value via interactions (Nambisan & Baron 2009) Conclusion of the significance of social interaction as it: creates an atmosphere of camaraderie, builds social bonds, and facilitates future interactions. (Hijacker et al., 2016)
	Story Element	Sense of joy impacting (Hofacker et al. (2016), transporting into new world acceptance of values and beliefs (Slater & Rouner 2002). Mobile has reclassified (Hofacker et al., 2016), able to track heart rate, distance covered, and generated argument worlds (Review 50 mobile apps in chapter 2)
	Aesthetic Element	The pictorial representation is more effective as it enhances engagement (Hofacker et al., 2016) Engagement is considered through a breadth of literature in (Brodie et al., 2011; Sashi, 2012; Van Doorn et al., 2010; Vivek et al., 2012), results in the adoption of the study of Thakur's (2016) model of CE shopping on mobile.
	Technology Element	Mobile devices and apps, increased personalisation, and move towards wearable devices (Stern 2015). Hardware enhances the games' experiences, and software through personal data is incorporated to personalise. (Hofacker et al., 2016)
Social –	Theme of	Zhao and Balugue (2015) user-generated content and co-reaction as the theoretical underpinning of

Centric	informing. Theme of Co-communicating Theme of co-creating Pioneering	social-centric. Mobile apps central hub of all these forms of UGC/co-creation (Dube, 2012; Hudson, Huang, Roth, & Madden, 2016; Kaplan, 2012; Kulkarni, 2017; Lamberton & Stephen, 2016; Lamberton and Stephen, 2015; Rashid et al., 2019; Roma, & Aloini 2019; Sterling, 2016) Creative consumers show interest, by sharing opinions, inventions, and insights (O'Hern & Kahl 2013). O'Hern and Kahl (2013) four typologies (informing, co-communicating, co-creating, and pioneering) provide the framework.
M-Commerce-Centric	Scan barcode/QR code/Vouchers and Coupons Location Awareness Augmented reality and Virtual Mirror Mobile payments	Zhao and Balugue (2015), Skeldon (2011), M-commerce apps include: scan barcode/QR code, location awareness, augmented reality/virtual mirror & mobile payments. Khajehzadeh, Oppewal, & Tojib. (2014) hedonic shoppers (offers) vs utilitarian (personalization) of vouchers. McCarthy & Rowley (2013) users vs none-user affected by attitudes to; positive about use, ease of use, information/content, benefits of scanning. Schmitz & Weiss (2013) concluded with benefits; significance of mobility, location, accessibility, and convenience. AR apps support consumers in product decisions (Adhani & Rambli, 2012), the importance of using own image to interact with a product (Blazquez, 2014) Chang, Chen, & Zhou, (2009), of mobile payment adoption dependent on a secure, reliable payment system alongside convenient and easy to use.
Design-Centric	Theme of brand name Theme of Brand design Theme of Branded Logo Theme of Brand content	Sharing a consistent brand image with objectives of consistent brand values and increasing brand image (Zhao & Balugue (2015) Lack of research on branding and mobile design, McGrath and McCormick validated the m-branding framework includes name, design, logo, and content (2012) Trust and awareness positive impact on the brand name. McGrath and McCormick (2012) Consistency of message is important for (Rowley, 2009) creating a "brand norm" for brand design (Harridge-March, 2006) & delivering brand

		personality for branded content (Okazaki, 2006) Growing reliance on video content for mobiles apps, aid the purchase intention (Kim et al., 2011)

Table 3.1: *Table on themes of mobile apps, extracted from a review of 50 mobile apps and the extant literature review.*

3.3.1 Pre-Testing Rationale Interviews

From the literature review and review of the 50 mobile apps a clear set of themes emerged (see Table 3.1). It is critical in operationalising these themes that piloting is used to ensure a robust and effective research instrument (Ruel, Wagner, & Gillespie, 2016). Therefore, stage two's aim was to test the survey instrument, with tool-centric factors informed by the review of the 50 mobile apps and four functions of mobile apps informed by the literature. This resulted in the creation of the first stage research survey instrument.

Developing a survey instrument requires careful consideration in encouraging respondents to complete and avoid biased questions. The use of pre-existing scales was adopted, to increase the reliability and validity of the survey (Gray, 2017). Gray (2017) explained a scale comprises a number of items that make up the questionnaire and it is the scale that seeks "to measure a phenomenon that we believe to exist, but which we cannot assess directly" (p. 379). A wide plethora of literature in the study included scales (involvement in cycling, SDT in sport, and customer engagement in mobile apps) a number of measurement scales from earlier quantitative studies exist affording an opportunity to utilise validated measurement tools. For example, within the literature review (see Chapter Two) with the adoption of the recreation specialisation model by Lamont and Jenkins (2013), Sport Motivation Scale by Pelletier et al. (1995) and model of CE shopping on mobile by Thakur (2016), which was utilised for stage two of the survey instrument. The existing validated scales were drawn upon for each of these studies: involvement in cycling (Lamont & Jenkins, 2013), SDT motivation in sport (Pelletier at al, 1995) and customer engagement in mobile apps (Thakur, 2016).

In the review of mobile apps, in particular, the work of Zhao and Balugue (2015) identified a number of conceptualisations of the five functions of mobile apps. The detailed literature review investigated the conceptualisation of the five functions of mobile apps with additional research based on the initial conceptualisation. Each of the five themes is supported with additional academic research as previously seen in Table 3.1, building on this in stage two, these themes were created into questions, Table 3.2 identifies each of the questions against the support literature.

Function	Item	Supporting research
Tool-Centric	Assist with the planning of cycling route(s) and make suggestions on the best route of travel	Review of 50 mobile apps in cycling: navigation
	Helps you find new locations to explore on the bike	Review of 50 mobile apps in cycling: navigation
	Provides a cycling computer to measure the performance of my ride (distance/speed/average)	Review of 50 mobile apps in cycling: cycling Computer/Data on performance
	Review and compare my previous performance (e.g. segment data and leader boards)	Review of 50 mobile apps in cycling: cycling Computer/Data on performance
	Develop and use training plans	Review of 50 mobile apps in cycling: training platform
	Review my cycling performance of a ride (e.g. heart rate, cadence and power)	Review of 50 mobile apps in cycling: training platform
	Immerse myself in a virtual reality world to help achieve my goals	Review of 50 mobile apps in cycling: virtual reality

	Social interactions with others through virtual reality worlds (e.g. Strava KOMs/ Zwift),	Review of 50 mobile apps in cycling: virtual reality
	Support my interest of cycling (e.g. weather forecast or bike maintenance guides)	Review of 50 mobile apps in cycling: wallet of cycling
	Helps me find the information I need when using cycling mobile applications	Review of 50 mobile apps in cycling: wallet of cycling
Game-Centric	If goals are provided and rewarded with badges, points, or leader boards	Hofacker et al. (2016).
	If my badges or KOMs are rewarded with social status	Hofacker et al. (2016). Nambisan & Baron (2009)
	If develops my skills of cycling, while I learn more about my performance	Nambisan & Baron (2009).
	Others engage or comment upon my performance	Nambisan & Baron (2009)
	Immersed into a new World of Rules	Slater & Rouner (2002) Hofacker et al. (2016)
	I'm part of the story as a character	Hofacker et al. (2016)
	I'm able to direct and lead the story	Hofacker et al. (2016)
	I'm able to use in game data (e.g. heart rate)	Hofacker et al. (2016)
Social-Centric	Sharing my opinions with fellow cyclist	O'Hern & Kahle (2013) Chevalier & Mayzlin (2006) Mayzlin (2006) Moe & Schweidel (2012)
	Seeing online products reviews including the views of others	O'Hern & Kahle (2013)
	Sharing content about cycling, that helps others	O'Hern & Kahle (2013)
	Sharing design and creative ideas of advertising to cycling companies	O'Hern & Kahle (2013)
	Sharing new product design ideas to cycling companies	O'Hern & Kahle (2013)
	Sharing new product design ideas to other cyclist/communities	O'Hern & Kahle (2013)
M-Commerce	Discounted voucher or coupons	Khajehzadeh, Oppewal, & Tojib. (2014) Skleton

Centric		(2014)
	Easy of checking-out	Khajehzadeh, Oppewal, & Tojib (2014)
	Bar code scanners or QR codes	Khajehzadeh, Oppewal, & Tojib (2014) Watson, McCarthy & Rowley (2013)
	Location sharing	Skeldon (2011)
	Convenient methods of payment	Chang, Chen, & Zhou (2009)
	Able to virtually check out products (e.g. overlay new bike on myself)	Blazquez (2014)
	Secure payment methods	Chang, Chen, & Zhou (2009)
Design-Centric	Well know branded names	Mcgrath & McCormick (2012)
	Short promotional text about the app	Mcgrath & McCormick (2012)
	A aesthetics appealing mobile application	Mcgrath & McCormick (2012)
	Logo that resonates with me	Mcgrath & McCormick (2012)
	A good range of content	Mcgrath & McCormick (2012) Ibeh et al. (2005)
	Inclusion of video	Mcgrath & McCormick (2012)

Table 3.2: *Scales from five functions of mobile apps, stage two.*

As supported by Sullivan (2013), the use of an ordinal scale is beneficial as it is “used by respondents to rate the degree to which they agree or disagree with a statement.” (p.541). Ordinal scales typically involve the use of statements on a questionnaire accompanied with balanced seven points, one of which is selected by the respondent to indicate the extent of agreement or disagreement with a given statement and allow for “responses to be rated or ranked” (Sullivan 2013, p. 541). The inclusion of a seven-point ordinal scale where 1 = strongly agree to 7 = strongly disagree was therefore adopted within the questionnaire for the five functions of mobile apps, with a midpoint of 4 = neither agree nor disagree.

The literature recommends that a pre-testing stage is undertaken (Harkness, 2012) in order to pinpoint any problems, reduce measurement errors, and ensure the order of questions is not influencing the way a respondent answers (Ruel, Wagner & Gillespie, 2016). The purpose of pre-testing is critical to examine the survey instrument with the purpose of determining whether it functions as a valid and reliable research tool (Converse & Presser 1986). Academic research stresses the importance of pre-testing in ensuring that the researcher and the respondents interpret the survey instrument in the same way. Converse and Presser (1986) state that pre-testing is the best mechanism to ensure this, aiding the rigor and validation of the creation of the five functions of mobile apps that was developed during stage two.

Therefore, meticulous pre-testing of the questionnaire was undertaken prior to self-administration of the survey instrument, it develops greater creditability of the research and further accountability to the researcher, along with the increased probability of obtaining research findings (Ruel, Wagner & Gillespie, 2016; Converse & Presser, 1986). This was of particular importance due to the early stage of research into the five functions of mobile apps, and the early stages of academic research into mobile apps in the cycling sector. Conducting a pre-testing stage is vital to improve the data collection for the overall quality of the study.

3.3.2 Pre-Testing Interviews Sample Size and Selection

As noted above, pre-testing is advocated in the academic literature to ensure rigour and validity of the data tool (Reynolds, Diamantopoulos & Schlegelmilch, 1993; Lapka, Jupka, Wray, & Jacobsen, 2008). Pre-testing must reflect the context in which the full questionnaire will be subsequently fielded. Reynolds, Diamantopoulos and Schlegelmilch (1993) stress the significance of including representatives of the target population in the testing sample to “be sufficient to satisfy the similarity to target group considerations of the pre-test and the variety of the respondents and the complexity/uniqueness of the questionnaire should also be considered” (p.4). With such a variety of motivations and interests in cycling collecting a variety of different vantage points is crucial to the pre-testing, as collecting both recreational and commuting cyclists, along with the level of involvement in cycling via number of years are two key considerations.

The respondent-based approach was drawn upon to pre-test the study. Respondent-based pre-testing is the most useful and is defined as being completed on a small subsample of the sample population. Therefore, the pre-testers reflect the cultural and demographic profile of the larger sample be surveyed at a later date (Ferketich, Phillips & Verran, 1993). Given the nature of the study, collecting respondent-based samples on six cyclists was decided upon to initially validate the pre-test survey tool. However, when further consulting the literature, the concept of collecting the pre-testing with some variation within the broader profile is suggested (Ruel, Wagner, & Gillespie, 2016), in order to notice issues across the range of the spectrum. With this in mind, using the level of expertise in cycling was important to collecting both novices to experienced cyclists to ensure a representative sample (Anderson & Bennett, 2003; Freeman, 2011; Cohen, Manion, & Morrison, 2005) was obtained, aiding the generalisation. This resulted in selecting a sample of two cyclists described as having novice cycling experience, two further described as intermediate cycling experience, and finally, two cyclists described as having advanced cycling experience. This spectrum in terms of experiences allows us to capture a wider scope of potential problems being uncovered in the data tool.

When collecting pre-test validation data, each of the six respondents completed the survey instrument online, using the same administration technique as the full-scale survey instrument, which is identified as good practice (Ruel, Wagner & Gillespie, 2016; DeMaio, Rothgeb & Hess, 1998). The online survey instrument was completed with the researcher being physically present in the room, this allowed for behavioural coding pre-test assessment to be undertaken. Using behavioural coding pre-test assessment allows the researcher to watch as the respondent progresses through the survey, with notes made on behaviours indicating any problems such as hesitation, confusion, and frustrations (Ruel, Wagner & Gillespie, 2016) for example identification of skipped items, or any crossed-out items.

Following the respondent completing the online survey, the individual debriefing assessments were undertaken. An individual debriefing assessment is described as "questions being used to assess how respondents interpret the scope of a survey" (Hess, & Singer,1995, p.3). This aids understanding of concepts that influence the broader design of a questionnaire and allowed the researcher to explicitly gather feedback and reactions to all the questions, the survey design, and the process (Ruel, Wagner, & Gillespie, 2016; DeMaio, Rothgeb & Hess, 1998). Furthermore, each question was reviewed with each respondent exploring: wording and language, measurement, exclusive measurement, and additional comments (Ruel, Wagner & Gillespie, 2016). The rationale for undertaking individual debriefing assessments is due to evoking a greater range of feedback than other approaches such as cognitive interviews (Ruel, Wagner & Gillespie, 2016). However, it does encourage respondents to retrospectively over-consider responses to each question and answer, within an unnatural context (Ruel, Wagner & Gillespie, 2016). The pre-testing stage of the individual debriefing was vital in taking the literature concepts and operationalising the survey for the representatives of the target population in a meaningful way given there are no prior studies on cycling apps.

Following the individual debriefings, the responses captured in Table 3.3 below were used to decide to amend or delete questions.

Unclear directions
Skipped items
Refusal or inability to answer
Other response
Little or no response variation
Easily misinterpret questions
Sensitive Questions
Inconsistent scales
Order or response questions
Computer-based or technical problems

Table 3.3: *Individual debriefings items reviewed and rationale for deletion* (Adapted from Ruel, Wagner & Gillespie, 2016).

The above insight was used to make changes to the survey prior to full the pre-testing which are seen in Table 3.4. The changes in Table 3.4 are included in the next stage (Stage Three) of the full pre-testing stage and seen in the survey instrument (see Appendix 3).

Question	**Amend of questions**	**Justification**
Q 3	For how many years have you been a regular recreational cyclist?	Individual assessments identified this as being an easily misinterpreted question. This resulted in wording change of this with the deletion of 'recreational'
Q 3a	How many non-competitive cycling events have you actively	Further clarity was required to complete this question leading to it being identified as an easily misinterpret questions, from the

	participated in during the previous 12 months?	individual assessment de-briefing. This resulted in the inclusion of an example, of supportive.
Q 5	What is your preferred type of bike to ride? Use a ranking order of 1-5, 1 being most preferred.	Individual assessment and debriefing identified that respondents described unclear directions. In addition the respondents also identified other response of single gear and BMX. This resulted in the additional instructions for the question being added and bolding these instructions and the addition of two responses: single gear and BMX.
Q 6	Are you a member of any of the following?	Within the individual assessment and de-briefing respondents identified other responses of the British Triathlon. This resulted in the inclusion of the response of British Triathlon in the survey for the pre-testing.
Q 7	Are you a member of a cycling?	Within the individual assessment de-briefing is was identified there was other response of triathlete club. This resulted in the inclusion of the triathlete club in the pre-testing question.
Q 13.6 and 13.8	Q13.6 I regularly watch cycling race highlights Q13.8 I regular watch live cycling races and content	Within the individual assessment, de-briefing respondents noted confusion between watching live and highlights. This resulted in the two questions being combined into one about watching cycling in the resultant pilot survey.
Q 14.	On a yearly basis how much do you spend on cycling (bikes, equipment, clothing and accessories) through the following means?	Within the individual assessment, de-briefing respondents found this question easily misinterpreted, including examples of retailers would reduce the cognitive loading of this question. This resulted in the inclusion the examples of Wiggle, Evans Cycles, local bike store, Evans Cycles/Wiggle in the pre-test survey.
Q 15	When out cycling, I regularly use the following device to measure my performance?	Within the individual assessment, de-briefing respondents found this question difficult to respond to. This resulted in the examples of Garmin and Wahoo, Garmin forerunner or Apple watch, Fitbit being included in the pre-test survey.
Q 17	Do you use or have you used in the past, a cycling subscription such as Strava Summit or Zwift?	Within the individual assessment, de-briefing respondents found this question difficult to respond to. This resulted in adding the following response, based on the seasonality of

		these subscriptions. Currently, subscribe and making monthly, however I plan to cancel within 6 months
Q18.1-Q18.28	Why do you practice cycling?	Through the individual assessment, de-briefing respondents described unclear directions. This resulted in the additional instructions, page break and re-ordering of the scale in the pre-test survey.
No question number	Not included within interviews	Through the individual assessment de-briefing respondents described confusion on the order of questions with not including questions on mobile phones. This resulted in the following question on mobile phones and usage of mobile with the following added in the pre-test survey. Q19. Which brand of smartphone do you own? 20. How many mobile applications are downloaded onto your phone? Q21. On average, how many mobile apps do you use on daily bases? Q22. What is your most used types of mobile application?

Table 3.4: *Amends from individual debriefing to survey instrument prior to pre-testing*

3.3.3 Rationale for Pre-Testing the Survey Instrument

The second stage of the method is pre-testing for a survey to validate the instrument within the field. Literature argues that the goal of pre-testing of the survey is determining whether it functions as a valid and reliable research tool (Converse & Presser, 1986). Often the literature debates the significance of getting as close to the target population/study population, to aid the reliability prior to the final instrument (Ruel, Wagner & Gillespie, 2016). The need for pre-testing is of importance to this study, as the conceptualising of the five functions of the mobile apps in the cycling sector is developed across multiples stages (Klein & Kozlowski, 2000) and there is a need to apply the survey instrument to a new field of study (Chenail, 2011; Bal, 2019). Likewise, academic literature argues the need for multiple stages of development when it comes to conceptualising models and frameworks (Converse & Presser, 1986; McIntyre & Hobb, 1999; Baxter & Magoldac, 2004). Whilst the pre-testing individual debriefing operationalised the five functions of mobile apps, the pre-testing of the survey supports further the validity and reliability of the survey instrument of these five functions of mobile apps.

3.3.4 Sample Size and Selection for Pre-test Stage Survey

Full pre-testing of the survey instrument (Stage Three) was facilitated across a small number of social media cycling group pages and cycling groups, along with using local university circulation lists via email. This enabled the pre-test study to get as close as possible to the target population with a wide variety of cyclists' motivations and levels of involvement in cycling, whilst not impeding the final data collection (Ruel, Wagner & Gillespie, 2016). Other studies which have investigated cycling motivations have used similar approaches when pre-testing surveys, thus adding support and justification (Kolyesnikova, Dodd & Wilcox, 2009; Winters, Davidson, Kao & Teschke, K. 2011; Máca, Ščasný, Zvěřinová, Jakob & Hrnčíř, 2020; Van den Steen, Herteleer, Cappelle & Vanhaverbeke, 2019).

The anticipated sample size for a pre-test survey is 100 respondents, often argued as a reliable sample size (Reynolds, Diamantopoulos & Schlegelmilch 1993) for pre-testing stages. Whilst sample size is often debated in the literature for pre-testing to define validity, more significantly utilising representative sample selection for pre-testing is seen as important when conceptualising models (Olson, 2010: Randall & Sanjur, 1981). The pre-test study returned 69 responses which were used to shape, refine and validate the resulting survey instrument for the pilot study. This furthered the rationale for getting close to the target population to further aid the rigor of the five functions of mobile prioritised.

3.3.5 Methods of Analysis in the Pre-Testing Stage

The data analysis approach used an extant approach (Brown, 2011) commencing with coding the data, into data fields (ordinal, nominal, Likert scale) using a multi-stage approach to analysis.

The first stage was to sense-check the data set using an extant approach (Brunton, Oliver & Thomas, 2020). This systematic approach utilised both internal range and average response rates to each question. Using the internal range allows the differences between the minimum and maximum values of a data set and serves as an efficient mechanism to ensure the validity of questions (Fink & Litwin 1995). The data was then imported into Statistical Product and Service Solutions (SPPS) 28, and a descriptive overview was constructed. This approach is commonly used in academic research, as it allows for the conclusion of the distribution of the data and assists in detecting errors and outliers along with identity similarities (Saunders, Lewis & Thornhill, 2009). The major elements of the descriptive data analysis from the pre-testing were present, along with the development of the pilot and the final survey instrument.

After checking, the internal consistency of the questionnaire was considered using Cronbach's Alpha which is a measurement of internal consistency and a measure's reliability (Rust & Cooil, 1994) and thus confirms and measures the validity of factors of the models and framework using Cronbach's Alpha. Cronbach's Alpha is often seen to test multiple questions through Likert scales to measure latent variables (Saunders, Lewis & Thornhill, 2009; Rust & Cooil, 1994). The literature often indicates the minimum acceptable value for Cronbach's Alpha is 0.70 to be considered satisfactory (Taber, 2018). The academic literature argues Cronbach's Alpha has disadvantages, most significantly having inherited assumption of only measuring one variable. Moreover, the literature notes two ways to overcome this disadvantage by splitting the Cronbach's Alpha into parts of different latent variables or factor analyses (Biggs, Kember & Leung, 2001).

For the nature of the pre-testing, the survey instrument split the different latent variables into differing parts, using Exploratory Factor Analysis (EFA) – an approach often used in research within social sciences (Fabrigar & Wegener, 2011). The data from the EFA was analysed to reduce the number of variables to create the resultant revised questionnaire and conceptual model of the five functions of mobile apps for cycling, for later stages of the study.

3.3.6 Instrument refinement from Pre-Testing

The above processes were used to refine the resultant survey instrument from pre-testing, to achieve maximum validity. The internal range and average response rate, along with the descriptive data analysis, and Cronbach's Alpha, allowed the development of the survey instrument for example with the deletion of certain questions from the pilot instrument, Table 3.5 summarises these as:

Question	Amend of questions	Changes Made	Justification
11	This question centred on the weekly time spend cycling indoors in intervals or hours, changing the intervals to include minutes	Time intervals, changed: zero, Fewer than 30 minutes, 30 minutes - < 1 hours, 1 hour - < 2 hours, 2 hours - < 3 hours, 3 hours - < 4 hours, 4 hours +	Consistent of time intervals being more user friendly.
12.4	The question asked about ability to ride in straight line, and will be removed	Question is deleted.	Whilst the literature supports the inclusion the internal range of 2, shows respondents are comfortable with riding a

			bicycle.
13.6 & 13.8	These two separate questions enquiring whether watching cycling racing highlights (13.6) live (13.8)– combing the question into one including both highlights and live	Question changed to: I regularly watch cycling races (e.g. highlights or live)	On reviewing both questions respondents provide exactly the same response – for improved user experience these questions were combined.
14	This question enquired about average annual spend on cycling over four channels (online, offline, independent store, chains). Reframe the question to a typical month and amend the internals to smaller boundaries. The question will also be taking away the spend on each channels – and instead ask the respondents preferences on channel choice	Question changed to: On average, how much do you spend on cycling each month? £0-£24, £25-£49, £50-£74, £75-£99, £100-£124, £125-£150, £150-£174, £175-£199, £200-£299, £300-£399, £400-£499, £500 +	The internal range for all the channels is between 0 and 1. The vast majority are respondent in the £0-499, the framing of this question requires further context, using on typical month time frame is easier to recall.
16	This question enquired about connecting GPS device to a mobile app. The question is to be deleted.	Question is deleted.	The nominal question is deleted to streamline the survey and shorten the length. Other questions on devise (GPS, watch phone) are more meaningful.
22	The question enquired around the types of mobile apps consumer regular use – it used priorities' ranking.	An example of question: I use social media mobile apps (e.g. Facebook, Instagram) Very Frequently - 1, 2, 3, 4, 5, 6, 7- Very infrequently	The ranking order nature of these questions ensures unable to confirm internal validity, questions will all be moved to Likert-Scale.
22.12	The question enquired around the types of mobile apps consumer regular use – one of responses is publisher to be deleted.	Question is deleted.	Whilst the literature supports the inclusion of publisher. The internal range of 0, shows no responses from the 69 respondents.

24	The questions centred on Mobile Technology Acceptance – to be deleted from the study	Questions deleted from study.	The Mobile Technology Acceptance Model (MTAM)– a large amount of responses are just 1 across these 6 questions. MTAM will be taken out of the scope of the study.
25-30	A range of questions on the 5 functions of mobile apps. Additionally, changed the tense of questions to the first person.	An example of question: It helps me with the planning of cycling route(s) Strongly agree - 1, 2, 3, 4, 5, 6, 7- Strongly disagree	As each question as response rates, shows the conceptualising of the model is valid. Qualtrics (2021), defines less than 10% as low response rate for survey design so this principle will be applied to each question with anything less than 10% being reframed/reworked.
25.5	The question enquired about developing and using training plans – reframed this question taking focus away from developing towards following training plans	Question changed to: It helps me to follow training plans	This has response rate of 5.7%, Qualtrics defines less then 10% as poor response rate. The focus on following training – simples the question taking away strain.
25.7	The question enquired about immersing self in virtual reality worlds to achieve goals – reframed this question taking focus immersing self in word instead the world helps you achieve the goals	Question changed to: It allows me into a virtual reality world	This has response rate of 4.3%, Qualtrics defines less then 10% as poor response rate. The focus on following the world achieving goals– simplifies the question and takes away the immerse self.
26.5	The question enquired about immersing into a new World of Rules – reframed question taking focus from immersing instead the world creates the rules	Question changed to: It helps when a mobile app transports me into a new world with its own rules	This has response rate of 8.6%, Qualtrics defines less than 10% as poor response rate. The focus on following the world creating the rules - simples the question and taking away the confusion of immerse.
26.7	The question enquired about directing and leading the story in VR world – reframed question to taking the lead with the story	Question changed to: It helps me to the lead take in the story	This has response rate of 8.6%, Qualtrics defines less then 10% as poor response rate. Simplifies the question and taking away the strain.

28.4	The question enquired about mobile app shopping and location sharing – reframed question to include convenient and example	Question changed to: It provides me with convenient location sharing (e.g. check-in with a retail store)	This has a response rate of 8.6%, Qualtrics defines less then 10% as poor response rate. Simplifies the question and taking away the strain.

Table 3.5: *Final refinement to survey following pre-testing analyses.*

With both pre-testing stages of interviews and surveys, conclusions were to be drawn which aided both the research validity and reliability (Converse & Presser, 1986) of the survey instrument with suitable changes made as discussed in Table 3.5. This ensured a survey instrument that could be robustly used during the pilot stage.

3.4 Stage Three Pilot Study Rationale and Justification

The need for a pilot study became apparent when reviewing the first stage pre-stage data and through the initial stage of systematic sense checking of the data along with Cronbach's Alpha and EFA. The rationale for the pilot is to focus on the conceptualisation of five functions of mobile apps (tool-centric, game-centric, social-centric, design-centric and M-Commerce-centric) and further testing to support the reliability of these factors.

Such an approach is often considered common as the purpose of a pilot study is to increase resultant research quality (Gudmundsdottir & Brock-Utne, 2010; van Teijlingen & Hundley, 2001). As the five functions of mobile apps are being used within the context of a cycling-focused study for the first time, the need to ensure the rigor of these was at the forefront of the decision. With this in mind, the purpose of the pilot is not simply to declare that has indeed been conducted (Malmqvist, Hellberg, Möllås, Rose & Shevlin, 2019) but to identify the necessity to modify questions or alternatively critique procedures that do not elicit appropriate responses or enable the researchers to obtain rich data

(Gudmundsdottir & Brock-Utne, 2010; Kim, 2010).

The pre-testing stage allowed for the refinement of the survey instrument resulting in aiding the flow of the survey and increased comprehension and response rates to individual questions. Seen within Table 3.4, the most significant changes were made to questions 25-30 seeing a change of response mechanism to a Likert Scale and the reframing of the tense of these questions. As suggested by Malmqvist et al. (2019), identifying questions to be modified is a central element of the study and the need for further research data for questions 25-30 was essential to ensuring the rigor in order to aid the conceptualisation of the model (Gudmundsdottir & Brock-Utne, 2010.) As the five functions of mobile were central to the objectives of this thesis and the overarching research question, a pilot of the survey instrument followed the advice of Poggenpoel and Myburgh (2003) for researchers to be humble which encourages reflexive practice. Piloting is further supported by Holbrook, Bourke, Lovat and Dally (2004), when it comes to examining doctoral theses exploring the importance of conducting effective piloting of instruments.

Literature identified several challenges in terms of pilot studies and their success including pilot study size, methods and content of pilot study (Malmqvistet et al., 2019; Gudmundsdottir & Brock-Utne, 2010; Kim, 2010, van Teijlingen & Hundley, 2001). This was argued especially on large-scale research projects to impact the need for a number of pre-testing and pilot studies to test the content of the survey (Malmqvistet et al., 2019), with the challenge of the five functions of mobile applications tending to be inline to resonate with participants and the Likert-based scale allowing for a greater level of research data analysis.

When conducting the initial pilot, a shortened version of the pre-testing instrument was utilised. Firstly, the time constraints of the research project, along with already previous validation of the excluded elements in the pre-testing stage. Thus, the pilot survey includes questions, which had been significantly amended (questions: 11,14, 22, 25-30) (see Table 3.4). In addition to including the questions with significant amends, further question types on both cycling involvement (e.g. amount of cycling per week and preferred bike) and mobile usage (e.g. mobile phone, number of apps, and preferences on mobile apps) were included to aid contextual sense-making for the respondent (Michailova 2011).

This resulted in a pilot survey of 13 questions. Academic literature notes the importance of context for survey instruments and the potential danger of different contexts within different settings (Michailova, 2011). In order to contextualise the survey for respondents the approach of including additional questions on cycling involvement and mobile usage ensures the survey required less strain and is more user-friendly (Lamont & Jenkins, 2013).

3.4.1 Sample Size and Selection of the Pilot Stage

The sample selection process for the pilot reflected a similar approach to the full-scale survey (Section 3.5.1), in order to utlise the learnings in moving forward (Elfeky et al., 2022). The survey instruments for the pilot will be shared through A) a small number of cycling social media, forums and blogs; B) 20 amateur cycling clubs in each region of the UK. The pilot planned engagement from social media groups, forums and blogs with different motivations for cycling from indoors to commuting and different forms of bike ownership from e-bikes to road bikes and other groups related to the interest whilst also using amateur cycling groups. Examples of social media groups, forums and blogs include: cycling North East, Sustrans North, and Sustrans South, indoor cycling group, mountain biking and road biking. The range of cycling groups and cycling clubs was important due to the range of levels of involvement in cycling and methods of cycling from indoors to outdoors and such a variety of types of bikes, ensuring a closeness to the representative sample (Kelley, Clark, Brown & Sitzia, 2003) as much as possible from such a diverse range of motivation for cycling. Insights and developments from the approach were reflected upon and built into the final study sample approach.

Taking the analysis further, EFA is often used in studies when it comes to mobile apps (Gerlich, Drumheller, Babb & De'Armond, 2015; Kwon, Bae & Blum, 2013; Ozcinar, Ekizoglu & Kanbul, 2016), presenting an ideal analysis approach for the study. The sample size for the pilot was informed by data using EFA with Bagozzi and Yi (2012), stating the proposed sample size to be above 100, this is also supported by additional research from Hair et al. (2010) who mirrored this figure, stipulating that where models had five or fewer factors (as reflected in this thesis of the functions of mobile apps model as five factors) a minimum sample size of 100 is needed. Bagozzi and Yi (2012) also stated when using Exploratory Factor Analysis with a sample of 100 then proceed with a level of caution when using a sample size of such levels, which will be applied to the study. However, as the pilot is prototyping the statistical tools, it will be used to eliminate items/factors with no specific claims being made until the larger sample size of the final data collection is collected and analysed (Bagozzi & Yi 2012).

3.4.2 Stage Three Analysis of Data

The first stage of analysis was to use statistical techniques with internal validity through Cronbach’s Alpha and Spearman Rank Correlation Coefficient which is noted in the literature, as the first stage of data analysis to aid rigor (Saunders et al., 2009). These techniques were applied to data types with a Likert scale.

Cronbach's Alpha is accepted in the academic literature as a measure of consistency and reliability of data (Rust & Cooil, 1994). The minimum acceptable value for Cronbach's Alpha to be considered satisfactory is 0.70 (Taber, 2018). The scores for Cronbach's Alpha for the five functions of mobile apps (n=108) are seen in Table 3.6 below, with all being well above the satisfactory level and confirming the validity of the data set

The functions of mobile apps	Cronbach's Alpha	Strength of Alpha
Tool-Centric (10 items)	0.9	Outstanding
Game-Centric (8 items)	0.9	Outstanding
Social-Centric (6 items)	0.9	Outstanding
M-Commerce Centric (6 items)	0.9	Outstanding
Design-Centric (7 items)	0.9	Outstanding

Table 3.6: Cronbach's Alpha on the five functions of mobile apps. Sample 108

Spearman Rank Correlation Coefficient was used to measure the strength and direction of the association between two ranked variables (Fieller, Hartley & Pearson, 1957; Stephanou & Varughese, 2021). Table 3.7 shows relationships offered by Dancey and Reidy, (2007), who identify 0.40 and above as moderate relationships.

Spearman Rank Correlation Coefficient	Strength of Relationship
p= 0.80-1.00	Very strong relationships
p=0.60-0.79	Strong relationship
p=0.40-0.59	Moderate relationship

Table 3.7. Spearman Rank Correlation Coefficient: Source: Dancey, & Reidy, 2007

Spearman Rank Correlation Coefficient was utilised to measure the association between the variable of the five functions of mobile apps, for stage three of the study. All variables include at least a moderate relationship through to very strong relationships with p values ranging from p= 0.411 – p=0.960 (Dancey & Reidy, 2007).

The second stage of analysis was to use EFA to review the data set. The use of EFA is often seen in academic literature as factors deriving from statistics determine the underlying pattern of the data, for example the factor structure (Hair et al., 2010). EFA uses pre-defined guidelines to determine the variable loads on each factor to decide on the number of factors that emerge. Completing EFA after data collection is seen as a positive, but most significantly allows the study to use a statistical test to support the number of factors in the five functions of mobile apps. This technique uses variable load to decide which factors should remain or which should be removed.

In applying EFA Bartlett's test of sphericity, commonality and eigenvalues factors loading and measure of sample adequacy through Kaiser-Meyer-Olkin (KMO) were used. Hair et al. (2010) stated that the significance of EFA is examining the correlation matrix and justified the use of both Bartlett's test and KMO to test the correlation among variables. The seminal literature of Hair et al. (2010) states that Bartlett's test of sphericity number of factors is determined by eigenvalues, and eigenvalues greater than one should be selected. Following this principle, axis factoring, using the Kaiser-Meyer-Olkin, with the extraction of factors whose eigenvalues exceed one, was used to establish the number of factors, with rotations being used to decide on the group of factors which are statistically independent (Bryman & Cramer, 1994).

The Kaiser-Meyer-Olkin (KMO) statistic is a Measure of Sampling Adequacy (MSA) when then used to quantify the degree of inter-correlation among the variables. The interpretation of the results is presented in Table 3.8.

KMO index	**Strength**
0.9 or above	Excellent
0.8 or above	Great
0.7 or above is good,	Good
0.6 above	Fair
Less than 0.5	To be deleted

Table 3.8: *KMO Index scores and strength.* Source: Hair et al. (2010), Tabachnick and Fidell (2013)

KMO index of 0.6 above is further supported by Hair et al. (2010) and Tabachnick and Fidell (2013) as good EFA. Using this rationale, KMO index scores above 0.60 was adopted to decide which factors to retain in the five functions of mobile apps. In addition, Bartlett's test measures the presence of correlations among the variables, suggesting a significance of 5% is required for a set of variables, to indicate sufficient correlation exists (Hair et al., 2010) and was used within this thesis study.

Following this, the Varimax Method of Rotation is a statistical technique for factor analysis to clarify the relationship among factors (Dilbeck, 2017). This technique is used to maximise the variance of loadings with factors (Tabachnick & Fidell, 2013 and Hair et al., 2010). In doing so it allows for higher loads to be represented and low loads to be represented (Bryman & Cramer, 1994). For the nature of this thesis, the Varimax Method of Rotation was decided upon as the ratio for the number of factors was 2.92 (sample size of 108 with 37 factors for functions of mobile apps). On consulting the literature

Bagozzi and Yi (2012), defined this as a suitable range for the Varimax Method of Rotation, however, they also suggest a level of caution in interpreting the outcome. Hence, a range of techniques was applied to confirm validity – as such in order to define which factors are factorisable then a KMO coefficient of above 0.60 (Tabachnick & Fidell, 2013) and Bartlett's test with a significance of 5% (Hair et al., 2010). Therefore, a rotated solution can be run by setting the number of factors that are defined within the number of dimensions within the theoretical model, which for the case of this thesis generates the rotation of five solutions (Williams, Onsman & Brown, 2010).

The process of analysis was used to refine the survey instrument and to determine where items needed to be removed or refined. The literature argues that items can be removed from factors for the following purposes: miss-specification, low levels of loading and low levels of communality (Williams, Onsman & Brown, 2010). Following the deleting of factors, checking the reliability is often argued in the literature (Shrestha 2021). Therefore as good practice, using Cronbach's Alpha Coefficients will be carried out for this study. As each factor is excluded from the survey instrument, the impact of Cronbach's Alpha coefficients was reviewed to assess the internal consistency, with 0.7 and above for higher reliability.

3.4.3 Instrument Refinement

The first stage of data analysis for the model of five functions of mobile apps indicated that the Bartlett Test of Sphericity is significant at the 0.000 level of significance and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is good at 0.899. However, from this process it was clear factoring was required as individual items, did not meet the KMO index scores above 0.60 (Tabachnick & Fidell, 2013).

On consulting the analysis, 28 items were retained when reviewing the Varimax Method of five rotations, as each meets the KMO index scores above 0.60 (Tabachnick & Fidell, 2013). This process also showed that nine items did not meet the KMO index score of 0.60 (see Table 3.9). Each of the nine items were reviewed against the criteria of deletion on three grounds: miss-specification, low levels of loading and low levels of communality (Williams, Onsman & Brown, 2010). Each of these items was then deleted from the survey one by one with Cronbach's Alpha Coefficient being re-run after each deletion. The results of the Cronbach's Alpha Coefficients are seen in Table 3.8, commencing with 0.966 for the 37 items and after the deletion of items ending with 0.952 for 28 items, being well above 0.7 thresholds.

Factor	**Initial Cronbach's Alpha**	**Item(s) Removed**	**Final Cronbach's Alpha**
1	0.966		0.966
2	0.966	Q11.4 - Com_Perf	0.965
3	0.965	Q11.6 - Rev_Perf	0.964
4	0.964	Q11.7 - Vir_Goal	0.964
5	0.964	Q11.8 - Vir_Social	0.963
6	0.963	Q11.9 - Int_Cyc	0.963
7	0.963	Q11.10 - Inf_Cyc	0.961
8	0.961	Q12.3 - Perf_Mon	0.960
9	0.960	Q12.5 - Wor_Rule	0.959
10	0.959	Q12.8 - Ingame_dat	0.960
11	0.960	Q13.1 - Own_Opin	0.958
12	0.958	Q13.2 - See_Rev	0.956
13	0.956	Q13.3 - Oth_Opin	0.953
14	0.953	Q14.6 - Vir_Proc	0.952

Table 3.9: *Cronbach's Alpha following deletion of each of item.*

Following the deletion of these nine items (see Table 3.9), the remaining 28 items resulted in Bartlett's test significance of p= 0.000. Along with the Kaiser-Meyer-Olkin (KMO) statistic as a Measure of Sampling Adequacy (MSA) of 0.907, a value interpreted as "highly desirable" (Field, 2005, p. 640) or "excellent" (Hair et al., 2010), drawing the conclusion, the following nine items from table 3.10 could be statistically proven through EFA to be deleted from the final survey instrument.

Theme	**Questions Delete**	**Kaiser-Meyer-Olkin (KMO)**
Mobile App Tool centric	14.6. It helps me to follow training plans	0.558
Mobile App Tool centric	14.8. It allows me into a virtual reality world	0.563
Mobile App Tool centric	14.10. It helps support my interest of cycling (e.g. weather forecast or bike maintence guides)	0.448
Mobile App Game centric	15.3. It helps me develop my skills of cycling	0.513
Mobile App Game centric	15.8. It helps me to use in game data (e.g. heart rate)	0.543
Mobile App Social centric	16.1. I am able to share my opinions with fellow cyclists	0.415
Mobile App Social centric	16.2. I am able to see online products reviews including the views of others	0.481
Mobile App Game centric	16.3. I am able to share content about cycling that helps others	0.439
Mobile App Design centric	17.6. It helps me if an mobile app lets me overlay products into a real world situation (e.g. overlay new bike on myself)	0.525

Table 3.9: Items deleted due to KMO below 0.6. Sample 108

3.5 Stage Four Full Study

The previous three stages of the method and analysis aided the rigor of the final survey instrument (Stage Four), in particular, the rigor of the conceptualisation of the five functions of mobile apps (tool-centric, game-centric, social-centric, design-centric and m-commerce-centric) with each stage supporting the reliability of these factors. In addition, the three prior stages supported the validity of the final instrument with amends at each stage, along with pre-testing the sample selection and data analysis. The results in the development of the final instrument are found in Appendix 3, and the four stages are the full-scale study.

3.5.1 Sample Selection of Full-Scale Study

The sample selection process for the pilot survey was reflected upon, for the full-scale survey instrument which adopted a simple random sampling. Singh (2003) defined simple random sampling as “being selected unit by unit with equal probability of selection from each unit at each draw” (p. 71). A subset of the population of this study is cyclists in the UK, with each unit having an equal chance of inclusion in the sample, which benefits the estimate of the parameters of the population (Singh & Masuku, 2014). Whilst the survey will be open to all types of cyclists, it includes criteria for inclusion:

- Being over 18 years of age, living in the UK.
- A cyclist, who uses a bike indoors or outdoors, at least every six months (Mintel, 2022).
- Digital access to the computer, smartphone, tablet or suitable another connected internet (Gov, 2019).
- Digital literacy, being able to use a computer, smartphone tablet or suitable another connected internet (Gov, 2019).

- Engagement in either electronic forms of communication (such as social media, blogs, and forums) on cycling or engagement in a cycling club in the UK (Gov, 2019).

These inclusions are seen as acceptable in order to meet the study's objectives. For example, a focus on mobile apps in the study would require cyclists to be IT savvy and able to use a computer or smartphone. Hence deliberately contacting cyclists through electronic channels and being able to respond to an online survey and living in UK will be deemed as accepted. This results in a probabilistic simple random sampling, as any cyclists meeting these inclusion criteria was equally likely to be accepted.

The population of the sample is typical of a UK cyclist as it was shared throughout the two approaches. These approaches positioned two groups; A) 10 amateur cycling clubs in each region of the UK; and B) all types of cycling social media, forums and blogs UK-wide. Both A and B ensure random selection, covering the length and breadth of the UK cyclist community, resulting in an equal chance for the population to partake (Brecht, 1983; Singh, 2003; Singh & Masuku, 2014). Approach A randomly selected 10 cycling clubs in each region of the UK from British Cycling's website. British Cycling note there are over 1,700 clubs across all forms of cycling throughout the UK (British Cycling, 2022). As the cycling clubs are geographically dispersed along with the type of cycling (e.g. road, mountain bike, BMX etc) this ensured a broad representation of cyclists. Whereas Approach B, shared the survey widely across avariety of social media, blogs, and forums providing the ability to collect views and opinions on all forms of cyclists in terms of bike ownership, preference for cycling indoors or outdoors, whether they are cycling for recreation or commuting, and the amount of involvement within cycling. In using both A and B approaches, the population of UK cyclists, were presented with an equal opportunity of being selected, ensuring the sampling approach is representative of all

UK cyclist (Singh, 2003; Singh & Masuku, 2014). A review of the sampling approach can be seen in Table 3.11.

The simple random sampling ensures the population of UK cyclist is typical as it considers different levels of involvement in cycling, methods of cycling from indoors to outdoors and forms of bike ownership being considered to ensure a representative sample due to the diverse range of motivations for cyclists (Lamont & Jenkins, 2013). The sample selection for the full-scale study is a simple random sampling technique, chosen as a best-fit technique as the approach of A and B ensures UK cyclists are presented with an equal opportunity of being selected (if meeting the criteria set out earlier in the chapter) and thus allowing generalisations about the population due to being representative of UK cyclists (Singh, 2003; Singh & Masuku, 2014; Brecht, 1983). The approaches of A and B result in the confident conclusion have indeed reached the vast majority of the eligible population.

Date	Tranche	Sub-sample size	Source	Comments
First posted early December 2021 Follow up posts late December 2021	120 responses, 30% respondents.	This reached a combined audience from all groups of 503,000	Social media pages through Facebook of cyclist-focused groups. For example, British Cycling, Strava UK, and regional groups around UK, the whole range of bike types included within the survey.	Posted on 43 Facebook social media groups, within different regions in the UK – to give UK-wide vantage. Also posted on all bikes types included within surveyed included (from the road through BMX).
First posted early December 2021 Follow up	30 responses, so 7.5%	Six cycling clubs confirmed they shared survey. The estimated reach is	Cycling clubs shared this through a number of mechanisms from social media pages, newsletters, and WhatsApp	Made contact with 15 cycling clubs who are registered with British Cycling, throughout the country, at least 2

posts late December 2021		7,000	groups.	within each geographical region. Made a request for each club to share, however, some clubs declined or did not respond. The key learning was gaining to the gatekeeper and the importance of snow balling sampling to other cycling clubs.
First posted early January 2022 Follow up posts middle January 2022	0 responses, so 0%	This reached an audience of all these groups is 10,000	Strava Groups centred on cycling interests for example Great North Bike Ride Cycle Club, Over 40's CC, and Pedalling Squares	Posted on 11 Strava groups. The lack of responses on this is accredited to the lack of conversations on the platform of Strava.
First posted early January 2022 Follow up posts middle January 2022	10 responses, so 2.5%	This reached an audience of all these groups is 215,000	Cyclist media such as Cycling Weekly, CyclingTips Podcast, and Cyclocross Magazine.	Shared on social media platforms for 10 cyclists-focused media. The media companies lacked support in sharing this, so refrained from following this approach.
First posted early February 2022 Follow up posts middle February 2022	120 responses, so 30%	This reached an audience of all these groups was 601,000	Social media pages through Facebook of cyclist-focused groups for example UK cycling Events, Cycling associations around the UK, and different bike interested groups gravel to indoors.	Posted on 20 new social media groups through Facebook, within different regions in the UK. Also posted on all bikes types included within surveyed included (from indoor bikes to gravel).
First posted middle of February	10 responses, so 2.5%	This reached an audience of all these groups was	Selected the 6 UK-focused forms, for example, CTFroum RCUK forum. Either post on the	The response rate for forums was lower than expected. Due to this decision to

2022 Follow up posts end of February 2022		600,000	most relevant thread or create new threads when necessary.	focus on other sampling methods.
Shared the end of February 2022 and the start of March 2022.	100 responses, so 25%	10 cycling clubs are confirmed to share. The estimated reach is 20,000. In addition, snowballing sampling was used to share this with 4 additional cycling clubs with a reach of 6,000	Cycling clubs shared this through a number of mechanisms from social media pages, newsletters, and WhatsApp groups.	Made contact with 120 cycling clubs that are registered with British Cycling, throughout the country. Contacted 10 in each geographical region. Made a request for each club to share, however, some clubs declined or did not respond. For each club that shared, request for other local clubs that may be willing share.

Table 3.11: Sampling approach

3.5.2 Sample Size of Full-Scale Study

The sample size chosen for the full-scale study was dictated from the type of study that is being undertaken and the techniques used, which in the case of this thesis followed Exploratory Factor Analysis in order to test the five functions of mobile apps and a two-step cluster to divide the segments into distinct groups.

On consulting the literature for Exploratory Factor Analysis, Tabachnick and Fidell (2013) reached the conclusion at least 300 is adequate for factor analysis. This figure is also supported by Norusis (2007). On closer inspection of further academic literature, the sample size for factor analysis is additionally supported by the rule of thumb of a sample size of 200 offering adequate statistical power for data analysis (Hoe, 2008; Sigh et al., 2016). Whilst the literature is often at odds for optimum sample size, for the purpose of this study the adequate sample size used by Tabachnick and Fidell (2013) is decided upon. This figure is considered appropriate as it goes beyond the rule of thumb (Hoe, 2008 & Sigh et al., 2016). In addition, as EFA is being utilised for the development of model with this study, DeVellis, (2017) concluded that with the general rule of thumb for a unidimensional scale constructed a sample size of 300 is classified as sufficient. This is also supported by additional research from Comrey and Lee (1992) with a sample size of 300 and above being defined as good.

In addition, this sample size reflected valid levels for cluster analysis as used in the final stages of data processing within this thesis. The final data analysis used two-step cluster analysis to divide the segments into discrete groups. Consulting the academic literature often concludes that there is no rule of thumb when it comes to sampling size for two-step cluster analysis (Dolnicar, 2002). With this in mind, consulting other studies in the fields of cycling and marketing segmentation results in a sample size between 141 (Hopkin & Moore, 1995) and 1707 (Damant-Sirois & El-Geneidy, 2015). With such a widespread sample size, closer inspection into previous studies in the cycling sector which use cluster analysis to segment audiences sees two key studies Chen and Chen (2012) and Misra and Watkins, (2018) use a sample size of 232 and 437 respectively. Thus, reaching the conclusion that a sample size of 300 minimum for the nature of this study is perfectly suitable for both EFA and two-step cluster analysis.

3.5.3 Methods of Analysis in Stage Four

The method of analysis of Stage Four follows the same process used in Stage Three in the analysis of the functions of mobile apps. As such the same analysis methods were used starting with Cronbach's Alpha, Spearman Rank Correlation Coefficient before moving on to Exploratory Factor Analysis as discussed above.

The first stage of data analysis in Stage Four applied statistical techniques to determine internal validity with Cronbach's Alpha and relationships between variables with Spearman Rank Correlation Coefficient. Within Section 3.3.5, Cronbach's Alpha was identified as measuring consistency and reliability (Rust & Cooil, 1994) with academic literature defining minimum acceptable value as 0.70 to be considered satisfactory (Taber, 2018). Exploratory Factor Analysis was used to overcome the disadvantage of latent variables (Tabachnik & Fidell, 2013). The scores for Cronbach's Alpha analysis for the five functions of mobile apps (n=434) were considered to be well above the satisfactory level (as shown in Table 3.12 below)

The functions of mobile apps	**Cronbach's Alpha**	**Strength of Alpha**
Tool-Centric (7 items)	0.8	Good
Game-Centric (6 items)	0.9	Outstanding
Social-Centric (3 items)	0.9	Outstanding
M-Commerce Centric (6 items)	0.9	Outstanding
Design-Centric (6 items)	0.9	Outstanding

Table 3.12: *Cronbach's Alpha on the five functions of mobile apps*

In Section 3.4.2, the Spearman Rank Correlation Coefficient was identified as measuring the strength and direction of the association between two ranked variables (Fieller, Hartley & Pearson, 1957; Stephanou & Varughese, 2021). This was used to measure the association between the variable within the five functions of mobile apps, with literature often noting that Spearman scores of: p=0.40-0.59 have a moderate relationship, p=0.60-0.79 have a strong relationship and p= 0.80-1.00 have very strong relationships (Dancey & Reidy, 2007). Within the five functions of mobile apps, for the full-scale study, all variables include at least a moderate relationship through to very strong relationships with p values ranging from p= 0.404 – p=0.936.

After undertaking Cronbach's Alpha and Spearman Rank Correlation Coefficient, Exploratory Factor Analysis (EFA) was applied following the same process used in Stage Three (see Section 3.4.2). On consulting literature on mobile applications, EFA analysis is often utilised as data analysis (Gerlich, Drumheller, Babb & De'Armond, 2015; Kwon, Bae & Blum, 2013; Ozcinar, Ekizoglu & Kanbul, 2016). When investigating the approach of Kwon, Bae and Blum (2013), the study investigates mobile apps in the hospitality sector. EFA was adopted from Kwon, Bae and Blum, (2013) in exactly the same approach as this study adopted, which the next part of the chapter outlines.

As outlined in 3.4.2, EFA utilises statistics to derive factors and to determine the underlying pattern of the data in factor solutions (Hair el al 2010). In using EFA, pre-defined guidelines determine the variable loads on each factor and thus conclusions are drawn on the number of factors that emerge. EFA is ideally positioned for statistical tests to be adopted for the final study and used to decide the variable loads and factors that should remain or be deleted in the development of the final model of the five functions of mobile apps.

Both Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) was applied following the processes outlined in Stage Three (see Section 3.4.2). Firstly, Bartlett's test of sphericity was applied to identify eigenvalues greater than one should be selected and extracted (Hair et al., 2010). Principal axis factoring using KMO was applied to establish the number of remaining factors, with rotations being used to decide on the group of factors which are statistically independent (Bryman & Cramer, 1994). In using the KMO, the

Measure of Sampling Adequacy (MSA) is adopted in Stage 4, quantifying the degree of inter-correlation among the variables, Table 3.7 shows the KMO index scores, with items above 0.6 remaining and those below resulting in deletion (Hair et al., 2010; Tabachnick & Fidell, 2013).

The same statistical method of rotation, the Varimax Method, is adopted from Stage Three (Section 3.4.2) and used within Stage Four, to clarify the relationships among factors (Dilbeck, 2017). The Varimax Method is adopted with the factorisable when a KMO coefficient is above 0.60 for items (Tabachnick & Fidell, 2013) and Bartlett's test with a significance of 5% (Hair et al., 2010). Within Stage Four, the number of factors is five, defined by the theoretical model of the five functions of mobile in Stage Three (Williams, Onsman & Brown, 2010). Any deleted or reduced item was argued as being: miss-specification, low levels of loading and low levels of communality (Williams, Onsman & Brown, 2010). An additional layer of rigor will be added, as each item deleted will have internal consistency reviewed with Cronbach's Alpha Coefficients measured and the impact on the model (Shrestha, 2021).

Finally, cluster analysis was applied to consolidate Stage Four. Cluster analysis is heavily used in academic studies when it comes to research on segmentations. Cluster analysis is defined as a data processing technique that organises items into appropriate groups/clusters based on how closely they are associated (Hennig, Meila, Murtagh & Rocci, 2015). Whilst there is a diverse number of ways and methods of conducting cluster analysis, the method of two-step cluster analysis is significant for the study, due to the standardisation of the method by the World Health Organisation's Expanded Programme on Immunization (WHO EPI) in 1978 (Lemeshow & Robinson, 1985). A two-step cluster analysis automatically selects the number of clusters and creates groups on both categorical and continuous variables, when compared to other forms of cluster analysis such as hierarchical (Tkaczynski, 2017). The automatic selection of the number of clusters is particularly significant to the study, as it is segmenting audiences on mobile apps for the first time, so adopting a two-step cluster analysis determines the optimal number of clusters (Benassi et al., 2020) and adopts both categorical and continuous variables; it assumes variables to be independent and for this study aids knowledge of the distinctions of each cluster (Tkaczynski, 2017).

Two-step cluster analysis is defined as a hybrid approach that first uses a distance measure to separate groups and then a probabilistic approach (similar to latent class analysis) to choose the optimal subgroup model (Gelbard et al., 2007; Kent et al., 2014). On closer inspection of the academic literature two-step cluster analysis is seen to provide a number of advantages when compared to more traditional techniques, such as defining the number of clusters based on statistical techniques via measurement of best fit (AIC or BIC) whereas traditional techniques are determined by individual preference or convenience (Benassi et al., 2020). Furthermore, Benassi at al (2020) noted other advantages of two-step cluster analysis of being able to utilise both categorical and continuous variables at the same time along with the ability to analyse and remove atypical values or outliers. Numerous other studies note two-step cluster analysis as being able to handle large datasets (Chiu et al., 2001; Bacher at al 2004; Gelberd et al., 2002; Mooi & Sarstedt, 2011). A large body of academic literature draws conclusions that two-step cluster analysis is the most reliable when compared to other techniques (Bacher at al 2004; Gelberd et al., 2002; Kent et al., 2014).

The rationale for the significance of reliability is often attributed to two-step cluster analysis providing distinct benefits of detecting the number of subgroups, probability classification of assigning individuals to subgroups, and finally, the ability to reproduce findings in other settings (Bacher at al 2004; Gelberd et al., 2002; Kent et al., 2014).

Such distinct advantages are the rationale to aid the validity and reliability of using two-step cluster analysis within the study to divide cyclists into distinctive subgroups, meeting the study's objectives.

When consulting the academic literature, Tkaczynski (2017) offers a process of two-step cluster analysis often defined as:

1. Deciding on the variables
2. Using auto-clustering to define the best fit on the number of solutions based on the Log-likelihood distance measure and the Bayesian Information Criterion (BIC) (Burnham & Anderson, 2002)
3. Reviewing the cluster distribution to ensure the frequency of each cluster with the rule of thumb of the ratio being under 2:1 is good practice as defined by the Anderson-Rubin method (DiStefano, Zhu, & Mindrila, 2009)
4. Ensuring the attribute importance of each variable is a close to one as possible, so each variable is equal weight in the scoring of importance
5. Consulting with silhouette measure of cohesion and separation with a good cluster quality defined as 0.5 above (de Amorim & Hennig, 2015)
6. In order to validate, re-run the analyses with cluster solutions one and below the model of best fit, and use criteria from steps 2-5 to support the best cluster solution.

Therefore, the use of a two-step cluster analysis was considered perfect due to the nature of the study's objectives, which are to investigate the segmentation in the cycling sector of mobile applications.

Whilst multiple comparable studies conclude that two-step cluster analysis is more reliable than other forms (Bacher at al 2004; Gelberd et al., 2002; Kent et al., 2014), it is noted that this form of exploratory analysis is not without critique, for example, the interpretation of clusters is in part down to the judgment of researchers (Thoma, 2006); whilst the multiple steps 1-6 recognised by Tkaczynski (2017), above, attempts to overcome this an additional stage will be added by seeking the expertise of an academic expert who is well versed and published in the area of cluster solutions.

The academic literature argues that seeking the expertise of an academic further aids the study by ensuring the correct process is adhered to, the best-fit cluster resolution is found, the ability to reproduce findings is assessed which all ultimately aid the rigor of the study (Tkaczynski, 2017). In adding this stage, it removes the critique of exploratory research as it takes away the subjectivity of the interpretation of clusters and aids the generalisability of the research findings.

3.6 Ethical Considerations

The importance of ethical implications was considered throughout for the purpose of the study, along with the wider scope of the impact of the guiding principles of the research. The principles of the ethical research committee of Newcastle Business School were sought, which can be seen in Appendix Two, which followed the University's policies on ethics.

Each stage of data collection followed the ethics policies by obtaining informed consent from all research participants prior to this commencing. The principles of research ethics were obtained from commencing the self-administrated survey from all participants and being able to withdraw this informed consent at any point, by providing contact details of the primary investigator. Ethical considerations were embedded throughout the research from survey design and data collection. All survey participants were anonymous with all data being processed anonymously and stored securely. All data was stored electronically through password-protected university IT systems, as acknowledged in the University's Ethics policy. Furthermore, all participants were over the age of 18 years and from non-vulnerable groups, both of which were acknowledged as restrictions of the sampling for the University's Ethics policy.

3.7 Strengths and Limitations of the Research

As with every study there are strengths and limitations to the methodology. The academic literature notes the significance of acknowledging both of these, in order to develop the method (Saunders at al 2009).

The limitations of the study can be summarised as follows. Firstly, it was a UK-centric study and only collect data from the UK. This ensures the results only apply within the UK, however, the study objectives were only to understand a cluster analysis of UK cyclists. Secondly, simple random sampling is not without its disadvantages, in particular, the significant time and effort in the administration of the approach. The repeatability of the study is considered within the sample selection, for a simple random sampling. The results in Table 3.11 show a representative sample of UK cyclists. However, both limitations of time and cost were considered when deciding on sampling selection, with the study focus being on collecting data from the representative target population.

Lastly, a limitation of the study is acknowledged that those engaging within online forms such as social media, blogs, forums, and cycling groups are highly engaged in the sport and already self-identify as cyclists and as such have high involvement in the category of cycling. However, in sample selection a wide distribution of levels of involvement in cycling was utilised, so opportunities were provided for those less involved to part take in the study. Thus, attempts were made to aid the generalisability of the study as it was opened up to a broad group of people involved in cycling. Self-identification as a cyclist ensures the general views of cyclists are included thus making the findings generalisable across the cycling sector. It could be argued that using online methods such as social media forums and blogs may carry bias in terms of the sample with internet usage and access, age, and education proficiencies. However, as discussed in Section 3.5.2 on the sample size of the full-scale study, efforts were made to collect as representative a target population as possible.

On balance, the study methodology has several strengths. Firstly, the four-stage process of data collection, at each stage the final survey instrument is further developed. This aids the complexity of conceptualising the five functions of mobile apps in the cycling sector, as each stage adds rigor to the interpretation of Zhao and Balugue's (2015) functions of mobile apps for the context of the study. At each of the four stages, suitable statistical techniques were employed to test the five functions of mobile apps in a new context.

Secondly, the resulting sample size of 434 collected ensures representativeness, and makes it possible for generalisations to be made on the segmentation of UK cyclists. Additionally, the four stages of data collection support the validity of the study, as respondents are represented at different stages of data collection. In using an exploratory approach, the validity of interpretations of findings was developed, as the research uses multiple data collection points which are analysed and findings refined for the next stage.

Finally, to approach the area of research on the segmentation of cycling using mobile apps the importance and significance in terms of aiding market strategy with the understanding of how mobile apps are changing consumers' attitudes and behaviours within the cycling sector is stressed. Whilst previous studies have sought to understand consumers' views on mobile apps (Zhao & Balugue, 2015) in a holistic sense, no prior studies have investigated this within the context of cycling. Such studies (see for example Zhao & Balugue, 2015), have stressed the importance of mobile application research being context specific within the industry in question, due to unique characteristics along with the development of mobile apps to respond to consumers.

As such a study into mobile apps in the cycling sector is largely unexplored and ripe for further research as technology-based companies such as Zwift and Strava have radically changed the marketplace in a short period of time and gained major traction in usage. Hence, this is unique in the following major ways:

- To understand the five functions of mobile apps in the context of the cycling sector within the UK market.
- To understand how to use the five functions of mobile apps in order to segment the cycling market. To divide cyclists into distinct segments using these five functions of mobile, to understand each segment's behaviours and attitudes.

As such the study focus is uniquely positioned to examine the degree to which the five functions of mobile apps in the cycling sector can be used to segment audiences.

3.7 Chapter Conclusion

This chapter has reviewed the following areas: epistemology, theoretical perspective, methodology, and methods used for data collection. The methodology selected for this study consists of a four-stage approach, in order to aid the rigor and robustness of the study in conceptualising the five functions of mobile apps in the cycling sector. Within the four-stage approach, EFA and two-step cluster analysis are considered the most suitable statistical techniques to meet and fulfill the research aims and objectives.

The primary data collection is considered, with the focus on gaining access to a representative target population of cyclists considering two pillars of involvement in cycling and motivations. Following the data collection, the data analysis uses a quantitative approach and selects suitable statistical techniques to explore factors of functions of mobile apps in the cycling sector. This results in the use of a two-step cluster analysis to segment and understand the attitudes, behaviours, and motivations of cyclists. This aids the theoretical contribution of understanding cyclists' attitudes towards mobile apps and segments through their utilisation of the functions of mobile apps.

Moving on, Chapter Four will go on to describe the findings and analysis of EFA and present the findings and analysis of the two-step cluster analysis and the cluster solutions of cyclists.

Chapter Four: Findings and Analysis

4.1 Chapter Overview

This chapter presents the findings and analysis of data collected in stages three (Pilot) and four (Final Survey) using statistical analysis as discussed within the methodology (Chapter Three). Initially, this chapter will explore and explain the development and deployment of the pilot survey (Stage Three) before presenting an analysis of this data in considering and applying the statistical techniques of Cronbach's Alpha (Saunders, Lewis & Thornhill, 2009; Rust & Cooil, 1994) and Spearman's Correlations (Fieller, Hartley & Pearson, 1957; Stephanou, & Varughese, 2021). This section will also explore data using Exploratory Factor Analysis (EFA) (Hair at al 2010) in order to bring insights and confirm the factors for the final survey instrument.

This chapter then moves to final stage survey (Stage Four) presenting descriptive analysis and an overview of the data set. Exploratory Factor Analysis (EFA) was used to confirm the reliability and validity of the latent factors presented and resulting in the five functions of mobile apps and presentation of the final framework. Finally, this chapter will present cluster solutions for segments of cyclists using a two-step cluster analysis on the factors of mobile apps for cyclists. This chapter will conclude by using data visualisation techniques to present a four-cluster solution of cyclist segments.

4.2 Stage Three: The Pilot Study

The literature review and method chapter unpacked the five factors of mobile apps. Figure 4.1 illustrates the various functions within each to provide an understanding of the meaning and use in Mobile Apps.

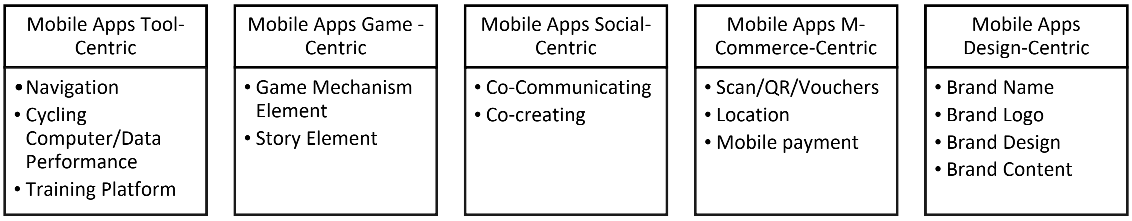


Figure 4.1: Conceptualised model of the five functions of Mobile Apps

The primary data collection method used within this thesis is the questionnaire drawing quantitative insights from the cycling community on the five functions of mobile apps as considered material. While this approach was chosen to garner a wider sample of insights than qualitative studies would return, the limitations of this method are widely acknowledged within academic literature such as typically lower response rates (Flick, 2015) often due to a lack of interest for respondents in the subject matter, length of the survey instrument, and competing activities and time pressures (Cohen et al., 2018). In acknowledgement of this a two-stage approach favouring the piloting of the survey instrument before wide-scale deployment was implemented as advocated (Ruel, Wagner & Gillespie, 2016; Converse and Presser 1986; McIntyre & Hobbs 1999; Baxter & Magoldac, 2004) and discussed within this section exploring data collection, survey testing, deployment and testing.

4.2.1 Pilot Survey and Data Collection

Following best practice suggested in literature (Converse & Presser, 1986) deployment of the pilot survey followed a two-step approach as illustrated below:

- **Step One – Soft Launch:** A short-window pilot was mobilised to test the survey instrument before full roll-out. This soft launch of the questionnaire (Converse & Presser, 1986) was used to confirm the validity of the initial responses, explore the error rate and assess respondent engagement. This initial distribution (between 28th October 2021 and 1st November 2021) engaged respondents via social media platforms, blogs, and forums, and emailed to cycling groups and cycling clubs. The soft launch drew a sample of 20 surveys which confirmed the robustness of the survey instrument to progress to the full pilot stage.

- **Step Two – Full Distribution:** Following soft launch validity checks the questionnaire was released to a wider selection of distribution channels between (28th October 2021 and 8th November 2021) via social media, blogs and forums, including Cycling UK, Sustrans UK.

The incremental deployment strategy of the full survey resulted in 319 engagements leading to 108 fully completed questionnaires with these responses being used to shape the resultant final survey instrument as explored in Chapter Three (see Section 3.4). As a quantitative sample, low response rate is often commented on in the academic literature, as a general limitation of using questionnaires (Flick, 2015), however the pilot stage closed with 108 completed surveys, in excess of the reliable sample size as stated by Reynolds, Diamantopoulos and Schlegelmilch (1993) and Bagozzi and Yi (2012).

When assessing the level of return rates, a somewhat lower response can be considered as being common within studies using questionnaire instruments (Baruch, & Holtom, 2008). Comparatively, however there was a high level of fully completed responses (33.86%) showing the robustness of the data collection instrument. This solid foundation ensured that the findings and analysis of data collected during this pilot stage aided the refinement of the final questionnaire instrument (Stage Four) used within this study as discussed in Section 3.4 of Chapter Three (Methodology).

The iterative stages of testing data collection, analysis and refinement are essential in aiding the generalisability of the five functions of mobile apps (Zhao & Balugue, 2015) and contributing to the validity of the methodology and approach underpinning this study as well as increasing the ability of the survey instruments to return meaningful and insightful data.

4.2.2 Pilot Study – Statistical Analysis Techniques

To analyse the generalisability within the pilot data several approaches were used, as well as formal testing. Initial analysis used Cronbach's Alpha (Saunders, Lewis & Thornhill, 2009; Rust & Cooil, 1994; Park, 2021) and Spearman's Rank Correlations Co-efficient (Fieller, Hartley, & Pearson, 1957; Stephanou & Varughese, 2021) to validate the scales of mobile applications within the context of cycling. Firstly, this chapter considers the application of Cronbach's Alpha to the pilot study. Cronbach's Alpha explored the measurement of internal consistency and reliability (Saunders, Lewis & Thornhill, 2009; Rust & Cooil, 1994). This measurement was used to test the internal validity of the sample and questions used with the survey instrument. Academic literature often indicates a minimum acceptable value of 0.70 to be considered satisfactory (Taber, 2018. Data collected within the pilot stage met the satisfactory value tolerance of this scale as illustrated in Table 4.1 below. By meeting and exceeding the satisfactory value, data collection findings can be considered to correlate with and validate the reliability of the five functions of mobile apps.

Factors	Number of items	Cronbach's Alpha	Strength of Alpha
Five functions of mobile – Tool-Centric	10	0.9	Outstanding
Five functions of mobile – Game-Centric	8	0.9	Outstanding
Five functions of mobile – Social-Centric	6	0.9	Outstanding
Five functions of mobile – M-Commerce Centric	6	0.9	Outstanding
Five functions of mobile – Design-Centric	7	0.9	Outstanding
Basic Cycling Skills	3	0.7	Acceptable
Mobile Apps downloads and daily usage	16	0.8	Good

Table 4.1: Cronbach's Alpha Pilot n=108.

The internal validity and robustness of the sample data was further explored using Spearman Rank Correlation Coefficient, before finally moving on to the Exploratory Factor Analysis (EFA) to further develop the survey instrument. The Spearman Rank Correlation Coefficient measures the strength and direction of the association between two ranked variables to provide a rationale for their use (Saunders at al 2009). Each of the five functions of using Mobile Apps are explored in turn using the Spearman Rank Correlation Coefficient. This is illustrated in Tables 4.2 to 4.6, illustrating the relationships of each. The use of the Spearman Rank Correlation Coefficient in this context is particularly important to this thesis. As the study is conceptualising the framework for the first time, checking relationships is vital to ensure which items and factors should remain. In applying the Spearman approach academic literature often notes scores of: p=0.40-0.59 (moderate relationship, p=0.60-0.79 (strong relationship) and p=0.80-1.00 (very strong relationships) as confirming validity.

		Route	Exp_locat	Meas_Perf	Com_Perf	Train_Plan	Rev_Perf	Vir_Goal	Vir_Social	Int_Cyc	Inf_Cyc
Route	Correlation Coefficient	1.000	.773**	.723**	.213*	.265**	.360**	0.163	.196*	.340**	.539**
	Sig. (2-tailed)		0.000	0.000	0.027	0.006	0.000	0.092	0.042	0.000	0.000
Exp_locat	Correlation Coefficient	.773**	1.000	.701**	0.121	.285**	.452**	0.175	.225*	.395**	.484**
	Sig. (2-tailed)	0.000		0.000	0.214	0.003	0.000	0.071	0.019	0.000	0.000
Meas_Perf	Correlation Coefficient	.723**	.701**	1.000	.212*	.241*	.358**	0.109	0.100	.218*	.503**
	Sig. (2-tailed)	0.000	0.000		0.028	0.012	0.000	0.261	0.305	0.023	0.000
Com_Perf	Correlation Coefficient	.213*	0.121	.212*	1.000	.652**	.312**	.468**	.258**	.421**	.281**
	Sig. (2-tailed)	0.027	0.214	0.028		0.000	0.001	0.000	0.007	0.000	0.003
Train_Plan	Correlation Coefficient	.265**	.285**	.241*	.652**	1.000	.602**	.652**	.467**	.557**	.434**
	Sig. (2-tailed)	0.006	0.003	0.012	0.000		0.000	0.000	0.000	0.000	0.000
Rev_Perf	Correlation Coefficient	.360**	.452**	.358**	.312**	.602**	1.000	.617**	.561**	.556**	.540**
	Sig. (2-tailed)	0.000	0.000	0.000	0.001	0.000		0.000	0.000	0.000	0.000
Vir_Goal	Correlation Coefficient	0.163	0.175	0.109	.468**	.652**	.617**	1.000	.495**	.523**	.456**
	Sig. (2-tailed)	0.092	0.071	0.261	0.000	0.000	0.000		0.000	0.000	0.000
Vir_Social	Correlation Coefficient	.196*	.225*	0.100	.258**	.467**	.561**	.495**	1.000	.664**	.337**
	Sig. (2-tailed)	0.042	0.019	0.305	0.007	0.000	0.000	0.000		0.000	0.000
Int_Cyc	Correlation Coefficient	.340**	.395**	.218*	.421**	.557**	.556**	.523**	.664**	1.000	.508**
	Sig. (2-tailed)	0.000	0.000	0.023	0.000	0.000	0.000	0.000	0.000		0.000
Inf_Cyc	Correlation Coefficient	.539**	.484**	.503**	.281**	.434**	.540**	.456**	.337**	.508**	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	

Abbreviation Key			
Route	It helps me with the planning of cycling route(s)	Exp_locat	It helps make suggestions on the best route of travel
Meas-Perf	It helps me find new locations to explore on the bike	Com_Perf	It provides me with a method to measure the performance of my ride (distance/speed/average)
Train_Plat	It helps me to review and compare my previous performance (e.g. segment data and leader boards)	Rev_Plat	It helps me to follow training plans
Vir_Goal	It helps me review my cycling performance of a ride (e.g. heart rate, cadence and power)	Vir_Social	It allows me into a virtual reality world
Int_Cyc	It helps me socially interact with others through virtual reality worlds (e.g. Strava / Zwift)	Inf_Cyc	It helps support my interest of cycling (e.g. weather forecast or bike maintenance guides)

Table 4.2: Spearman Rank Correlation Coefficient Pilot Mobile Apps Tool Centric =108.

		Badge_Rew	Badge_Soc	Perf_Mon	Perf_Soc	Wor_Rule	Story_Cha	Story_Lea	Ingame_dat
Badge_Rew	Correlation Coefficient	1.000	.813**	.526**	.754**	.527**	.342**	.293**	.517**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.002	0.000
Badge_Soc	Correlation Coefficient	.813**	1.000	.465**	.802**	.503**	.375**	.369**	.548**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000	0.000	0.000
Perf_Mon	Perf_Mon	.526**	.465**	1.000	.582**	.467**	.379**	.359**	.506**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000	0.000	0.000
Perf_Soc	Correlation Coefficient	.754**	.802**	.582**	1.000	.451**	.305**	.301**	.438**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.001	0.002	0.000
Wor_Rule	Correlation Coefficient	.527**	.503**	.467**	.451**	1.000	.736**	.659**	.620**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.000	0.000
Story_Cha	Correlation Coefficient	.342**	.375**	.379**	.305**	.736**	1.000	.922**	.504**
	Sig. (2-tailed)	0.000	0.000	0.000	0.001	0.000		0.000	0.000
Story_Lea	Correlation Coefficient	.293**	.369**	.359**	.301**	.659**	.922**	1.000	.527**
	Sig. (2-tailed)	0.002	0.000	0.000	0.002	0.000	0.000		0.000
Ingame_dat	Correlation Coefficient	.517**	.548**	.506**	.438**	.620**	.504**	.527**	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Abbreviation Key			
Badge_Rew	It helps me to achieve rewards with badges, points, or leader boards	Badge_Social	It helps me when others like or comment on my badges (e.g. Kings or Queens of Mountains/Course Records/Local Legends)
Perf_Mon	It helps me develop my skills of cycling	Perf_Social	It helps me when other users like or comment upon my performance
Wor_Rule	It helps when a mobile app transports me into a new world with its own rules	Story_Cha	It helps me to be part of the story as a character
Story_Lea	It helps me to the lead take in the story	Imgame_dat	It helps me to use in game data (e.g. heart rate)

Table 4.3: Spearman Rank Correlation Coefficient Pilot Mobile Apps Game Centric =108.

		Own_Opin	See_Rev	Oth_Opin	Creat_Cyc	Desg_Cyc	Desg_Com
Own_Opin	Correlation Coefficient	1.000	.610**	.715**	.447**	.434**	.455**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000
See_Rev	Correlation Coefficient	.610**	1.000	.784**	.527**	.540**	.577**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000
Oth_Opin	Correlation Coefficient	.715**	.784**	1.000	.575**	.556**	.597**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000
Creat_Cyc	Correlation Coefficient	.447**	.527**	.575**	1.000	.964**	.924**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000
Desg_Cyc	Correlation Coefficient	.434**	.540**	.556**	.964**	1.000	.960**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000
Desg_Com	Correlation Coefficient	.455**	.577**	.597**	.924**	.960**	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	

Abbreviation Key			
Own_Opin	I am able to share my opinions with fellow cyclists	See_Rev	I am able to see online products reviews including the views of others
Oth_Opin	I am able to share content about cycling that helps others	Creat_Cyc	I am able to share design and creative ideas of advertising to cycling companies
Desg_Cyc	I am able to share new product design ideas with cycling companies	Desg_Com	I am able to share new product design ideas with other cyclists/communities

Table 4.4: Spearman Rank Correlation Coefficient Pilot Mobile Apps Social Centric =108.

		Dis_Vou	Check_out	Bar_code	Locat	Con_Pay	Vir_Proc	Sec_Pay
Dis_Vou	Correlation Coefficient	1.000	.768**	.631**	.560**	.588**	.448**	.586**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.000
Check_out	Correlation Coefficient	.768**	1.000	.749**	.697**	.794**	.518**	.777**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000	0.000
Bar_code	Correlation Coefficient	.631**	.749**	1.000	.815**	.670**	.603**	.613**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000	0.000
Locat	Correlation Coefficient	.560**	.697**	.815**	1.000	.679**	.592**	.582**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.000
Con_Pay	Correlation Coefficient	.588**	.794**	.670**	.679**	1.000	.504**	.794**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.000
Vir_Proc	Correlation Coefficient	.448**	.518**	.603**	.592**	.504**	1.000	.443**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.000
Sec_Pay	Correlation Coefficient	.586**	.777**	.613**	.582**	.794**	.443**	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	

Abbreviation Key			
Dis_Vou	It helps me if I can use discount voucher or coupons	Check_out	It helps me if a mobile app has an easy checkout
Bar_code	It helps me if an mobile app uses bar code scanners or QR codes	Locat	It provides me with convenient location sharing (e.g. check-in with a retail store)
Con_Pay	It provides me with convenient methods of payment	Vir_Proc	It helps me if an mobile app lets me overlay products into a real world situation (e.g. overlay new bike on myself)
Sec_Pay	It helps me if I can use secure payment methods		

Table 4.5: Spearman Rank Correlation Coefficient Pilot Mobile Apps M-Commerce Centric =108.

		APP_Brand	App_text	App_Aesth	App_Logo	App_Cont	App_Vid
APP_Brand	Correlation Coefficient	1.000	.805**	.783**	.792**	.784**	.728**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000
App_text	Correlation Coefficient	.805**	1.000	.789**	.730**	.696**	.643**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000
App_Aesth	Correlation Coefficient	.783**	.789**	1.000	.742**	.795**	.687**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000
App_Logo	Correlation Coefficient	.792**	.730**	.742**	1.000	.652**	.682**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000
App_Cont	Correlation Coefficient	.784**	.696**	.795**	.652**	1.000	.723**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000
App_Vid	Correlation Coefficient	.728**	.643**	.687**	.682**	.723**	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	

Abbreviation Key			
APP_Brand	It helps to see a well known brand name	App_text	It helps to review the short promotional text about the app
App_Aesth	It helps if an aesthetically pleasing mobile application is provided	App_Logo	It helps to see a cycling logo that resonates with me
App_Cont	It helps to see a good range of content	App_Vid	It helps me when videos are included

Table 4.6: Spearman Rank Correlation Coefficient Pilot Mobile Apps Design Centric =108.

Summing up the Spearman Correlation Tables 4.2 to 4.6 show that all variables include at least a moderate relationship through to very strong relationships with p values ranging from p=0.434 to p=0.964. The benchmark of a moderate relationship for Spearmans Correlation is defined as 0.40 and above (Dancey & Reidy, 2007), resulting in all the items being above 0.40, supporting the inclusion in the five functions of the framework. Due to the strength of relationships this study draws the conclusion that all items be included within the five functions of mobile apps for the final survey instrument. Moving on, these functions were further assessed using Exploratory Factor Analysis to sense check data patterns and findings.

4.2.3 Pilot Study – The 5 Functions of Mobile Reviewing the EFA

Exploratory Factor Analysis (EFA) is a statistical test used to determine the underlying pattern of the data (Hair at al. 2010), for example the factor structure. Within this study EFA has been used to pilot test the five functions of mobile apps and provide rationale to support the decision on which of the 37 items, and the resulting factors within the five functions (introduced in Tables 4.2 to 4.6), should remain or be removed. The application of EFA at this stage was central to addressing the research aims of this study (see approach in Chapter Three) in responding to the study's main aims to test a method to cluster cycling audiences based on their engagement in the functions of mobile apps.

The EFA tests the viability of these items with a variety of analysis approaches being applied sequentially. This was achieved through multi-stage analysis. This sequential approach to analysis supports the conceptualising of the resultant survey instrument or model, with academic literature positioning the need to undertake multiple stages in order to develop the rigor of such a model (Creswell & Creswell 2018; Thakur, 2016).

Data was initially explored using the Kaiser–Meyer–Olkin (KMO) test to determine suitability of data for factor analysis. The KMO test measures sampling adequacy for each variable in the model and the complete model overall with the resultant statistic being a measure of the proportion of variance among variables that might be common variance. The higher the proportion, the higher the KMO-value, the more suited the data is to factor analysis. Values less than 0.6 indicate the sampling is not adequate and that remedial action should be taken (Tabachnick & Fidell, 2013). KMO was applied to each item/function with those with scores less than 0.6 being identified for further testing of internal validity being the rationale for removal of items deemed inadequate. These items/functions are noted below in Table 4.7.

Theme	Questions Deleted	KMO Score
Mobile App Tool centric	14.6. It helps me to follow training plans	0.558
Mobile App Tool centric	14.8. It allows me into a virtual reality world	0.563
Mobile App Tool centric	14.10. It helps support my interest of cycling (e.g. weather forecast or bike maintenance guides)	0.448
Mobile App Game centric	15.3. It helps me develop my skills of cycling	0.513
Mobile App Game centric	15.8. It helps me to use in game data (e.g. heart rate)	0.543
Mobile App Social centric	16.1. I am able to share my opinions with fellow cyclists	0.415
Mobile App Social centric	16.2. I am able to see online products reviews including the views of others	0.481
Mobile App Social centric	16.3. I am able to share content about cycling that helps others	0.439
Mobile App Design centric	17.6. It helps me if an mobile app lets me overlay products into a real world situation (e.g. overlay new bike on myself)	0.525

Table 4.7: Items identified for deletion using the KMO method

Moving on, the Varimax Method (Dilbeck, 2017; Hair et al., 2010) of five rotations was used to test the viability of the of nine items with a KMO index score below 0.60 (Tabachnick & Fidell. 2013) as illustrated in Table 4.7 reducing the set of 37 items to 28. In deleting these items, the literature argues the rationale based on the following grounds: firstly, miss-specification, secondly low levels of loading, and thirdly low levels of communality (Williams, Onsman & Brown, 2010). This sequential approach to analysis supports the conceptualising of the resultant survey instrument or model, with the academic literature positioning the need to undertake multiple stages in order to develop the rigor of such a model (Creswell & Creswell 2018; Thakur, 2016).

To aid the internal validity of the findings from the Varimax method, the Cronbach's Alpha Coefficient (Chan & Idris, 2017) was used as an additional statistical method to measure internal consistency and reliability of the survey instrument (Rust & Cooil, 1994). This confirmed the rationale for the deletion of the nine items as illustrated in Table 4.7. These items were subsequently deleted, one by one with the Cronbach's Alpha Coefficient being run following each deletion in an iterative process. The results of this process are illustrated in Table 4.8.

Applying the Cronbach's Alpha Coefficient moved the sequence scores from 0.966 for the initial 37 items to 0.952 for the resultant 28 items, representing a small change of 0.012, showing that deleting the nine items results in a small and insufficient impact on internal consistency and reliability (Rust & Cooil, 1994). Therefore, the resultant instrument shows a Cronbach's Alpha Coefficient sore 0.952, which is significantly above the 0.7 threshold. This suggests a significantly higher internal consistency and reliability than what is considered baseline (Rust & Cooil, 1994).

Item	Initial Cronbach's Alpha	Item(s) Removed	Final Cronbach's Alpha
1	0.966	Commences with 37 items.	0.966
2	0.965	Q14.6 - It helps me to follow training plans	0.964
2	0.964	Q14.8 - It allows me into a virtual reality world	0.963
3	0.963	Q14.10 - It helps support my interest of cycling (e.g. weather forecast or bike maintence guides)	0.961
4	0.961	Q15.3 - It helps me develop my skills of cycling	0. 96
4	0.959	Q15.8 - It helps me to use in game data (e.g. heart rate)	0.96
6	0.96	Q16.1 - I am able to share my opinions with fellow cyclists	0.958
7	0.958	Q16.2 - I am able to see online products reviews including the views of others	0.956
8	0.956	Q16.3 - I am able to share content about cycling that helps others	0.953
9	0.953	Q17.6 - It helps me if an mobile app lets me overlay products into a real world situation (e.g. overlay new bike on myself)	0.952

Table 4.8: Cronbach's Alpha following deletion of each of item.

The Bartlett's Test Significance (Hair et al., 2010) was used to test sphericity; the test provides information about whether the correlations in the data are strong enough to use a dimension-reduction technique such as principal components or common factor analysis. Applying the Bartlett Test returned a score of 0.000 (p = 0.000). This shows there are sufficient correlations between variables, compared to the required 5% (Hair et al., 2010).

Finally, results were reaffirmed using the Kaiser-Meyer-Okin method to explore the Measure of Sampling Adequacy (MSA) moving from 0.899 for the initial 37 items to 0.907 for the resultant 28 items. This shows that the resultant instrument used the function of mobile apps is a value interpreted as “highly desirable” (Field, 2005, p. 640) or “excellent” (Hair et al., 2010 p.136). Therefore, due to this excellence, conclusions can be drawn which confirm the robustness of the pilot analysis and suggest the final data collection and analysis in which using a larger sample size will undertake further EFA.

4.3 Stage Four: Final Survey and Data Collection

The resultant survey instrument was used to collect data between December 2021 and March 2022 via an online survey tool. Deployment of the survey followed approaches used within the pilot service using a two-step approach with a soft launch preceding full rollout. A soft launch was mobilised in early December 2012 via a small number of social media distribution channels. The purpose of the soft launch was to user-test the first 20 complete survey responses to ensure the survey had no errors or problems, with none being presented (Converse & Presser, 1986). Following the soft launch, the survey was distributed through a range of channels including social media pages, cycling clubs and online forums and blogs, a full scale sampling (see Table 3.11 in Chapter 3).

This resulted in 434 completed survey responses, following the deletion of any incomplete entries. Data collection was closed at the natural point when a drop off in responses was reached from the various online channels, reflecting arguments in literature which suggest that data collection will often reach a natural point with particular attention on a reduced number of daily completions (Couper, Traugot & Lamias, 2001).

The sample size was informed based on confirmatory factor analysis with Tabachnick and Fidell (2013) reaching the conclusion 300 is adequate and further supported Norusis (2007). Additional research identifies a rule of thumb of 200 when adopting EFA (Hoe, 2008 & Sigh et al., 2016), however DeVellis (2017) supports a sample size of 300, when a unidimensional scale is included. This study draws the conclusion that a sample size in excess of 300 (Tabachnick and Fidell, 2013; Norusis, 2007; DeVellis, 2017; Comrey & Lee, 1992) is defined as good.

The results in Table 3.11 are seen within the chapter on methods, with an estimate based on responses to completed surveys: 60% of responses from social media pages such as British Cycling, 33.5 % through cycling groups, 4% through cyclist media such as Cycling Weekly, and 2.5% through online cycling forums. The sampling approach is led toward a representative sample of UK cyclists, which is outlined under each of the demographic factors below, ensuring the validity and reliability of the data collection.

4.2.1 Respondents Overview

Demographic analysis of responses to questions 30 to 35 gives an overview of the demographical factors and is presented in Tables 4.9 to 4.14 exploring gender, age, income, employment status, educational background, and regional location. Collectively these demographic insights provide the demographic profile for this study.

Exploring the data in Tables 4.9 to 4.14 when compared to previous research (Cycling UK, 2021; Mintel, 2022) provides evidence that the simple random sample is representative of the population that been drawn from. Therefore, the findings of the sample can be generalised to the whole UK population.

Gender Demographics	Number	% (total)
Male	338	77.9%
Female	90	20.7%
Non-Binary/Third Gender	2	0.5%`
Prefer to Self-describe	2	0.5%
Prefer not to say	2	0.5%

Table 4.9 Respondent Demographics: Gender

The profile of respondents demonstrates a significantly higher contribution from males (77.9%) compared to females (20.7%) which reflects male participation in other cycling studies (Cycling UK, 2021; Mintel, 2022). A recent Mintel report (2022) concluded regular cyclists/occasional cyclist are heavily skewed toward males (70%) when compared to females (30%) and then goes on to state that the long-term male bias is actually widening. This study is broadly in line with this male and female split that is seen in other studies (Cycling UK, 2021; Mintel, 2022). The strong conclusion is that it is representative of the UK population of regular and occasional cyclists.

Age Demographics	Number	% (total)
18-24	13	3.0%
25-34	33	7.6%
35-44	73	16.8%
45-54	144	33.2%
55-64	121	27.9%
65-74	46	10.6%
75+	4	0.90%

Table 4.10 Respondent Demographics: Age

The majority of the respondents were aged between 35 and 64 accounting for 77.9% of the total number of responses. A recent study by Mintel (2022), concluded that serious cyclists over the age of 45 accounted for 72% of the sample, when compared to this study with 79.80% being 45 and above. Both studies show cyclists in the UK tend to be over the age of 45. Thus, the age profile of this study is broadly in line when compared to Mintel's (2022) study and confirms that this study is representative of the age profiles of serious cyclists in the UK.

Income Demographics	Number	% (total)
Less than £10,000	14	3.2%
£10,001 to £20,000	26	6.0%
£20,001 to £30,000	53	12.2%
£30,001 to £40,000	57	13.1%
£40,001 to £50,000	58	13.4%
£50,001 to £75,000	80	18.4%
£75,001 to £100,000	39	9.0%
£100,000+	51	11.6%
Prefer not to say	56	12.9%

Table 4.11 Respondent Demographics: Income

Levels of income of respondents fall significantly higher than the national average full-time average salary in 2021 of £38, 131 (Gov.UKc, 2022), with the final sample of 41.0% being above £50,001+. A recent Mintel report (2022) concluded regular cyclists as being affluent, with 31% having income above £50,000, compared with 21% of the overall GB population. The study draws conclusions that highly correlate cyclist income in line with other studies such as Mintel (2022), with a significant proportion of cyclists being identified as affluent, alongside socio-economics groups of AB (37%).

Location Demographics	Number	% (total)
East Midlands	27	6.2%
East of England	69	15.9%
London	22	5.1%
North East England	84	19.4%
North West England	12	2.8%
Northern Ireland	6	1.4%
Scotland	47	10.8%
South East England	51	11.8%
South West England	34	7.8%
Wales	15	3.5%
West Midlands	19	4.4%
Yorkshire and the Humber	48	11.1%

Table 4.12 Respondent Demographics: Regional Location

Responses were drawn from all UK regions with a range of 78 from the highest to lowest, with Northeast being highest at 84 (19.4%) to Northern Ireland lowest at 6 (1.4%). This study has collected cyclist views throughout the UK. Participation in cycling is influenced by geography with city dwellers (44%) more likely to cycle, second are those in larger towns (33%). Collecting respondents from throughout the UK ensures the study represents geographical locations that influence participation in cycling (Mintel, 2022).

Employment Status Demographics	Number	% (total)
Looking after home or family	1	0.2%
Self-employed or freelance	55	12.7%
Student	11	2.5%
Unemployed- actively looking for work	4	0.9%

Unemployed – not actively looking for work	1	0.2%
Working as employee - full-time	262	60.4%
Working as an employee – part time	29	6.7%
Other	2	0.5%

Table 4.13 *Respondent Demographics: Employment Status*

The profile of respondents demonstrates skews towards full-time employment status (60.4%) with fewer part-time employed (6.7%) and self-employed (12.7%) respondents. All employment combines for a total 79.8%, being well above the UK average (Gov.UK, 2022).

Employment Status Demographics	**Number**	**% (total)**
A Level / AS Level / VCEs / Higher Diploma	34	7.8%
Apprenticeship	7	1.6%
Bachelor Degree (e.g. BA, BSc)	130	30.0%
Higher Degrees (e.g. Masters, Doctorate)	164	37.8%
No formal qualifications	3	0.7%
qualifications are from outside the UK	5	1.2%
NVQ Level 2 / City and Guilds Craft / BTEC Diploma / RSA Diploma / Equivalent	19	4.4%
NVQ Level 3 / Advanced GNVQ / City and Guilds Advanced / BTEC National / Foundation Degree / Equivalent	48	11.1%
O Levels / CSEs / GCSEs / Foundation Diploma	24	5.5%
Total number of responses (per section)	434	100%

Table 4.14 *Respondent Demographics: Education Status*

The education level of respondents is significantly higher than UK average figures with 67.8% holding Bachelor's Degree or Higher Degree compared to national figures of 33.8% (Gov.UK, 2020). Comparing the Mintel report (2022) of higher socio-economic groupings than UK averages, it cross references well to this study, having higher than UK averages employee status and education levels, showing that a significant proportion of serious cyclists are higher socio-economic groups and educational levels. Thus the conclusion is drawn that this study has a representative sample of UK actively engaged cyclists.

As an overview, Table 4.15 compares the final data collection with other studies in cycling. Thus the conclusion is drawn that the demographics of the data collected within this thesis ensure a representative sample compared to other studies (Cycling UK, 2021; Mintel, 2022). This leads to representative sampling in line with Mintel's (2022) study of 'serious cyclists' defined as cycling at least once a week within the UK. Such a representative sample of 'serious cyclists' in the UK, across the range of demographic factors, aids the study's findings. The scope of the sampling approach ensures that the final data collection results in demographics aligning with previous studies (Cycling UK, 2021; Gov.UK, 2022; Gov.UK, 2020; Mintel, 2022) and represents UK 'serious cyclists' and consequently, on the generability of the conclusions and findings of the study.

Demographic	**Final Data Collection**	**Comparison to Studies**	**Comments**
Gender	High contribution from males (77.9%) compared to females (20.7%).	Regular cyclists/occasional cyclists are heavily skewed toward males (70%) when compared to females (30%) (Mintel, 2022)	A higher proportion of males reflect participation in other cycling studies (Cycling UK, 2021; Mintel, 2022)
Age	The majority of the respondents were aged between 35 and	Serious cyclists over the age of 45 accounted for 72%	Both studies show cyclists in the UK tend to be over the

	64 accounting for 77.9% of the total number of responses. With 79.80% being 45 and above.	of the sample (Mintel, 2022)	age of 45 with 72% of the sample for Mintel vs 79.80% for the final data collection.
Income	41.0% have an income above £50,001+.	Regular cyclists have an income with 31% being above £50,000, alongside socio-economics groups of AB (37%) (Mintel, 2022)	The study draws conclusions that serious cyclists' income is in line with other studies such as Mintel (2022), with a significant proportion of cyclists being identified as affluent 31%, alongside socio-economics groups of AB (37%).
Location	Respondents from all UK regions with Northeast being highest at – 84 (19.4%) to Northern Ireland lowest at 6 (1.4%).	Participation in cycling is influenced by geography with city dwellers (44%) more likely to cycle, second to those in larger towns (33%) (Mintel. 2022	Collecting respondents from throughout the UK, ensures the study represents geographical locations that influence participation in cycling (Mintel, 2022).
Employment	Full-time employment status (60.4%) with fewer part-time employed (6.7%) and self-employed (12.7%) respondents, being well above the UK average (Gov.UK, 2022).	Serious cyclists respondents had higher socio-economic groupings than UK average socio-economics groups of AB (37%). (Mintel, 2022)	Comparing the Mintel report (2022) of higher socio-economic groupings than UK averages, cross references well to this study, having higher than UK averages employee status and education levels. Showing that a significant proportion of serious cyclists are from higher socio-economic groups and educational levels.
Education	The education levels of respondents is significantly higher than UK average figures with 67.8% holding Bachelor's Degree or Higher Degree compared to national figures of 33.8% (Gov.UK, 2020).		

Table 4.15: *Final Data collection compared to existing secondary research in cycling*

4.4 Applying EFA Step 1 – Conceptualising Model Development

The first stage was to conduct Exploratory Factor Analysis (EFA) on the five functions of mobile apps using the final data set. EFA is often used in research within social sciences (Fabrigar & Wegener, 2011), on consulting Google Scholar search in October 2022 3.45 million studies utilised EFA. Hair at al. (2010) states that EFA is a statistical test to determine the underlying pattern of the data, for example the factor structure. As EFA uses pre-defined guidelines in order to determine the variable loads on each factors, using EFA allowed for a final decision on the number of factors that emerge on the five functions of mobile, prior to the two-step cluster analysis. The validity of data is justified in applying EFA on a larger sample size of (n=434), it is noted in academic literature (Hair et al., 2010) as aiding the rigor in the creation of the model. This is illustrated and reflected within this study.

Bartlett's test of Sphericity and Kaiser-Meyer-Olkin (KMO) was used in order to test the correlation of data and apply further rigour to assessment (seen Table 4.16). The KMO test returned a Measure of Sampling Adequacy (MSA) of 0.911. This value is interpreted as "superb" (Hair et al., 2010), as it is between 0.9 and 1.0. Bartlett's test showed significance being 0.000 for the factor analysis to be considered as fitting (Hair et al., 2010). Therefore, with a Bartlett's test 0.000 < 0.05 and KMO of 0.911 both are statistically significant allowing for the next stage of factor extraction and rotation.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.911
Bartlett's Test of Sphericity	Approx. Chi-Square	10010.120
	df	378
	Signifcance .	.000
a. Based on correlations		

Table 4.16: *KMO and Bartlett's test of Sphericity. N=434*

A Varimax method of rotation was undertaken in order to maximise the variance of loadings with factors (Abdi, 2003). Table 4.17 shows data using the sample size of 434 with 28 items/factors for functions of mobile apps, which noted is by Bagozzi and Yi (2012), as a good indicator of interpreting the outcome. Literature often argues the Varimax Method of Rotation is an objective statistical method to maximise the variance of loadings with factors (Tabachnick & Fidell, 2013; Hair et al., 2010). When deciding on which items remained or were deleted in the final instrument Tabachnick & Fidell (2013) defined a figure of 0.60 or above for a good EFA. This resulted in 24 items remaining (seen in green in Table 4.17) and the deletion of four items (seen in red in Table 4.18) for the final framework.

Rotated Component Matrix						
	Rescaled Component					
	1	**2**	**3**	4	5	6
Route	0.195	0.850	0.150	0.079	0.058	0.112
Exp_locat	0.191	0.801	0.167	0.070	0.010	0.221
Meas_Perf	0.199	0.823	0.169	0.117	0.048	0.100
Com_Perf	0.120	0.657	0.147	0.371	0.054	-0.126
Train_Plan	0.174	0.544	0.082	0.517	0.121	-0.058
Vir_Goal	0.050	0.521	0.126	0.437	0.171	-0.002
Int_Cyc	0.069	0.291	0.207	0.684	0.149	0.093
Badge_Rew	0.230	0.135	0.111	0.735	0.124	0.240
Badge_Soc	0.179	0.105	0.091	0.827	0.078	0.295
Perf_Soc	0.213	0.144	0.133	0.788	0.011	0.253
Wor_Rule	0.169	0.103	0.038	0.387	0.224	0.728
Story_Cha	0.070	0.083	0.067	0.195	0.278	0.875
Story_Lea	0.082	0.075	0.073	0.195	0.276	0.863

Creat_Cyc	0.119	0.078	0.035	0.094	0.855	0.266
Desg_Cyc	0.126	0.055	0.049	0.099	0.890	0.209
Desg_Com	0.126	0.069	0.120	0.123	0.848	0.162
Dis_Vou	0.337	0.049	0.624	0.262	0.142	-0.007
Check_out	0.370	0.190	0.805	0.126	0.004	0.032
Bar_code	0.348	0.164	0.526	0.178	0.303	0.081
Locat	0.279	0.138	0.507	0.108	0.408	0.195
Con_Pay	0.362	0.244	0.786	0.070	0.030	0.078
Sec_Pay	0.368	0.218	0.788	0.091	-0.037	0.023
APP_Brand	0.700	0.113	0.373	0.162	0.020	0.033
App_text	0.690	0.092	0.267	0.193	0.210	0.047
App_Aesth	0.744	0.234	0.327	0.108	0.030	0.054
App_Logo	0.779	0.127	0.193	0.169	0.172	0.118
App_Cont	0.783	0.236	0.299	0.132	0.066	0.087
App_Vid	0.689	0.183	0.292	0.128	0.160	0.119
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation.						

Table 4.17: *Varimax Rotation for the 28 items in the final survey. N=434*

Table 4.18 shows a comparison of the 28 items from the pilot and final studies were compared, identifying areas of difference between stages three and four of the data collection. Whilst the four fields deleted were identified as remaining in the pilot study (n=108), the final survey results (n=434), are noted in the literature as being more generalisable due to the increased sample size (Hair et al., 2010). Due to this, the results of from the final survey will be utilised to inform 24 items remaining and four items being deleted. Consulting the literature on post hoc testing using Cronbach's Alpha Coefficients the items being deleted is used to further support and justify this decision (Rust & Cooil, 1994).

Items	Pilot Study	Full Scale
Route	0.826	0.850
Exp_locat	0.812	0.801
Meas_Perf	0.81	0.823
Com_Perf	0.619	0.657
Train_Plan	0.734	0.544
Vir_Goal	0.67	0.521
Int_Cyc	0.66	0.684
Badge_Rew	0.751	0.735
Badge_Soc	0.746	0.827
Perf_Soc	739	0.788
Wor_Rule	0.69	0.728
Story_Cha	0.881	0.875
Story_Lea	0.849	0.863
Creat_Cyc	0.91	0.855
Desg_Cyc	0.928	0.890
Desg_Com	0.934	0.848
Dis_Vou	0.728	0.624
Check_out	0.883	0.883
Bar_code	0.753	0.526
Locat	0.734	0.507
Con_Pay	0.774	0.786
Sec_Pay	0.785	0.788
APP_Brand	0.862	0.700
App_text	0.707	0.690
App_Aesth	0.783	0.744
App_Logo	0.71	0.779
App_Cont	0.79	0.783
App_Vid	0.75	0.689
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation.		

Table 4.18: *Varimax Rotation comparison for pilot & final survey.*

The results of this Cronbach's Alpha Coefficient can be seen within Table 4.19, commencing with 0.941 for the items and after the deletion of items ending with 0.932 for 24 items, being well above 0.7 thresholds. In comparison to other studies Brown, O'Connor and Barkatsas (2009) developed the Cyclists Motivation Instrument (CMI) which resulted in α = .92 for four out of five subscales, however, the final factor of physical health has low internal consistency level, α = .63. In the final framework of the five functions of mobile apps α = 0.932, which is above Brown, O'Connor and Barkatsas (2009), and significantly all factors are well above the 0.7 thresholds.

Facto-r	**Initial Cronbach's Alpha**	**Item(s) Removed**	**Final Cronbach's Alpha**
1	0.941	None	0.941
2	0.941	Review & compare previous performance (e.g. segment data and leader boards)	0.939
3	0.939	Review cycling performance (e.g cadence & power)	0.938
4	0.938	Bar code scanners or QR codes	0.935
5	0.935	Convenient location sharing (e.g. check-in at retail store)	0.932

Table 4.19: Cronbach's Alpha following deletion of each of item.

Following the deletion of the four items and supported by the post hoc Cronbach's Alpha Coefficients the KMO and the Bartlett's test of Significance of the 24 items shows extremely strong support for this model. The Bartlett's test returned a statistic (Sig .000), demonstrating strong significance that the five functions of mobile significantly differ and the KMO statistic as a Measure of Sampling Adequacy (MSA) for the complete model was 0.904, a value interpreted as "superb" (Hair et al., 2010), for the value being between 0.9 and 1.0. This draws out and concludes a significant contribution of the study and presents for the first time an empirical testing of the five functions of mobile apps, having built on previous work by Zhao and Balugue (2015).

The final survey model includes five items in the factor of tool-centric, six game-centric, three social-centric, four m-commerce-centric and six design-centric – which is seen in Figure 4.2, below.

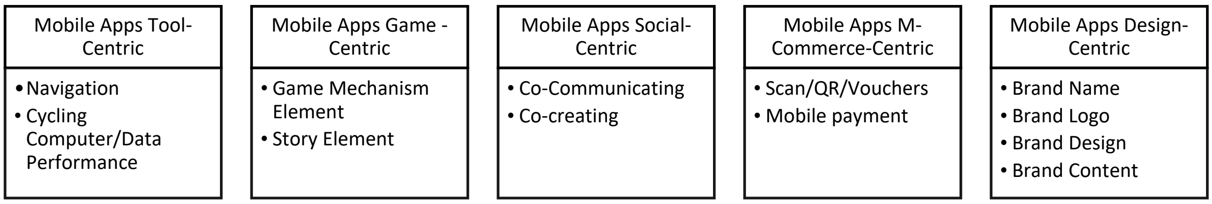


Figure 4.2: *Final framework of the five functions of mobile apps.*

Table 4.20 includes the final items for each of the five functions of mobile, along with Cronbach's Alpha and strength. For the first time, a framework for mobile apps usage in the context of cycling has been empirically tested, over the four stages of data collection and analysis. The four stages of data collection and analysis aid the validity of the findings. Due to the four stages of research, the findings of the study represent 'serious cyclists' (Mintel, 2022), in the UK. The multiple stages of data analysis ensure the final model of the five functions of the mobile apps is validated to the UK's serious cycling population. Thus, for the first time, the study will utilise the five functions of mobile apps as a way to cluster audiences of the UK ‘serious cyclists’ (Mintel, 2022) to generalise these findings into distinct clusters.

Table 4.20 draws out and concludes a significant contribution of the study and presents, for the first time, an empirical test of the five functions of mobile apps, having built on previous work by Zhao and Balugue (2015). This final model of the 24 items will be used when creating the next stage of the two-step cluster analysis in determining the best solution and types of segments of cyclists.

Function	**Item**	**Cronbach’s Alpha and Strength for the functions**
Tool-Centric	It helps me with the planning of cycling route(s)	Good: 0.8.
	It helps make suggestions on the best route of travel	
	It provides me with a method to measure the performance of my ride (distance/speed/average)	
	It helps me socially interact on performance with others through virtual reality worlds (e.g. Strava / Zwift)	
Game-Centric	It helps me to achieve rewards with badges, points, or leader boards	Outstanding: 0.9.
	It helps me when others like or comment on my badges (e.g. Kings or Queens of Mountains/Course Records/Local Legends)	
	It helps me when other users like or comment upon my performance	
	It helps when a mobile app transports me into a new world with its own rules	

	It helps me to be part of the story as a character	
	It helps me to the lead take in the story	
Social-Centric	I am able to share design and creative ideas of advertising with cycling companies	Outstanding: 0.9
	I am able to share new product design ideas with cycling companies	
	I am able to share new product design ideas with other cyclists/communities	
M-Commerce Centric	It helps me if I can use discount vouchers or coupons	Outstanding: 0.9
	It helps me if a mobile app has an easy checkout	
	It provides me with convenient methods of payment	
	It helps me if I can use secure payment methods	
Design-Centric	It helps to see a well-known brand name	Outstanding: 0.9
	It helps to review the short promotional text about the app	
	It helps if an aesthetically pleasing mobile application is provided	
	It helps to see a cycling logo that resonates with me	
	It helps to see a good range of content	
	It helps me when videos are included	

Table 4.20: *Final items for five functions of mobile apps.*

4.5 Two-Step Cluster Analysis

A two-step cluster analysis method was selected as it uses the distance measures to separate groups and then apply a probabilistic approach to choose the optimal subgroup model (Gelbard et al., 2007; Kent et al., 2014). In applying this method, the first stage is to decide the items to use to separate the groupings or segments for analysis. As a central observation of this thesis is to define cycling segments based on mobile apps, using the five functions of mobile apps was decided upon to meet the study's objectives.

Considering the various elements in the five functions of mobiles offered a structured way of considering all 24 items of the five functions of the mobile apps, following the EFA process outlined above. Here there was a particular strength in two items: 1) Badge of Honour (Q26.2: It helps me to achieve rewards with badges, points, or leader boards) and 2) World of Rules (Q26.4: It helps when a mobile app transports me into a new world with its own rules). The significance of these items was also demonstrated in stage one (review of 50 mobile apps) and stage two (pre-testing), and was in part attributed to the growth of two central apps in the cycling sector, Strava and Zwift (Business of Apps, 2022c).

Furthermore, the literature review (see Chapter Two) discovered the significance of mobile apps being investigated on a case-by-case based approach (Zhao & Balugue, 2015). Further justification of these two very items is offered by consulting the literature on game-centric functions, with Hofacker et al. (2016) including game mechanism and stressing the importance of "badging" (p.28). Hofacker et al. (2016) stipulates that badging provides visual identifiers, this transfers across to cyclists defining their Badge of Honour as the mobile apps of Strava. On consulting Hofacker et al. (2016) on story elements of game-centric functions, the study presented the importance of new immersive worlds of Augmented Reality (AR) and Virtual Reality (VR) having opportunities to track measurements such as heart rate and distance, which transfers to new AR worlds of mobile apps such as Zwift.

These items were identified in multiple data points recommending the two items, firstly it justifies such a robust approach of the method but secondly significantly aids the rigour, as the data collection empirically supported the use of these two items to distinguish the two-step cluster analysis. Whilst a two-step cluster solution ultises the two items, it results in one cluster (The Old-School Fanatic/Ultraconservative) that demonstrates no resonation with the Badge of Honour and World of Rules.

Reviewing stage one of data collection, the review of the 50 mobile apps stressed the tool-centric mobile apps, in particular, game mechanism, and secondly story element supported through the literature review (Hofacker et al. (2016). On closer inspection, the two mobile apps are at different ends of the spectrum with Zwift's virtual world of AR fitting with Zhao and Balugue's (2015) notion of a personalised user avatar, whereas, Strava aligns with Zhao and Balugue's (2015) premise of taking part in the game and sharing success with external social networks. Such a wide spectrum of differences is required in a two-step cluster to distinguish between the items (Bacher at al 2004; Gelberd et al., 2002; Kent at al 2014) and thus draws a conclusion that cyclist are significantly influenced by the mobile apps of Strava and Zwift. When transferring to the practical nature of mobile apps in the cycling market, both Strava and Zwift have revolutionised the marketplace in a short time frame (Business of Apps, 2022c). In the review of 50 mobile apps in stage one, Strava is seen as drawing on the game mechanism, for example leader boards, badges, and kudos, whereas Zwift used the story element via the gameplay via racing and community. This is also supported through the review which concludes the two apps of Strava and Zwift are designed as game-centric apps with high hedonic values (Zhao & Balugue 2015).

Exploring the commercial outputs of these apps shows significant annual turnovers; in 2021, Strava returned an annual income of $32.85 (million) and Zwift with $5.8 (million throughout the world (Business of Apps, 2022d). Both are monthly/annual subscription-based business models and thus require a high level of commitment, which is supported within the final data in which 73.39% (n=434) of respondents currently make monthly subscription payments for cycling-based apps. Such a high level of engagement within cycling apps such as Strava and Zwift would further aid the justification for using the items separately into distinct groupings.

The next stage was to undertake stages 2-5 of a two-step cluster, as outlined and justified in chapter 3.5.3, which is outlined in the bullet points below:

1. Using auto-clustering to define the best fit on the number of solutions considered based on the Log-likelihood distance measure and the Bayesian Information Criterion (BIC) (Burnham & Anderson, 2002)
2. Reviewing the cluster distribution to ensure the frequency of each cluster with the rule of thumb of the ratio being under 2:1 is good practice as defined by the Anderson-Rubin method (DiStefano, Zhu & Mindrila, 2009)
3. Ensuring attribute importance of each item/variable is as close to one as possible, so each item/variable is equal weight in the scoring of importance
4. Consulting with silhouette measure of cohesion and separation with a good cluster quality defined as 0.5 above (de Amorim & Hennig, 2015)
5. In order to validate, re-run the analyses with cluster solutions one and below the model of best fit, and use criteria from steps 2-5 to support the best cluster solution.

The remainder of this section will explore the application and results of the Four Cluster Analysis, illustrating how conclusions were drawn and resultant Four Cluster Model was developed.

4.5.1 Two-Step Cluster Solution – Four Cluster Solution

Auto-clustering using the Bayesian Information Criterion (BIC) (Burnham & Anderson,

2002) is often used within academic research to find the best number of cluster solutions. (DiStefano, Zhu & Mindrila, 2009). Exploring the findings of the 434 questionnaire responses the BIC yielded a cluster solution of four clusters when using the two items of Badge of Honour and World of Rules. This thesis will review a four-cluster solution first based on it presented as auto solution, however with silhouette scores of three, four and five cluster solutions all being 0.6 a deeper delve into all is presented, to justify the best solution.

Four clusters is considered to be the optimum number of clusters for this research, for the following reasons. Figure 4.3, presents a good silhouette of 0.6 (with 0.5 threshold abeing defined de Amorim & Hennig, 2015), for the four segments. Both items yielded a predictor of importance as: a Badge of Honour (0.88) and World of Rules (1.0), being comfortably in line within the benchmark norms of 0.5 (de Amorim & Hennig, 2015) and having an equal influence on the clusters.

Figure 4.3 shows that BIC allows for measurements of the efficiencies of the parameterised model in terms of predicting the data, which is independent of the items (Burnham & Anderson, 2002; Tkaczynski, 2017). Therefore, both items of predictors of the importance are broadly in line (Badge of Honour 0.88 and World of Rules 1.0) and further justifies these items as the discriminator. In addition, the attribute of importance for each item is required to be as close to one as possible (Rundle-Thiele, Kubacki, Tkaczynski & Parkinson, 2015), so each item is equal weight in the scoring of importance. This results in the best outcome when considering the items' predictors of importance in terms of the five functions of mobile apps; this is also supported by the academic literature review, stage one, and stage two of data collection.

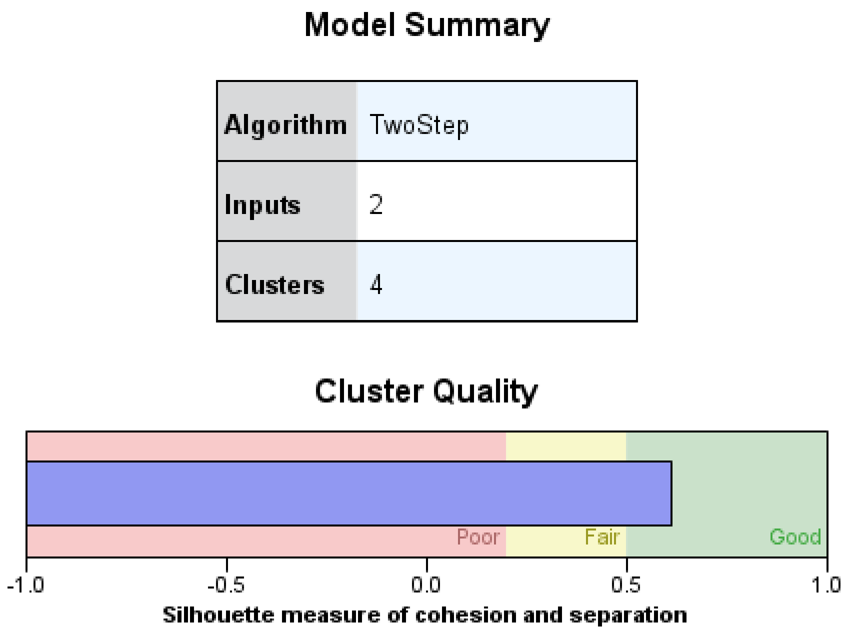
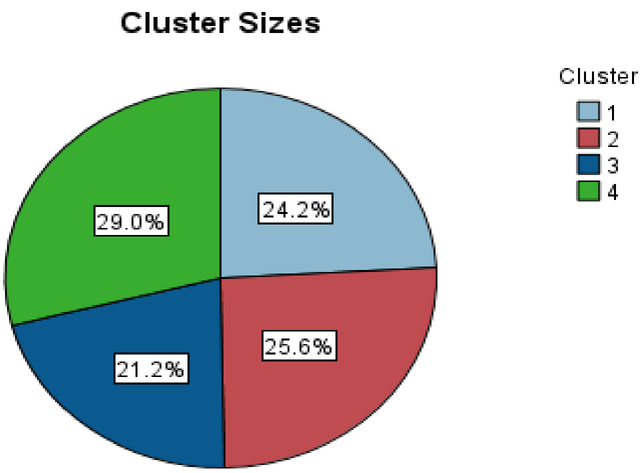


Figure 4.3: *Four Cluster Solution using BIC*

When applying a four-cluster solution, the cluster distribution is important to ensure the frequency of each cluster. The academic literature often concludes a rule of thumb of the ratio being under 2:1 is good practice as defined by the Anderson-Rubin method (DiStefano, Zhu & Mindrila, 2009). Applying the four cluster solutions, a ratio of smallest to the largest cluster being 1.37. This is illustrated within Figure 4.4 (overleaf) with cluster one at 24.2% (105), cluster two at 25.6% (111) cluster three at 21.2% (92), and cluster four at 29.0% (126). This results in cluster distribution having a ratio of 1.37:1 and is comfortably inside the benchmark by 0.63.



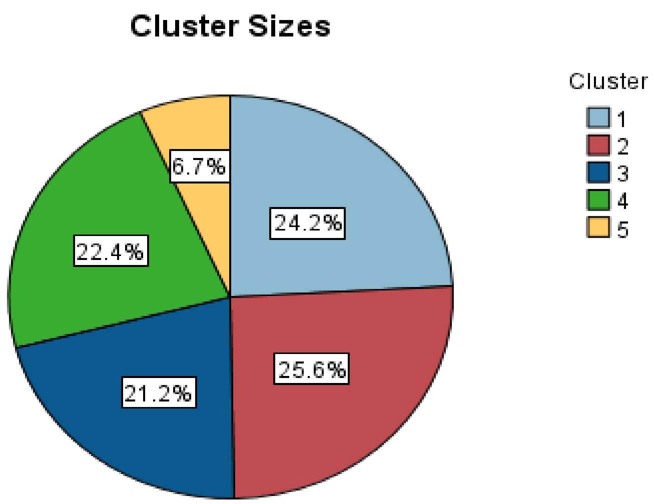
Size of Smallest Cluster	92 (21.2%)
Size of Largest Cluster	126 (29%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	1.37

Figure 4.4: Four cluster Ratio and Percentage split

Key conclusions drawn from the four-cluster solution show firstly a good range for the silhouette of 0.60 (de Amorim & Hennig, 2015), secondly the attribute importance of each item is as close to one as possible (Badge of Honour 0.88 and World of Rules 1.0) and finally, the cluster distribution of 1.37 is good (DiStefano, Zhu, & Mindrila, 2009). As an additional level of validation, this thesis re-runs the analyses with cluster solutions of one and below as is considered best practice (DiStefano, Zhu & Mindrila, 2009).

4.5.2 Comparing the Two-Step Cluster Solution Five Cluster Solution

Running a Two-Step Cluster Solution for five Clusters was used to compare and contrast against the four-cluster solution above. This showed that the BIC for the five-cluster solution yielded a silhouette of 0.60, which is exactly the same as the four-cluster solution and well above 0.5 thresholds (de Amorim & Hennig 2015). However, using the Anderson-Rubin method of the ratio and the rule of thumb under 2:1 (DiStefano, Zhu, & Mindrila, 2009) results in a five-cluster solution ratio of smallest to the largest cluster of 3.83, (see Figure 4.5) and suggests that the smallest cluster is too small to make a meaningful difference, leading to the conclusion that it is not the model of best fit.

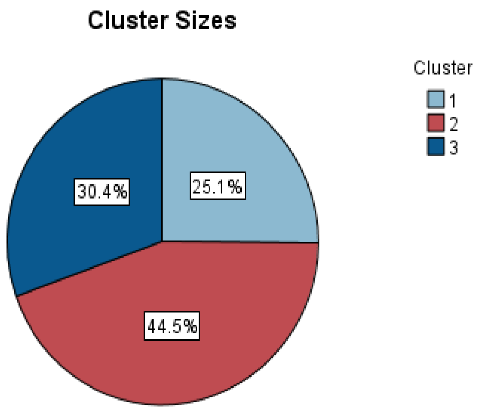


Size of Smallest Cluster	29 (6.7%)
Size of Largest Cluster	111 (25.6%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	3.83

Figure 4.5: *Five cluster Ratio and Percentage split*

4.5.4 Comparing the Two-Step Cluster Solution Three Cluster Solution

After ruling out a five-step solution, above, a three-cluster solution must be reviewed. A BIC three-cluster solution yielded a silhouette of 0.6, which results in all three solutions having the silhouette score. Using the Anderson-Rubin method of the ratio sees a ratio of 1.77:2, which is just within the benchmark of under 2:1 (DiStefano, Zhu & Mindrila, 2009). Closer inspection of the three clusters in terms of size shows no significant distinctiveness (McLeay, Yoganathan, Osburg, & Pandit 2018) (cluster one 25.1%, cluster two 44.5%, cluster three 30.4%). Therefore, cluster two is too large to represent a meaningful single segment as percentages of 35% are noted as being at the upper limits of providing unique differences in splitting audiences (Kaye & Johnson, 2011; Arimond & Elfessi 2001; McLeay et al., 2018).



Size of Smallest Cluster	109 (25.1%)
Size of Largest Cluster	193 (44.5%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	1.77

Figure 4.6: *Three cluster Ratio and Percentage split*

4.5.4 Additional justification for cluster solution of best fit

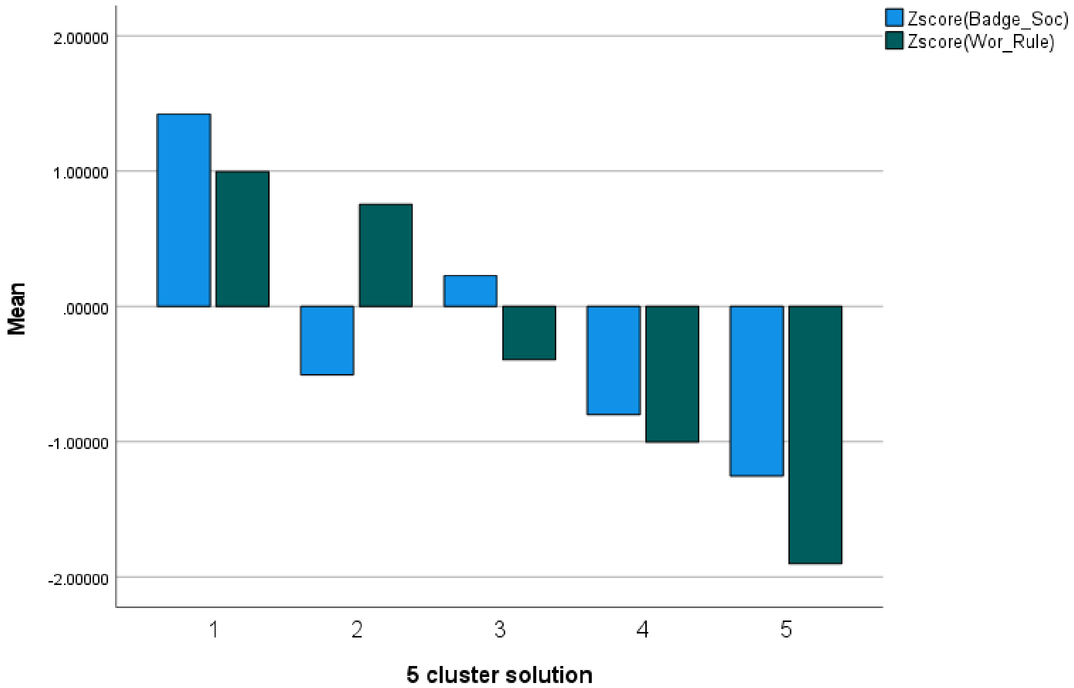
A summary comparison of the three, four and five cluster solutions is provided to explore and explain the rationale before moving on to conclude the rationale of the four-cluster solution the model of best fit. Whilst the silhouette for three, four, and five solutions were all measured at 0.60, (See Table 4.21) and could in theory be used within this study a further benchmark was taken using the Anderson-Rubin method (DiStefano, Zhu & Mindrila, 2009), to further justify a four-cluster solution using standardised scores (Field, 2013), supporting the decision of a four-cluster solution with a ratio 1.37:1.

Number of clusters	**Average silhouette scores**	**Ratio**
3	0.60	1.77
4	0.60	1.37
5	0.60	3.83

Table 4.21: *Cluster Solutions Silhouette Summary*

Using the Anderson-Rubin method demonstrated justification by drawing on similar studies, such as a review of segmentation within shopping for e-shopping (Allred, Smith, and Swinyard (2006), as the study investigated the digital behaviours of consumers it is relevant for this thesis. Allred, Smith, and Swinyard (2006) draws out key items for clustering and the importance of differences and adds further support to this study's approach of differences between Badge of Honour and World of Rules between three (Figure 4.8), four (Figure 4.9), and five (Figure 4.7), segments/clusters. The purpose of this method is to see if either of the solutions has meaningful differences when segmenting those audiences (McLeay et al., 2018).

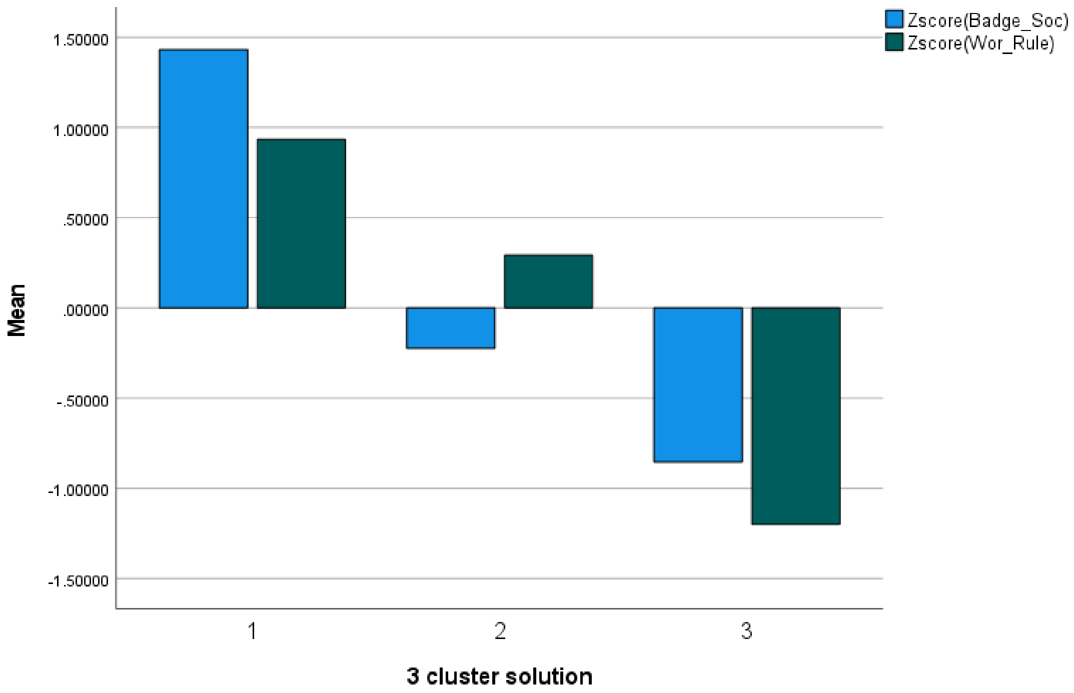
When consulting the five-cluster solution (see Figure 4.7) clusters two and three see very little differences between the two items leading to the conclusion that both these segments have similarities and overlap. This shows that a five-cluster solution has no distinct differences between cluster two and three presented in Figure 4.7. Clusters two and three have similar attitudes towards the Badge of Honour and World of Rules, resulting in this solution not being the best fit.



Abbreviation	
Zscore(Badge_Soc)	Item of Badge of Honour
Zscore(Wor_Rule)	Item of World of Rules

Figure 4.7 *Differences in Badge of Honour between five segments/clusters*

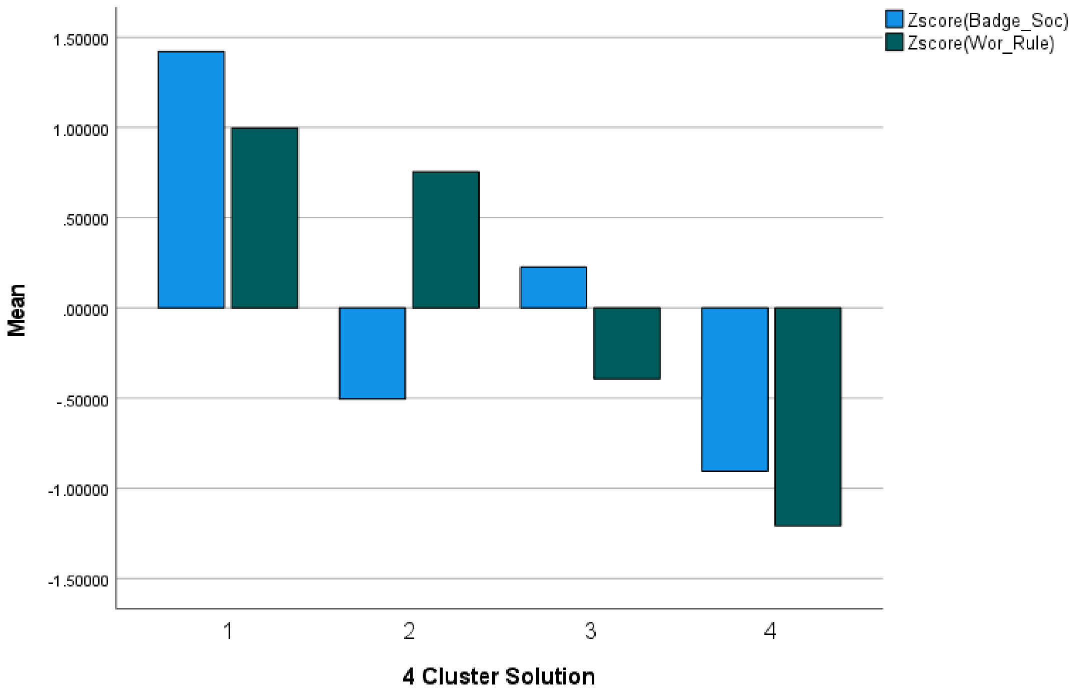
The three-cluster solution seen in Figure 4.8 sees cluster two being too large in size and also it combines the segment's views on mobile into a wide category, making for limited differences, as both Badges of Honour and World of Rules are close to zero. This further supports that the three-cluster solution is not the model of best fit.



Abbreviation	
Zscore(Badge_Soc)	Item of Badge of Honour
Zscore(Wor_Rule)	Item of World of Rules

Figure 4.8: *Differences in Badge of Honour and World of Rules between three segments/clusters*

Closer inspection of the four-cluster solution seen in Figure 4.9 allows the conclusion that four clusters provide a meaningful difference between two items. The split of four groups results in distinguishable differences in the connection with a Badge of Honour with mobile apps and transfer into a new virtual world via mobile apps. This further supports the use of the four-cluster solution as the model of best fit, as the four segments have meaning in the real-world context of cycling. This results in four evenly divided clusters, using the two items of Badge of Honour within mobile apps and transfer into a new virtual world via mobile apps. This is due to the distinguishable differences in the four segments which support the view on the four-cluster solution being the model of best fit.



Abbreviation	
Zscore(Badge_Soc)	Item of Badge of Honour
Zscore(Wor_Rule)	Item of World of Rules

Figure 4.9: *Differences in Badge of Honour and World of Rules between four segments/clusters*

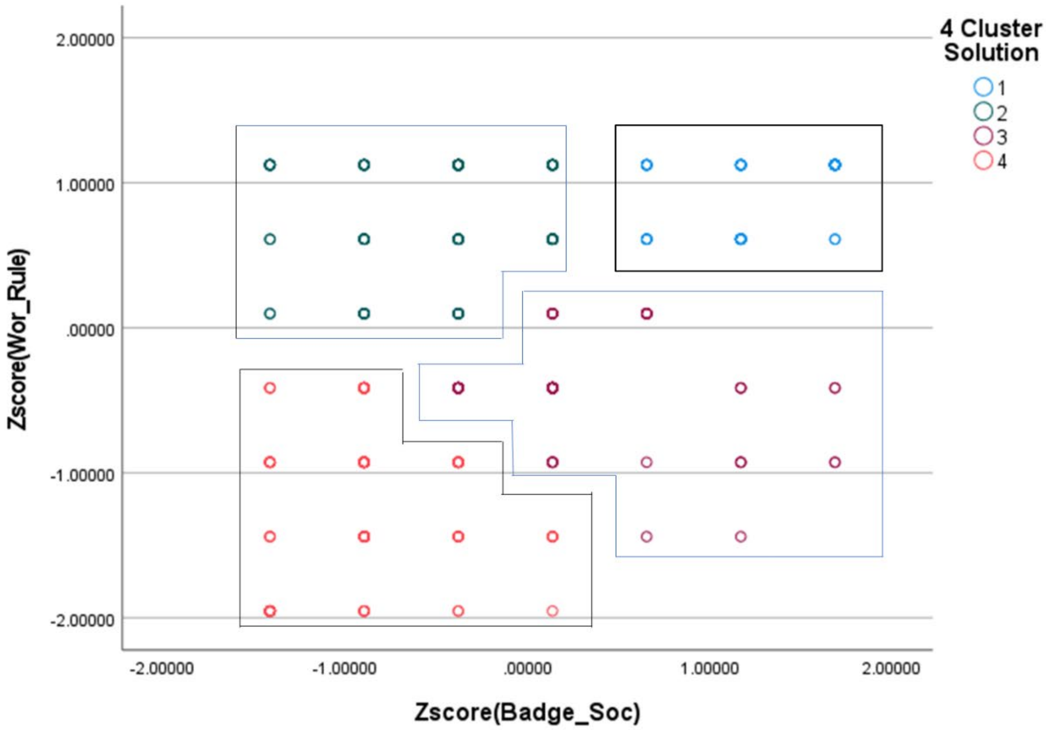


Figure 4.10: *Distribution of respondents across the four segments/clusters*

For the development of the four-cluster solution, consulting the centroids of means and standard deviation presented in Table 4.22 (Greenleaf, 1992). The means scores for the four-cluster solution, resulting in distinct groups based on the Badge of Honour with mobile apps and transfer into a new virtual world via mobile apps. The means scores ensure there are distinguishable differences between each of the segments/groups, which is seen in each of the groups' descriptions. In addition, the results in a standard deviation for each of the four clusters, close to the mean (low=0.434, high = 1.025). As the standard deviation is so close to the mean, it ensures the variation of dispersion from the set value of the mean is low. Likewise, with a low standard deviation, it shows the values are close to mean or expected value, aiding the robustness of each cluster (Greenleaf, 1992). Additionally, the distribution of respondents across the four clusters was consulted (McLeay et al., 2018) as evidence splits in distinct segments, on the Badge of Honour and World of Rules (seen in Figure 4.10)

Group	Size	Description	World of Rules Mean	World of Rules Std Dev	Badge of Honour Mean	Badge of Honour Std Dev
Cluster 1	n=105 24.2%	No/limited connection with a Badge of Honour with mobile apps and no/limited transfer into a new virtual world via mobile apps.	6.75	0.434	6.49	0.695
Cluster 2	n= 111 25.6%	A moderate Badge of Honour with mobile apps and No/limited transfer into a new virtual world via mobile apps.	6.28	0.788	2.76	0.956
Cluster 3	n=92 21.2%	A moderate Badge of Honour with mobile apps and moderate transfer into a new virtual world via mobile apps.	4.04	0.645	4.17	1.001
Cluster 4	n=126 29.0%	A very strong Badge of Honour with mobile apps and strong transfer then into a new virtual world via mobile apps.	2.45	1.025	1.98	0.780

Table 4.22: *Cluster centroids of means and standard deviation*

Footnote for table: Badge of Honour is the game mechanism element by Hofacker et al. (2016) “badging” (p.28) and is the visual identifiers due to cyclist defining their Badge of Honour as the mobile apps of Strava. *World of Rules* is the game mechanism element by Hofacker et al. (2016), new immersing worlds of AR and VR with gamification such as Zwift.

4.5.5 Two-Step Cluster Model of Best-Fit Conclusion

The two-step cluster analysis using the BIC, led to the conclusion that the four-cluster solution is the best-fit model based on a silhouette of 0.60, a ratio of 1.37:2, meaningful differences with each cluster, and the means and standard deviation. Finally, to overcome any subjective nature of cluster analysis, an expert in the field of two-step clusters in the field of marketing was sought to validate the process and model of best fit, which is considered best practice (Tkaczynski, 2017).

The results of the two-step cluster analysis were presented in advance of the online meeting, the meeting was 90 minutes in length and focused on the process adopted for two-step cluster and the resultant model for cluster solutions. The expert provided the following comment:

> “The 4-cluster solution offers a more interpretable result (judging by the bar charts in figures 4.3 to 4.11), whilst retaining the variability between user groups based on the cluster criteria entered into the model. Finally, the 4-cluster model’s average Silhouette score is excellent (comfortably > 0.5) – this is a measure of how well clusters separate, so the distinctiveness of each of the clusters resulting from this solution is also very reliably established.”

The additional layer of the expert further supports the notion of four-cluster solutions on the items of Badge of Honour with mobile apps and a new virtual world via mobile apps.

The multiple stages are used to validate the best cluster solution through statistical measures of silhouette scores, ratios, meaningful differences of means and standard deviations. Alongside the validation of an academic expert (published in world-renowned 4* journals on cluster analysis), they ensure the creditability and thus the generalisability of the findings is further aided. The multiple stages of validation for the best cluster solution result in four clusters that represent the UK’s ‘serious cyclists’ (Mintel, 2022).

This ensures each cluster presents findings that are generalised across the ‘serious cyclists’ (Mintel, 2022) within the UK.

Moving forward, the remainder of the chapter will turn to analyse each of the further clusters and go on to summarise the findings.

4.6 Presenting Each Cluster

Completing EFA resulted in the adoption of final variables to be included within five functions of mobile apps for cycling, (see part 4.4 of this chapter). This resulted in a two-step cluster analysis concluding the model of best fit to be a four-cluster solution which is presented in Figure 4.5. The remainder of this section will present the initial findings of the two-step cluster using the items of Badge of Honour with mobile apps and a new virtual world via mobile apps by building up a picture of the four clusters (Brickey, Walczak & Burgess, 2010).

For each of the items within the depiction of the four clusters (Brickey, Walczak & Burgess, 2010), the mean scores are presented (see Table 4.23). The mean is used with items with multiple questions and combines the average for each question into average item and is considered a suitable statistical method to overlay for clusters (Punj & Stewart, 1983). Mean averages are based on an analysis of Likert-based questions, in most cases using a 7-point scale. The mean average was utilised to identify any patterns for each of the items within the survey including: cycling involvement, purchasing habits, motivations for cycling, mobile phone usage, mobile shopping, functions of mobile apps in cycling, and demographics as illustrated in Tables 4.9 to 4.14. These patterns were determined as the item with the lowest mean for each factor.

Group	Size	Description	Persona Name	Wor Rule Mean	Badge Soc Std Dev
Cluster 1	n=105 24.2%	No/limited connection with a Badge of Honour with mobile apps and no/limited transfer into a new virtual world via mobile apps.	The Old-School Fanatic / Ultraconservative	6.75	6.49
Cluster 2	n= 111 25.6%	A moderate Badge of Honour with mobile apps and No/limited transfer into a new virtual world via mobile apps.	Technology Movers	6.28	2.76
Cluster 3	n=92 21.2%	A moderate Badge of Honour with mobile apps and moderate transfer into a new virtual world via mobile apps.	Mobile Savvy	4.04	4.17
Cluster 4	n=126 29.0%	A very strong Badge of Honour with mobile apps and strong transfer then into a new virtual world via mobile apps.	Fully Immersed	2.45	1.98

Table 4.23: *Summary Table of Four Cluster for Cycling using Badge of Honour and Virtual World*

Taking the insights further, the next stage of the two-step cluster solution was to overlay all the items for cycling involvement, purchasing habits, motivations for cycling, mobile phone usage, mobile shopping, functions of mobile apps in cycling, and finally demographics. The in-depth table was significant in developing an overview (and a more in-depth description (see Appendix 5) of each of the groups.

The four-cluster solution resulted in the creation of four segments:

- Group 1 (24.2%). The old-school fanatic/Ultraconservative
- Group 2 (25.6%) – Technology Movers
- Group 3 (21.2%) - Mobile Savvy
- Group Four (29.0%) – Fully Immersed

Each cluster was analysed in great depth (see Appendix 5), allowing for an immersed approach in order to further understand each of the segments (Jenkins & McDonald 1997). The detail of each of the segments is noted as a particular strength of the research, however, it is acknowledged that the level of detail is difficult to transfer into meaningful insight to inform management implications (Adlin & Pruitt 2010).

After conducting this detailed description of each of the clusters, the approach of Adlin & Pruitt (2010) was used to develop the unique characters of each of the segments and generated the highlights of each of the segments. The highlights of each of the segments are presented in Figure 4.11 as profile overviews, which are more meaningful takeaways for management implications (Adlin & Pruitt, 2010).

Cluster One **The Old-school Fanatic / Ultraconservative**

- Longest-serving cyclists mean of 25.1 years, demonstrating a long commitment.
- Prefer to cycle outdoors. The primary bike is a road but open to diversity in the form of bike
- Least likely to own a GPS device and often do not see value in having a cycling subscription.
- The routine of cycling linked to their intrinsic motivations. This is primary being about maintainin control and being competent as a cyclist (amotivated regulation) and a secondary focused on interest and enjoyment of cycling (intrinsic regulation)
- Mobile applications do not connect with them as means of shopping, but easy of check-out, coinvent, and secure payment does matter.
- They use cycling mobile apps for utility purposes such as planning routes, measuring performance, or comparing previous rides.
- The primary use of mobile apps for cycling is tool-centric mobile (mean 3.31) -functionality.
- Gamification and co-creation do not connect.

Cluster Two Technology Movers

- Second longest-serving cyclist mean of 18.42 years
- See cycling as an important part of their life, and this results in them organising elements of life around cycling (mean of 2.16) and recognising themselves as a cyclist (mean 2.48).
- Prefer to cycle outdoors for recreation. The primary bike being road and other bike choices are influenced by this focus to aid training and performance.
- They buy cycling products through online websites (mean of 2.60) via online big chains (mean of 2.23) however they are likely to use independent bike shops in person (3.41)
- Using mobile apps in daily life and seeing value in them, they have also bought into cycling subscriptions typically via Strava.
- They are already comfortable using mobile applications in daily life and their mobile commerce fits into a primary utilitarian and utilitarian, secondly they are developing towards a monetary experience and social facilitation
- The primary motivation for cycling is a strong connection with amotivated regulation and instructive regulation and being interested in and enjoyment of cycling.
- They use cycling mobile apps as a strong relationship with tool-centric (mean 2.3) and m-commerce (mean 2.85) and moderate connection design-centric (mean 3.35) and game-centric (mean 4.59).

Cluster Three Mobile Savvy

- Highest number of bikes ownership with a mean of 4 bikes (23.9%)
- Primary bike ownership is road bikes (mean of 1.52), only two types of bikes ownership - hybrid (mean 2.96) and full suspension (mean 2.59)
- Most likely to cycle for commuting purposes, with 17.4% commuting by bike weekly.
- Strong amount of cycling indoors on weekly basis (79.3%).
- GPS for bike ownership in line with other segment's at 79.3%, but highest use of GPS through other means with watches at 44.5% and mobile phones at 39.1% for cycling purposes.
- Second highest use of cycling -subscriptions, with 73.9% currently making monthly payments.Attracted to cycling subscriptions typical through badges of honors such as Strava and virtual worlds such as Zwift.
- Second highest number of apps used on daily basis between 6-10 (mean 1.97) and this strong use transfers into cycling with 90% using mobile apps daily or weekly.
- Motivations for cycling are particularly aligned with intrinsic regulation and the enjoyment of cycling, supported by closely introjected regulation the feelings of guilt.
- Highly engaged in mobile shopping through mobile apps and have different motivations for shopping depending on the context. A primary motivation for using is time filler, closely followed by secondary utilitarian and by monetary experience and social facilitation
- High engagement on mobile apps transfers into the cycling world, across all functions. High usage of tool-centric functions for navigation, measuring performance, and social interactions.
- The audience shows some interest in gamification through mobile apps.
- A small cluster of this segment wants to engage in co-creation.
- A mature use of mobile commerce when it comes to cycling purchases.
- All elements of design-centric mobile apps are equally weighted in terms of influence with show confidence in using mobile commerce

Cluster Four **Fully Immersed**

- Cycling is a central element of life, despite being the shortest in terms of number of years 16.79 years involved in cycling skills and experiences
- Likely to own one bike, which is likely to be a road bike (mean 1.48)
- Most engaged in taking part in events with 61.9% have taken part in event cycling events in the last year.
- Least comfortable with basic cycling skills and experiences, owning to virtual experience, and least time cycling.
- Product research on cycling is influenced by websites (mean of 2.25) and cycling magazines (mean of 3.81). With equal weighting of the brand (mean of 2.59), the performance of the product (mean of 1.62), and price (mean of 2.03).
- High level of involvement when making cycling purchases, highest average spend per month with most frequent of £24-£49 with 28.6%. With strongest relationship towards online through big chains and then offline independent cycling stores.
- Combining both indoors and outdoors cycling. Outdoors recreational, with the most frequent distant being 75- 99 miles (29.4%). They are significantly more likely than other groups to cycle indoors most frequently stating between 2 hours - under 3 hours (23.%).
- The outdoor cycling links to the badge of honor through the high use of apps such as Strava, were as the indoors links to virtual worlds and high use of apps such as Zwift.
- Most likely to use GPS devices to measure rides, with 85.7% stating they use such devices.
- High engagement with cycling subscriptions, 86.5% currently making monthly payments.
- Strongest motivated segment, a strong correlation with intrinsic regulation. Secondary motivations split between introjected regulation and identified regulation, show diversity towards the motivation of cycling.
- Highest number of apps downloaded on mobile phones and daily usage. They also use the widest array (from music to video) of mobile apps for regular use.
- This daily use of apps is important when it comes to cycling apps, with 58.7% using cycling apps daily.
- Most likely group to engage in mobile shopping via mobile applications, with a high number of motivations for engaging from social facilitation, time filler, utilitarian to monetary experience.
- Highest levels of engaged in cycling apps across the board for all five functions of mobile apps.
- Extremely high usage of tool-centric elements, across the three areas of navigation, measuring performance, and social interactions.
- Most engaged in the social element of mobile apps. Rewards, leader boards, and badges of honor along with kudos and comments on their performance resonate showing the importance of the game mechanism.
- Most likely to engage in co-creation with cycling brands through mobile apps, it's only a very small part of the segment who wish to partake.
- Influenced by mobile commerce when it comes to cycling-based applications, it's just expected that it's easy, convenient and easy and secure to pay, and effective to process.
- So used to mobile apps, they expect all element of design-centric to be consistent.

Figure 4.11: *Overview of Four Profiles for the four segments.*

4.7 Analysis and Interpretation of the Clusters

This section presents analysis and interpretations of the cluster, discussed through data visualisation. Data visualisation is defined as the visual presentation of data often in graphs and charts (Kirk, 2016). It is often noted that digital visualisation offers distinct benefits when presenting complex data information, the JISC (2013) positioned these as answering questions, posing new questions, exploring, and discovering, communicating information, supporting decisions, increasing efficiency, and inspiring. The academic support for data visualisation has seen significant growth within recent years (Lowe & Matthee, 2020) with further justification for presenting the analyse and findings through data visualisation offered when conducting a Google scholar search in October 2022, with 700,000 papers presenting findings in such a way.

Consulting the academic research shows data visualisation is often seen as telling a story to through data which makes for the narrative to be more accessible (Kirk, 2016; Kennedy & Allen, 2016). If the purpose is to make research more accessible, along with more impactful, then using audiences to review the data visualisation outputs to assess their interpretation and understanding is often noted as good practice (McIntosh et al., 2011; Robertson & Simonsen, 2012). With this in mind, this thesis will share the data visualisation outcomes of the study with a local cycling company, to assess both accessibility and impact.

The first part of this analysis and interpretations of the findings will use data digital visualisation to compare and contrast the four segments on level of cycling involvement, cycling indoors and outdoors, average spend, and cycling skills. The second part will then take each of the four segments individually and build up their motivation for cycling, mobile shopping and cycling mobile apps. Presenting this way allows for a comparison of the overarching level of involvement in cycling (as this is acknowledged as not a suitable way to segment) before developing the understanding of each cluster in terms of their attitudes and beliefs.

4.7.1 Part One – Compare and Contrast the Four Segments on Cycling

This section aims to demonstrate that each of the four clusters is indeed distinct from the others across various dimensions before presenting a detailed discussion of each cluster. Figure 4.12 shows the two key items used to divide the segments, the Badge of Honour (apps such as Strava) compared to the World of Rules (apps such as Zwift). The results are in four distinct segments:

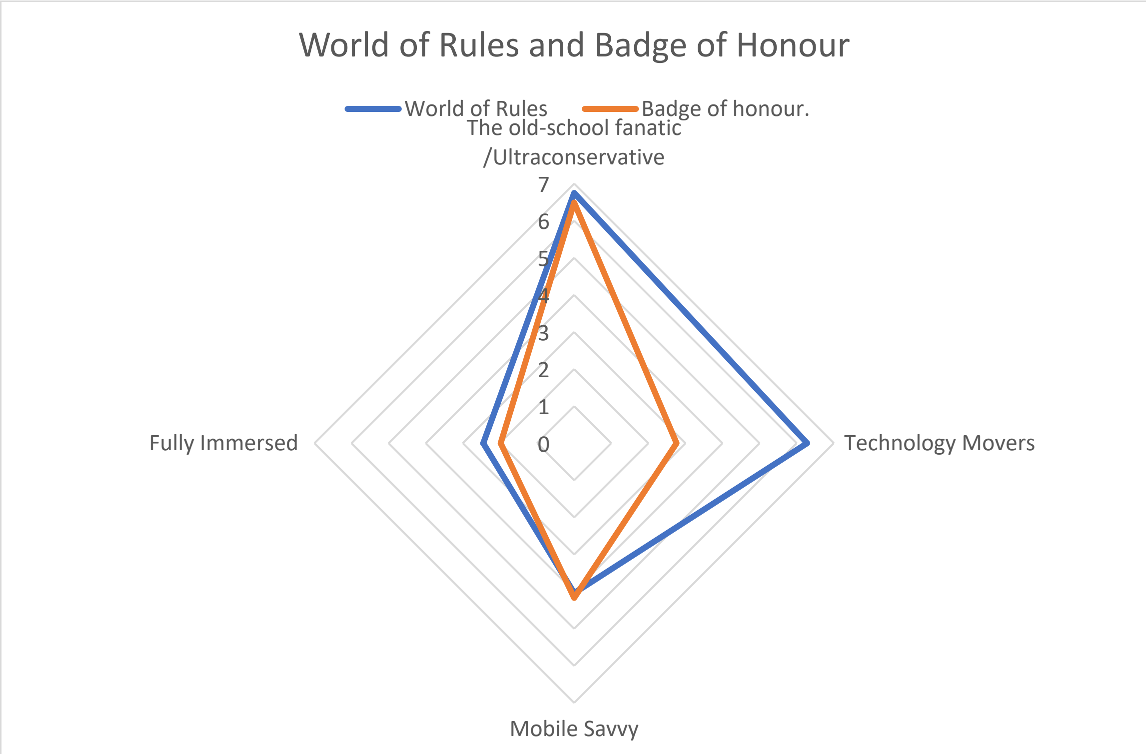


Figure 4.12: *World of Rules and Badge of Honour for the four segments.*

- **The Old-School Fanatic/Ultraconservative** (24.2%) – A limited interest in both Badge of Honour (apps such as Strava) and World of Rules (apps such as Zwift).
- **Technology Movers** (25.6%) – A moderate interest in Badge of Honour (apps such as Strava), contrasted with a limited interest in the World of Rules (apps such as Zwift).
- **Mobile Savvy** (21.2%) – A moderate interest in both Badge of Honour (apps such as Strava) and World of Rules (apps such as Zwift).

- **Fully Immersed** (29.0%) – A very strong interest in both Badge of Honour (apps such as Strava) and World of Rules (apps such as Zwift).

Exploring these segments further shows the level of involvement in cycling across the four groups differs (cycling involvement means of 1.28 through to 1.44 for the four segments), however, there are patterns that emerge which are seen in Table 4.25. The Fully Immersed are the most engaged segment across the four questions (cycling importance 1.28, cycling enjoyment 1.37 cycling commitment 2.05, cycling recognition 2.17), however they have the shortest length of time being a cyclist of 16.79 years. When compared to the Old-School Fanatic/Ultraconservative they have been cycling significantly longer than any other segment 25.1 years but are the least engaged across the four questions (cycling importance 1.44, cycling enjoyment 1.55, cycling commitment 2.38, cycling recognition 3.09). Both the Technology Movers (average mean 1.85) and Mobile Savvy (average mean 2.00) are broadly in line when considering the cycling involvement over the four questions and length of time cycling, and a similar number of years as cyclist technology movers 18.42 years against mobile savvy of 18.25 years.

Cluster Name	**The old-school fanatic /Ultraconservative**	**Technology Movers**	**Mobile Savvy**	**Fully Immersed**
Cycling Importance	1.44 (112.5%)	1.36 (106.25%)	1.38 (107.81%)	1.28 (100%)
Cycling Enjoyment	1.55 (113.14%)	1.38 (100.73%)	1.42 (106.65%)	1.37 (100%)
Cycling Commitment	2.38 (116.10%)	2.16 (105.37%)	2.38 (116.10%)	2.05 (100%)
Cycling Recognition	3.09(142.40%)	2.48 (114.29%)	2.82 (129.95%)	2.17 (100%)
Years Cycling (Years)	25.1	18.42	18.25	16.79

Table 4.25: *Raw Data of Cycling Involvement for the four segments.*

The level of skills for cycling across all four segments is high (See Figure 4.13), however, there is a relationship with the number of years as a cyclist. The segment with the lowest means across the three questions is Old-School Fanatic/Ultraconservative (average mean 1.65), who have been cycling the longest time (25.1years). The segment of Fully Immersed have been cycling the shortest length of time at 16.79 years, which results in them having the highest average mean for cycling skills of 1.79. This notion of length of time is also supported by the Technology Movers being second highest on cycling skills with a mean of 1.72 and the second length of time of 18.42 years. The Mobile Savvy segment is third on both length of time (18.25 years) and third on the average mean of cycling skill with 1.77. Seeing the level of skill of cycling related to the level of experience in terms of time is unsurprising as the time in the saddle develops comfort with the level of skills.

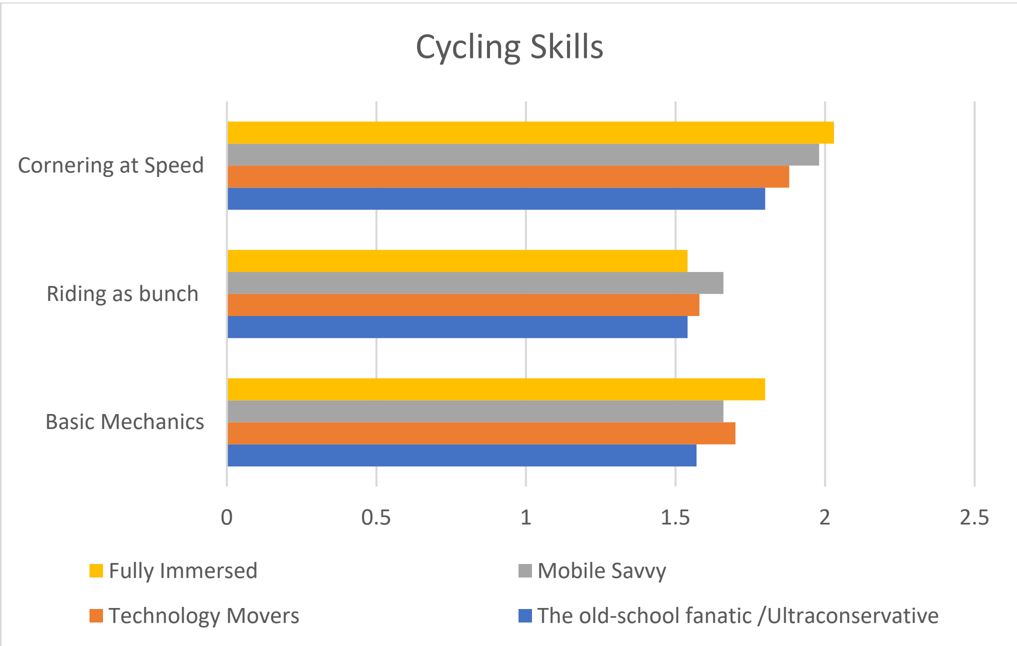


Figure 4.13: *Cycling Skills for the four segments.*
Note: Likert, based questions, with one being strongly agree and 7 being strongly disagree

The average spend across the four segments sees the Old-School Fanatic/Ultraconservative spend the least per month, with 24.8% spending in the range of £0-£24. The remaining three segments' spending average is £25-£49 per month, with the Fully Immersed having the highest percentage at 28.6% and Technology Movers and Mobile Savvy both being 26.1% (see Figure 4.14)

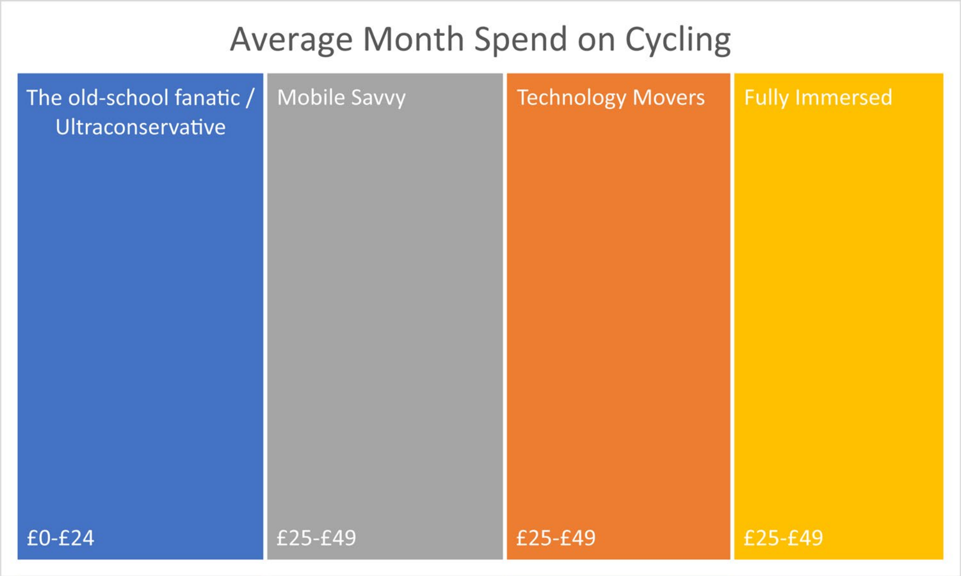


Figure 4.14: Modal of *Monthly average spend for the four clusters*

The significance of online channels is particularly important for all four segments (See Figure 4.15). In particular, all four segments are likely to make cycling purchases from online chain retailers as the first choice (means range from 2.09-2.45). However, in contrast, in all four segments the second channel of preference for purchase is offline independent retailers with a range of 3.33 to 3.60. This shows the significance of the small independent physical cycling retailer to all segments.

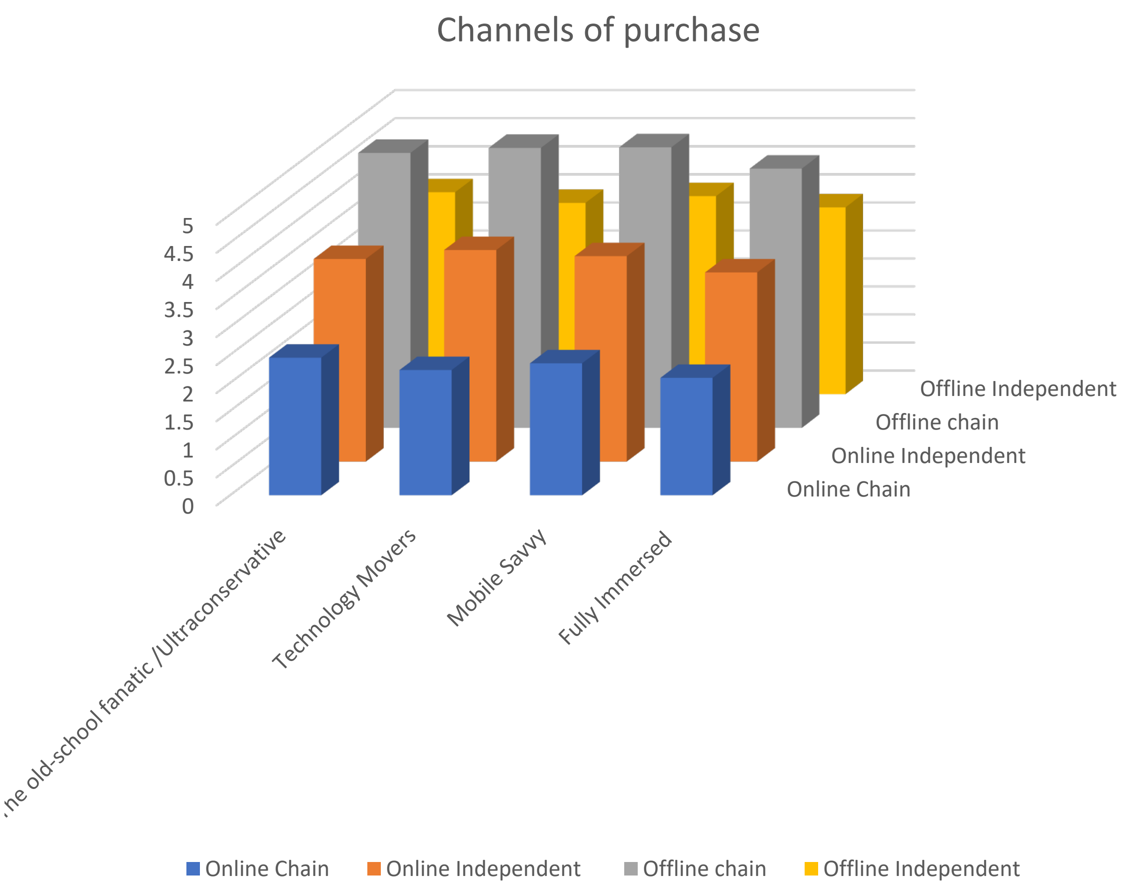


Figure 4.15: *Preferred channels of purchase for the four clusters*

The Fully Immersed has the strongest relationship with all channels of purchase, supporting them being the highest monthly spends. The Old-School Fanatic/Ultraconservative has the weakest connection with channels of online retailers and online independents, supporting their monthly spending being the least of any segment (see figure 4.15).

There is a correlation between the involvement in cycling technology along with cycling subscriptions and the propensity towards a segment's use of mobile apps (see Figure 4.16). When consulting with each of the four segments their likelihood of engaging in cycling technology and cycling subscriptions is directly correlated with their attitudes towards Badge of Honour (e.g. Strava) and Rule of Worlds (e.g. Zwift), which were the items used to distinguish the four clusters.

Old-School Fanatics/Ultraconservatives are least likely to engage in the use of mobile phones when cycling (0%), GPS while cycling (71.4%) and cycling subscriptions (46.7%) whilst also the least likely to engage in the mobile apps of Badge of Honour (mean 6.49) and rule of worlds (mean 6.75). This is in sharp contrast to the fully immersed, as they are most likely to use GPS while cycling (85.70%) along with a significant proportion of 86.50% having a cycling subscription. This transfers across to them also being the most likely segment to engage in the cycling mobile apps of Badge of Honour (mean 1.98) and Rule of Worlds (mean 2.45).

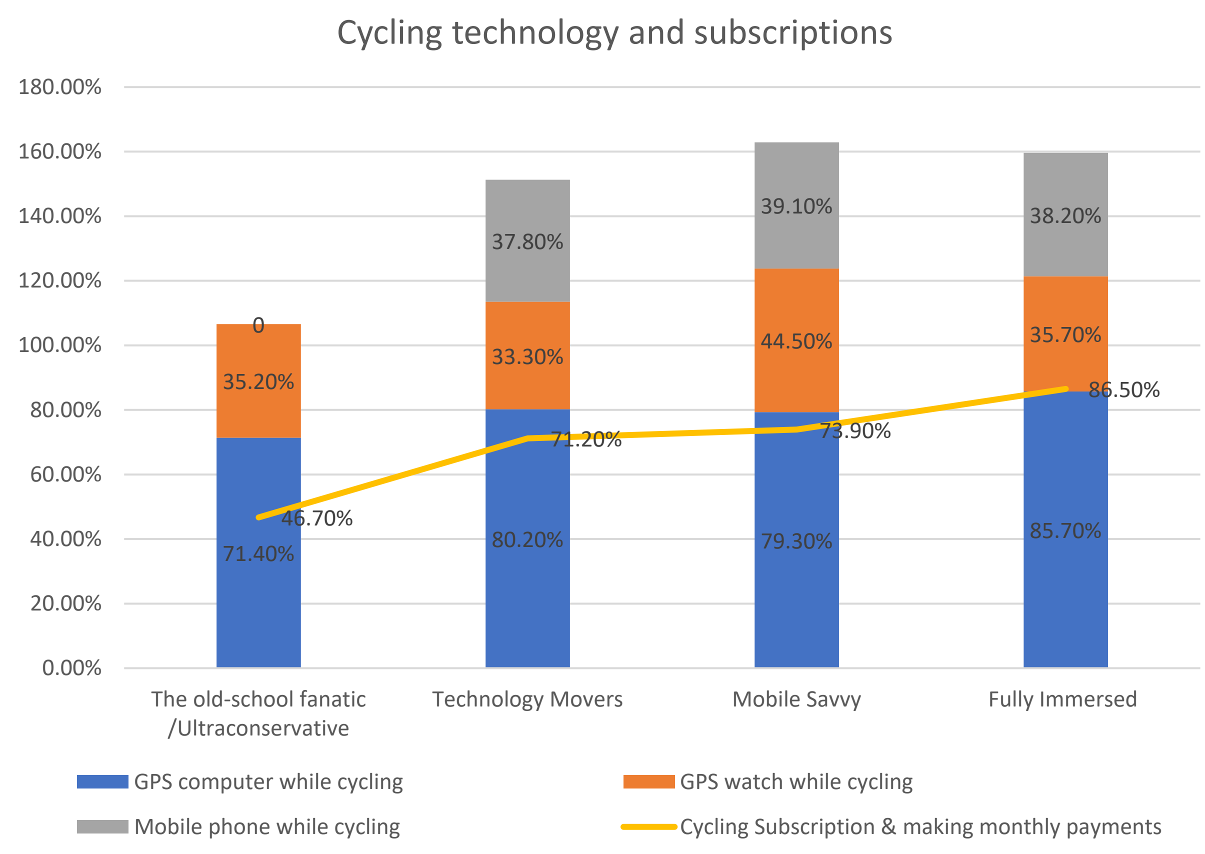


Figure 4.16: *Cycling technology and subscriptions for the four segments.*

The same correlation exists with the Mobile-Savvy, who are the most likely segment to use both a mobile phone while cycling (39.10%) and a GPS watch while cycling (44.50%), and also the second highest segment when it comes to cycling subscriptions with 73.90%. When exploring their attitudes towards cycling mobile apps this transfer of attitudes is seen with Badge of Honour (mean 4.17) and Rule of Worlds (mean 4.04). The Technology Movers again have high adoption of cycling subscriptions (71.20%) and usage of GPS devices while cycling with 80.20%. This high adoption is transfered across their attitudes towards the mobile cycling apps with a strong use of Badge of Honour (mean 2.76) which is attributed to their high use of monthly subscription apps such as Strava.

The conclusion drawn is that the propensity of each segment's use of mobile apps through their attitudes to Badge of Honour (e.g. Strava) and Rule of Worlds (e.g. Zwift) is influencing their likelihood to engage in technology they adopt whilst cycling. Those segments paying monthly subscriptions such as Strava and Zwift increase their adoption of GPS devices while cycling, GPS watches while cycling and mobile phones while cycling. It is interesting to note that increased adoption of technology such as devices enhance experiences of mobile apps such as Strava and Zwift.

4.7.2 Part Two – Data Visualisation for Each Cluster

The focus of this chapter will now turn to the use of data visualisation to further define each of the four clusters, using data visualisation, for type of cycling, motivations for cycling, mobile shopping and finally the five functions of mobile apps for cycling. In using data visualisation to explore each of the segments, the approach of Kirk (2016) was adopted in that data visualisation is noted for providing a method of storytelling in order to make it more accessible for the end audience.

4.7.3 Part Two – Data Visualisation for Old-School Fanatic /Ultraconservative

Old-Schoold Fanatic/Ultraconservatives are least likely of any segment to cycle when consulting overall distance, with a mode of 50-74 (27.6%), as shown in Figure 4.17. However, when it comes to the rationale for riding, motivation likely to be recreational, with the most frequent distance being 75- 99 miles (24.8%). This group is least likely to cycle with 31.4% never cycling indoors. This die-hard attitude is linked to their routine of being known as cyclists, attributed to their length of time of being cyclists, along with their primary intrinsic motivations of amotivated regulation (maintaining control and being competent as a cyclist).

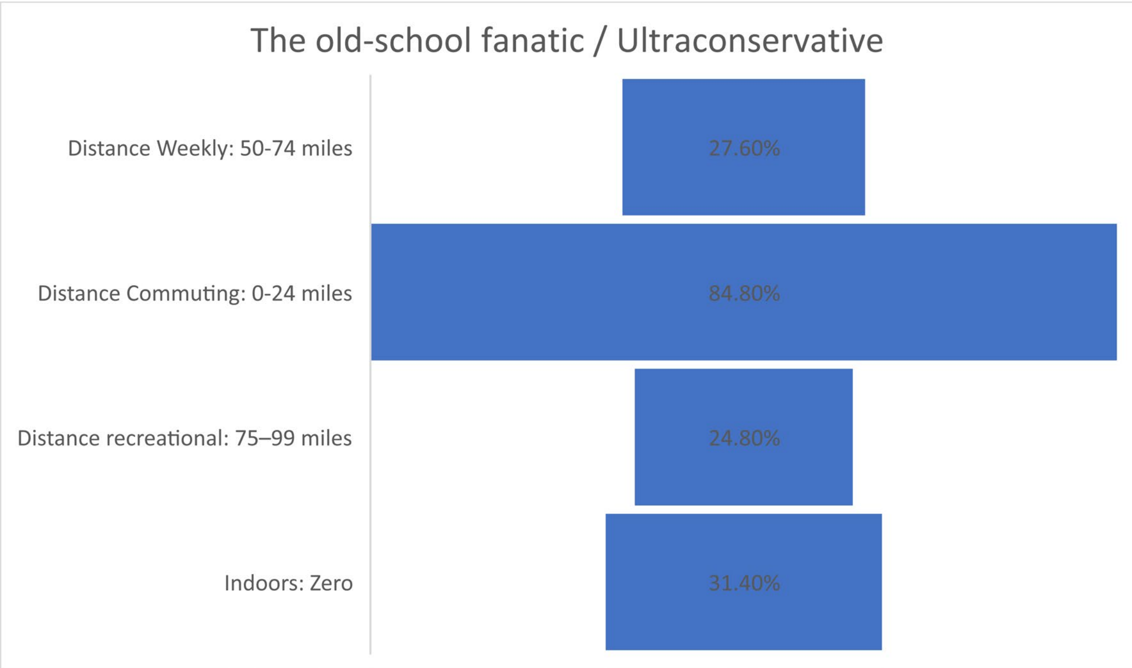


Figure 4.17 *Cycling type for old-school fanatic / ultraconservative*

Note: Four separate questions presented above. Modal data is presented for each question, as a percentage.

Figure 4.18 shows the motivations of cycling on the self-determined theory (Pelletier et al., 1995), with averages provided for each of the five functions. The Old-School Fanatic/Ultraconservative has a very strong primary intrinsic motivation with the focus being about maintaining control and being competent as a cyclist (amotivated regulation mean of 1.44) and secondary less strong motivation being focused on interest and enjoyment of cycling (intrinsic regulation mean of 3.72). This is supported by the Old-School Fanatic/Ultraconservative, who demonstrate the least likely motivation for external regulation (mean of 5.76) which is often linked to external motivation of rewards and punishments of being a cyclist.

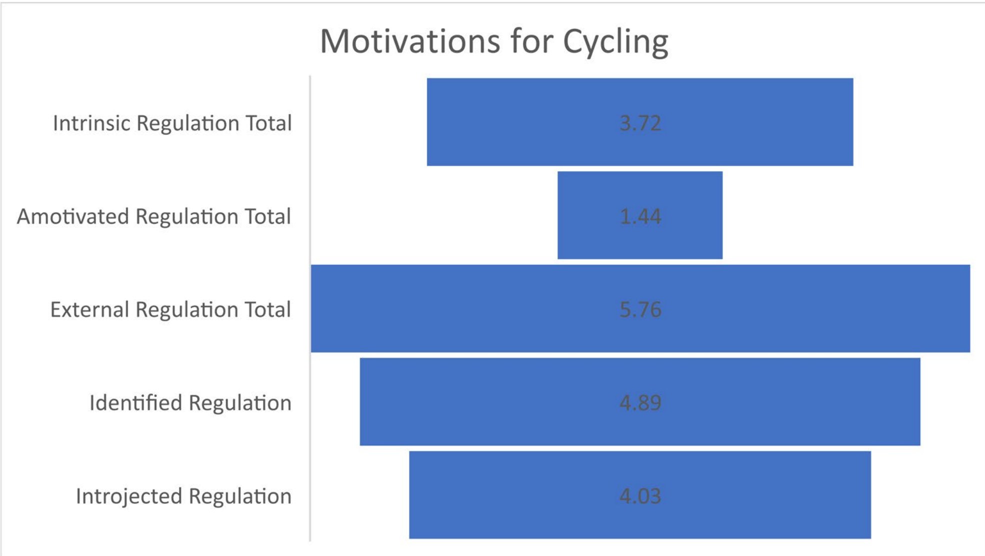


Figure 4.18: *Motivations for cycling for the Old-School Fanatic / Ultraconservative*

The above figure draws the conclusion that the Old-School Fanatic/Ultraconservative segment is not motivated by rewards and Badges of Honour such as Strava, or World of Rules through gamification such as Zwift. Instead, people in this segment are motivated by the primary focus of maintaining control and being a competent cyclist. As such their use of mobile apps is more focused on functional tools such as planning and social interaction with other cyclists, along with their monthly subscription for cycling being significantly lower, which stems from the reasoning and motivations for cycling.

Figure 4.19 uses the model of mobile app shopping (Thakur, 2016), to illustrate behaviours of the Old-School Fanatic/Ultraconservative. This segment is the least likely group to engage in shopping via mobile applications. Their primary motivation for using mobile apps for shopping is utilitarian (mean 3.34) and the secondary motivation for using mobile applications for shopping is as a time filler (mean 4.06). However, this segment obtains no intrinsic enjoyment from mobile shopping on applications. Intrinsic enjoyment does not resonate with this audience with means of 5.88.

Figure 4.19: *Mobile App Shopping for the Old-School Fanatic/Ultraconservative*

As such Figure 4.19 points to the conclusion the Old-School Fanatic/Ultraconservative is functional in the use of mobile apps for shopping, due to them being the least likely segment to engage and their primary motivation being utilitarian (means 3.34). This is further supported by intrinsic enjoyment of mobile app shopping not resonating with this audience at all (mean 5.88).

The level of involvement for the segment in mobile apps shopping is, not unsurprisingly, low across all the six factors (see Figure 4.19), drawing the managerial recommendation that mobile shopping apps are not designed with this segment as the primary target audience in mind.

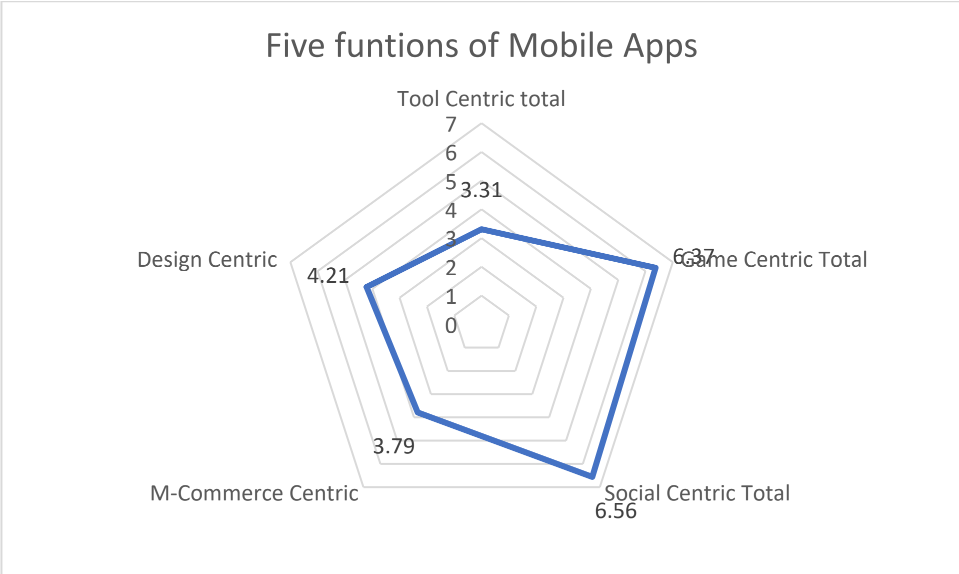


Figure 4.20: *The five functions of mobile apps in cycling for the old-school fanatic/ ultraconservative*

The Old-School Fanatic/Ultraconservative segment's use of mobile apps for cycling is described as functional as illustrated in Figure 4.20. The functionality is particularly seen within the average of tool-centric mobile apps 3.31 being the primary rationale. In particular, exploring deeper into the items of planning routes (mean of 2.79), measuring the performance of rides (mean 2.32), and comparing previous performance (mean 2.92) all show significance to this segment, drawing out the utility purposes of such apps.

Although mobile shopping via apps does not connect with this segment, as their focus is on utilitarian use (mean 3.34), the ease of checkout (mean 3.58), convenience (mean

3.81), and secure payment (mean 3.32) shows it matters and thus is supported with an overall average for m-commerce-centric app of 3.79. Therefore, a conclusion can be drawn that an Old-School Fanatic/Ultraconservative expects ease of use when it comes to m-commerce, which sits alongside their primary use of mobile shopping apps as utilitarian.

The Old-School Fanatic/Ultraconservative views on social-centric apps are not engaged in the social nature of cycling mobile apps (mean of 6.56). This lack of engagement may be attributed to their primary motivation of taking part in cycling being amotivated regulation (mean 1.44). This rationale extends to game-centric mobile apps, which do not resonate with a mean 6.37. Thus, both social-centric mobile apps and game-centric mobile apps are not the focus of the Old-School Fanatic/Ultraconservative and the conclusion can be drawn that mobile apps that are functional and utilitarian are what resonates with this segment.

The elements of design-centric mobile apps connect less significantly with Old-School Fanatics/Ultraconservatives when compared to the other three segments. However, it is still important to ensure that design-centric functionality is considered with an average of 4.21, placing particular importance on brand name (mean 3.90), brand content (mean 3.73).

4.7.4 Part Two – Data Visualisation for Technology Movers

Moving on to explore the Technology Movers cluster, the cycling type of this segment is illustrated in Figure 4.21, overleaf. The overall distance cycled by Technology Movers in an average week, broadly in line with the other two segments (Mobile Savvy and Fully Immersed), with a mode of 75-99 (31.5%). However, they are the least likely segment to cycle for commuting, with only 12.6% using a bike to travel to work.

Technology Movers are more likely to ride for recreational purposes, with a mode of 75 to 99 miles (30.6%) for weekly miles on the bike. Moreover, Technology Movers are unlikely to cycle indoors, with a mode of zero (32.4%) time spent cycling indoors. In terms of bike choices there is high preference based on the road bike (mean 1.68) and other bike interest influenced by the strong connection with a road bike (supportive 2.88, performance bikes 2.64, cross 2.58, gravel 2.72). The additional bikes have linkages to the road bike, in that they are all in the format of drop handlebars, it stresses the significance of the road bike. Thus, the primary road bike (mean of 1.68) and other bike choices are influenced by this focus to aid training and performance.

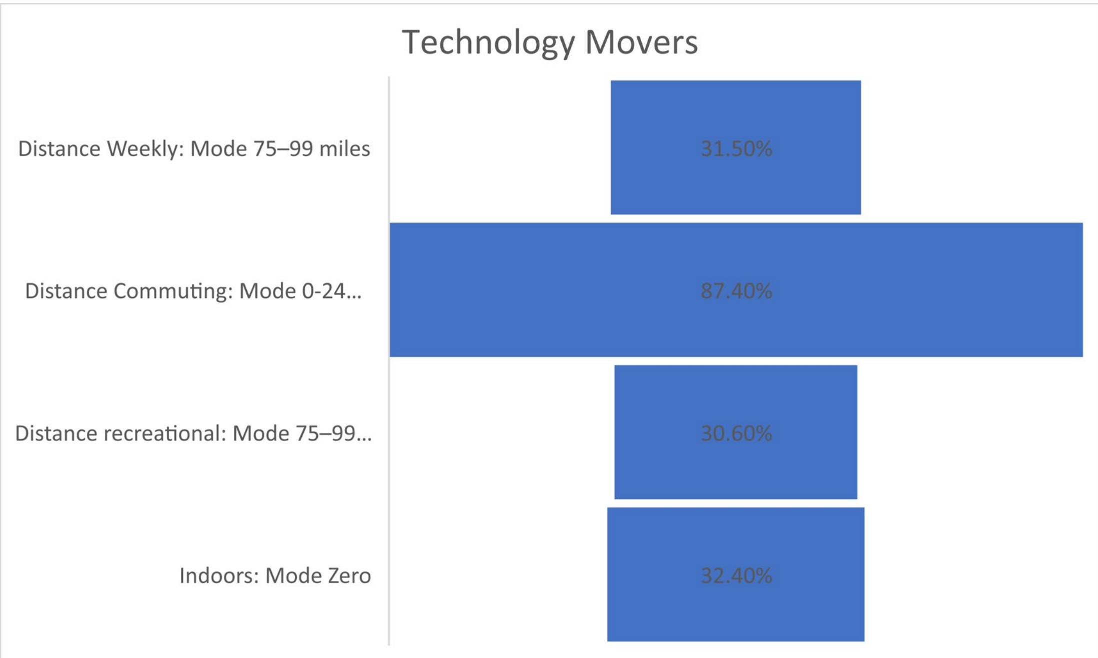


Figure 4.21 *Cycling type for Technology Mover*

Note: Four separate questions presented above. Modal data is presented for each question, as a percentage.

The motivation for cycling of the Technology Movers cluster is presented in Figure 4.22 using self-determined theory (Pelletier et al., 1995) for analysis. Technology Movers have two very closely aligned motivations, firstly amotivated regulation (mean 1.49) and secondly intrinsic regulation (mean 3.25). When it comes to amotivated regulation, the Technology Movers undertake cycling as a way of maintaining control along with being competent as a cyclist. The closer aligned secondary motivation, which shows a connection with instructive regulation, is motivated by the internal motivation of interest, enjoyment, and inherent satisfaction of cycling. The remaining motivations of identified regulation (mean 4.08), introjected regulation (mean 3.74), and external regulation (mean 5.11) only have a difference of 1.03 between the highest and lowest mean, showing no sharp contrast to the motivations of technology movers suggesting caution on the variety of motivations that exist within this segment.

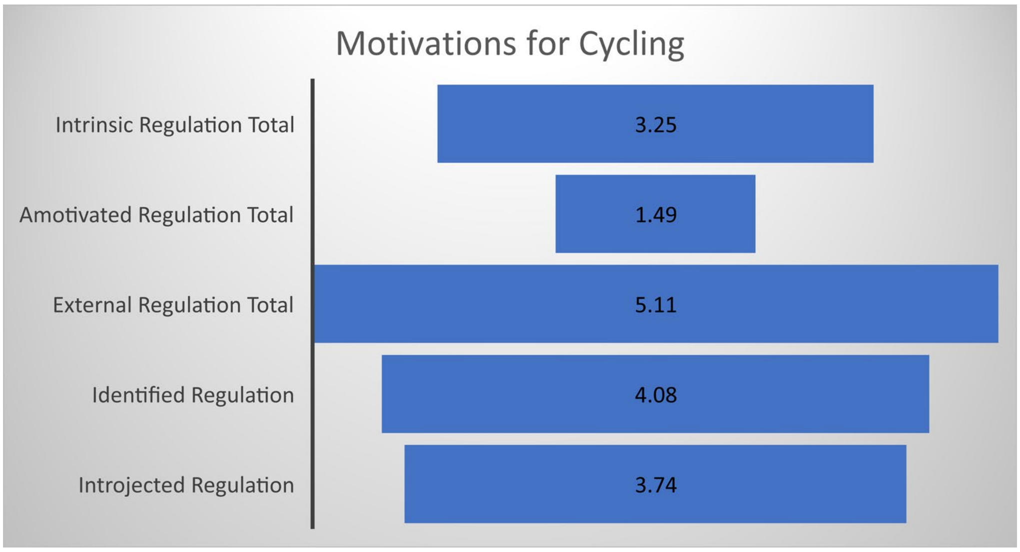


Figure 4.22: *Motivations for cycling for technology movers*

Exploring the engagement of the Technology Movers with mobile app shopping (Thakur, 2016) is illustrated in Figure 4.23. This figure illustrates firstly, the significance of four factors of mobile shopping: time filler (mean 3.3), utilitarian (mean 3.75), monetary experience (mean 4.03), and social facilitation (mean 4.21). However, in contrast, Technology Movers are not using mobile shopping apps for their intrinsic enjoyment (mean 5.5) or to self-connect (mean 5.17).

Figure 4.23: *Mobile App Shopping for the technology movers*

Technology Movers are comfortable using mobile apps in their daily life. This segment is the second-highest cluster of mobile app downloads, with 1-24 applications being the most likely (mean of 1.94). Daily use of mobile apps of this cluster include: social apps (mean of 1.86) health-related apps (mean of 1.49), news-based apps (mean of 2.71), weather-based apps (1.70), and mobile banking apps (mean 2.11). This has resulted in technology movers seeing value in the mobile apps they use each day, and this has transferred into cycling-based apps, in particular through subscription apps (71.2% currently making monthly payments) typically via Strava.

The technology movers' use of mobile apps for cycling shows a very strong connection with tool-centric functions (mean 2.3) and m-commerce (mean 2.85), along with moderate connection design-centric (mean 3.35) and game-centric (mean 4.59) functions, as illustrated in Figure 4.24

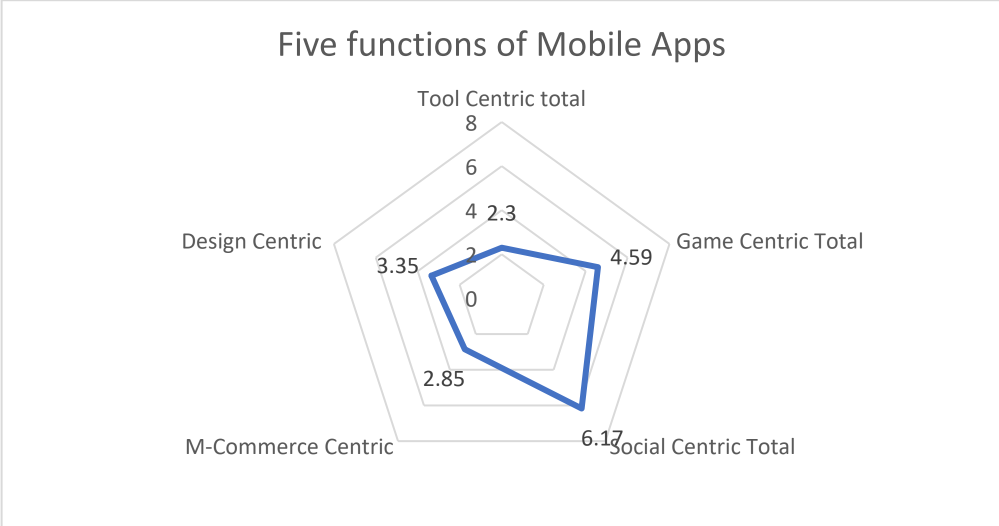


Figure 4.24: *The five functions of mobile apps in cycling for technology movers*

The high use of tool-centric mobile apps for cycling is for diverse reasons from navigation purposes (mean 2.15 and 2.77) through to the more significant for data performance (measure performance of rides 1.50), compare the performance of previous rides (mean 1.62), review more advanced data on cycling performance of a ride (1.82). This is not surprising given that apps with Badges of Honour such as Strava have a high number of features aligned to measuring performance, comparing data with previous rides. Thus, we can draw the conclusion Technology Movers find measuring the performance of rides and against previous rides to be part of the value of using cycling mobile apps.

Game-centric functionality is a moderate connection with this segment, with an average is 4.59. Closer inspection of the game-mechanism element of Hofacker et al. (2016) within game-centric fuctions for Technology Movers sees the importance of gamification with individual items of socially interacting with others through worlds (2.66), rewards with badges, points, or leader boards (3.14), users like or comment upon performance (2.62). This shows the significance of the game-mechanism element, with a mean of

2.81 across the three items of the game-mechanism element. This draws the conclusion of being a secondary focus for Technology Movers when it comes to cycling mobile apps, which again aligns to the features found in apps such as Strava.

As Technology Movers are comfortable using mobile apps, along with seeing value in using apps on a regular basis, it is not surprising to see an average of 2.85 for m-commerce. Looking at m-commerce, these previous experiences, and the comfort of using mobile apps regularly are noted with: ease of checkout (mean 2.87), convenient method of payment (mean 2.91), and secure payment method (mean 2.19). Their previous experiences of mobile apps also transfer across to a design-centric significance of 3.35, with particular importance placed on brand name (3.05), app brand content (2.82) aesthetically pleasing mobile application (2.99) by Technology Movers. However, Technology Movers are typically less influenced by promotional text about the app (3.98) when it comes to design-centric apps.

Technology Movers have a strong connection with tool-centric (mean 2.3) and m-commerce functions, along with a moderate connection with design-centric and game-centric functions (mean 4.59). This is in sharp contrast with Technology Movers' negative connection with social-centric mobile apps, with an average of 6.17. This resulted in Technology Movers being the second-lowest segment when it comes to social-centric functions. They are neither interested in designing advertising ideas (mean 6.30) or designing new product ideas (6.29) or sharing new product design ideas with other cyclists (5.94). Thus, conclusions can be drawn that the social-centric element of mobile apps does not resonate with Technology Movers.

Technology Movers' previous comfort with mobile apps from other experiences in life has seen a transfer into cycling mobile apps, in particular with apps such as Strava. Thus, this results in a connection with tool-centric (mean 2.3) mobile apps, with a very strong focus on monitoring, comparing, and contrasting previous cycling performance with features aligned in apps such as Strava. Moreover, this is supported by Technology Movers' importance of the game-mechanism element (mean 2.81) under the game-centric function of mobile apps. Both show the significance of apps such as Strava upon the Technology Movers segment. This segment also has expectations to see value from cycling mobile apps which are considered in the m-commerce (mean 2.85) and design-centric functions (mean 3.35). When creating mobile apps for Technology Movers in the cycling sector the value they expect is ease of checkout, secure and convenient payment along with branded app name, app brand content, and finally aesthetically pleasing mobile app.

4.7.5 Part Two – Data Visualisation for Mobile Savvy

The Mobile Savvy type of riding is seen in Figure 4.25. Weekly cycling distance is broadly in line with the two other segments (Technology Movers and Fully Immersed), with a mode of 75-99 (32.6%). Mobile Savvy reasoning for riding is most likely to be recreational, with the most frequent distance being 50- 75 miles (24.8%). There is a proportion of Mobile Savvy clusters who use the bike to commute (25+ miles, 17.4%) which makes them the most likely segment to commute via bike. This segment has a strong amount of cycling indoors with 79.3% weekly, which is linked to the adoption of mobile apps of virtual worlds such as Zwift.

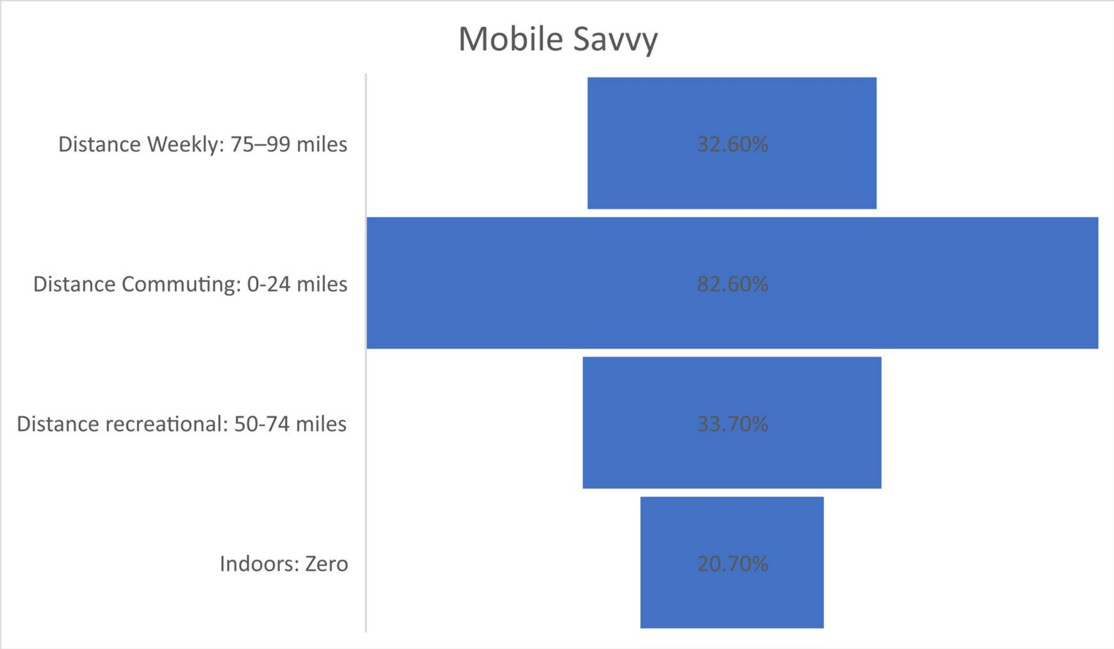


Figure 4.25 *Cycling type for Mobile Savvy*

Note: Four separate questions presented above. Modal data is presented for each question, as a percentage.

Bike ownership of the Mobile Savvy group is higher than any segment with a mean number of four bikes (with 23.9% of mode) with their primary ownership being road bikes (mean 1.52) with a strong connection to this. However, two types of bike ownership are highlighted with a hybrid (mean 2.96) and full suspension (mean 2.59), showing a moderate level of diversity in their bike ownership.

The Mobile Savvy take confidence from using mobile apps in their daily life, supporting their life and their involvement as a cyclist. This segment has the highest cluster of mobile app downloads, with 1-24 applications being the most likely (mean of 1.91) and second highest with daily app usage (mean of 1.97). Daily use of mobile apps in this cluster includes; health-related apps (1.85), weather-based apps (2.00), mobile banking apps (2.11), social apps (2.28) and news-based apps (2.88). This cluster sees mobile apps as an important part of their daily lives, which is transferred into moderate relationships with typically Strava and Zwift (44.6% use cycling apps daily). This segment has the second-highest use of cycling subscriptions, with 73.9% currently making monthly payments. Also worth noting is their adoption of technology while cycling, their use of GPS for cycling is in line with the segment of Technology Movers (80.20%). At 79.3%, Mobile Savvy has the highest use of GPS through other means with watches at 44.5% and mobile phones at 39.1% for cycling purposes.

The motivation for cycling of the Mobile Savvy segment is presented in Figure 4.26, and adopts Pelletier et al.'s (1995) self-determined theory. This segment has three very closely aligned motivations, firstly amotivated regulation (mean 1.59), secondly the enjoyment of cycling, intrinsic regulation (mean 3.37) and finally feelings of guilt introjected regulation (3.50). When it comes to amotivated regulation, the Mobile Savvy undertakes cycling as a way of maintaining control along with being competent as a cyclist, in line with the other three clusters. The closer aligned secondary motivation, which shows a connection with instructive regulation, is motivated by the internal motivation of interest, enjoyment, and inherent satisfaction of cycling. However, it is interesting to note the closely followed third motivation of introjected regulation (3.50) is often attributed to feeling guilty for not cycling. With Mobile Savvy having an introjected regulation a relationship is noted to their adoption of technology through cycling. For example, high adoption of monthly subscriptions (73.9%), which transfers into strong use of cycling apps, with 90% using mobile apps daily or weekly. Thus, the conclusioncan be drawn that the Mobile Savvy's final motivation of introjected regulation and their feelings of guilt are influenced by their high adoption of technology and mobile apps.

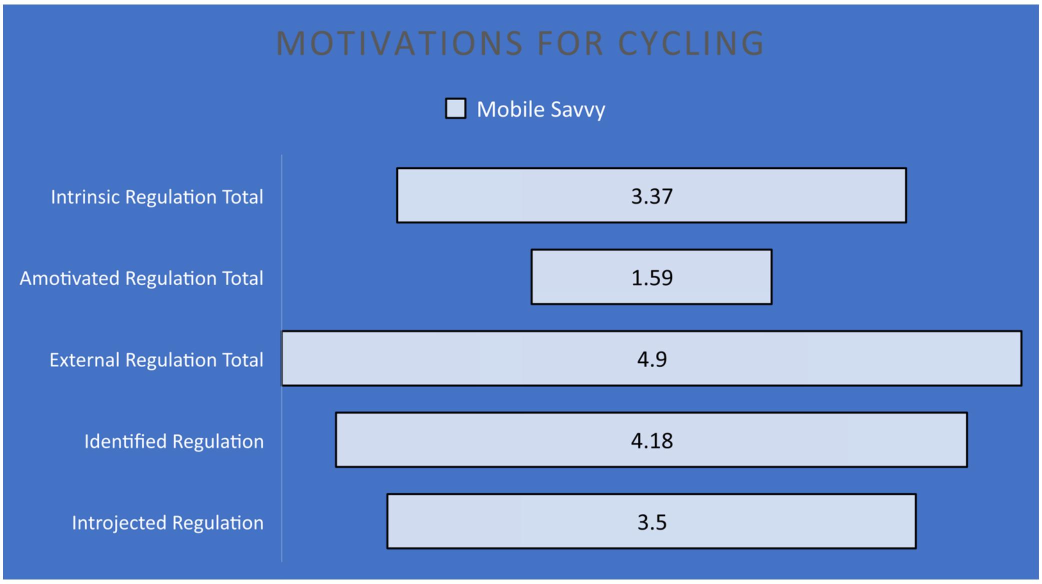


Figure 4.26: *Motivations for cycling for mobile savvy*

Within Figure 4.27, overleaf, the attitudes towards mobile app shopping of the Mobile Savvy is presented through six typologies (Thakur, 2016). This segment's rationale for engagement in mobile apps for shopping shows engagement with: time filler (3.18), utilitarian (3.34), social facilitation (3.33) monetary experience (4.15) self-connect (4.29), whereas the segment is less likely to engage in mobile apps shopping for intrinsic enjoyment (4.94). With strong engagement in mobile apps for shopping on time filler, utilitarian, social facilitation, monetary experience and self-connect, the conclusion can be drawn that the Mobile Savvy have different motivations for shopping, depending on the context. This segment has high adoption of technology and mobile apps which transfers across to a variety of different motivations for mobile shopping.

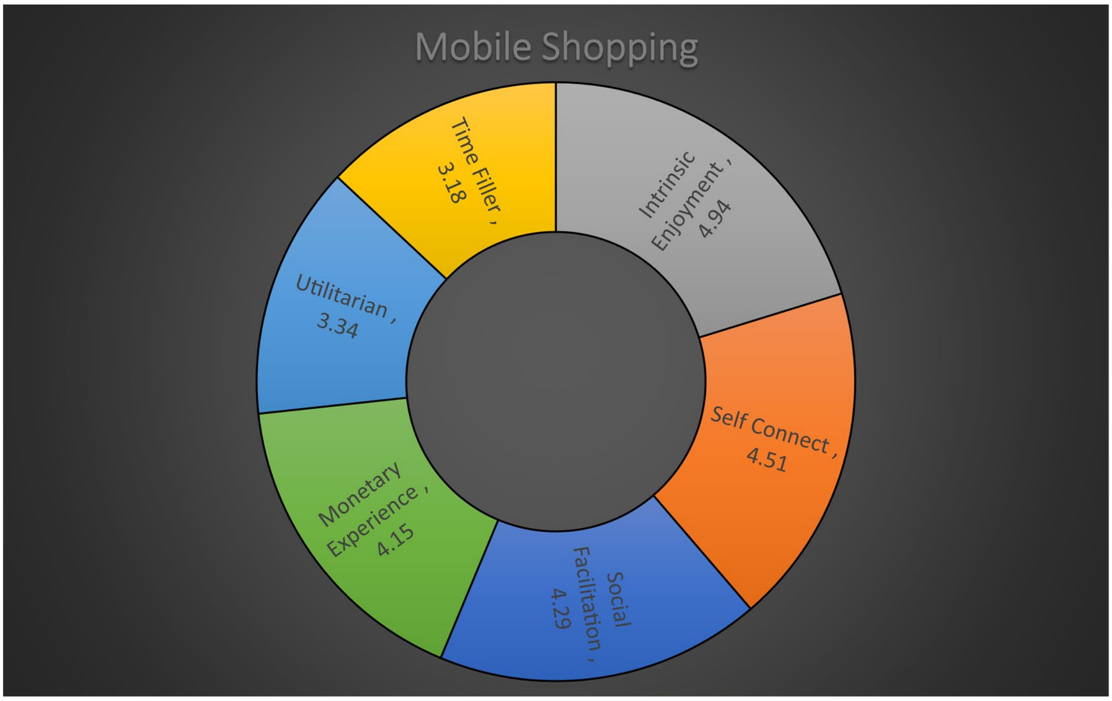


Figure 4.27: *Mobile App Shopping for the Mobile Savvy*

The Mobile Savvy use of mobile apps for cycling shows a very strong connection with tool-centric (mean 2.43) and m-commerce (mean 3.12), design-centric (mean 3.35) engagement along with a moderate connection with game-centric functions (mean 4.32), as illustrated in Figure 4.28.

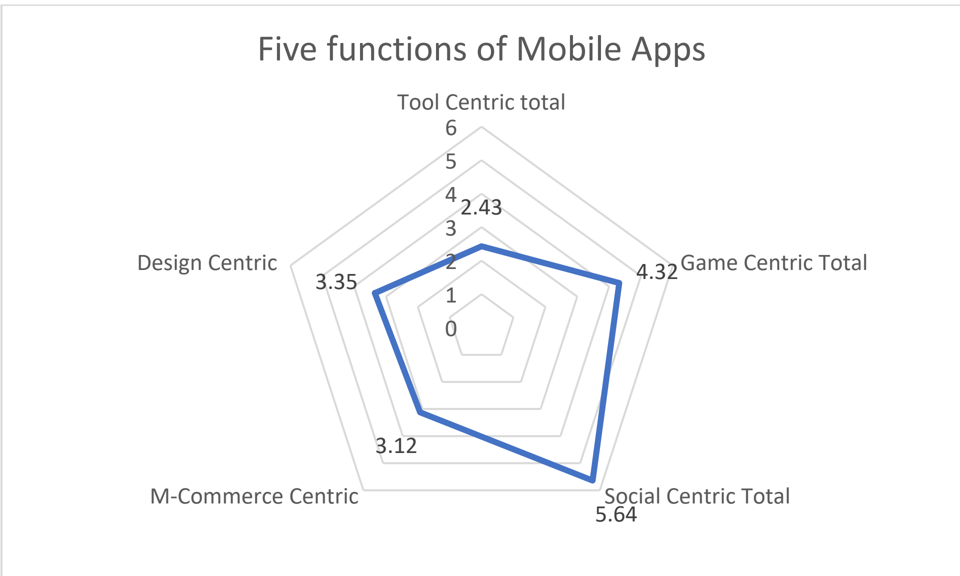


Figure 4.28: *The five functions of mobile apps in cycling for technology movers*

The above figure shows that the Mobile Savvy have adopted high engagement of tool-centric mobile apps (2.43) for cycling across both the factors of navigation purposes (mean 2.22 and 2.75) and data performance measure (measure performance 1.76, compared to performance 1.93, reviewing more advanced data 1.75). As the segment has a moderate connection with Badge of Honour and a moderate connection with new virtual worlds, mobile apps of Strava and Zwift have begun to resonate with the Mobile Savvy, as evidenced through tool-centric apps. The Mobile Savvy have a stronger connection with the factor of measuring performance with an average mean of 1.81. This high engagement across both factors points to the conclusion that the Mobile Savvy connect and engage with mobile apps for cycling, which is a direct transfer from their daily life, along with their adoption of technology.

In addition, the Mobile Savvy show a moderate connection with new virtual world mobile apps, this correlates with a moderate connection of game-centric functions (mean 4.32). Mobile Savvy attitudes towards the game-mechanism of Hofacker et al. (2016) notes a moderate influence of gamification with individual items of socially interacting with others through worlds (2.72), rewards with badges, points, or leader boards (3.83), users like or comment upon performance (3.70). This indicates that that the Mobile Savvy have commenced an interest in gamification, however, it resonates only moderately and is not their sole motivation for engagement in cycling mobile apps.

As the Mobile Savvy are extremely comfortable with mobile and mobile apps in their life, this transfers into their adoption of m-commerce-centric apps for cycling (mean 3.12). This comfort and confidence of using m-commerce centric apps are seen with an equal weighting across all the items: ease of checkout (mean 2.99), convenient method of payment (mean 3.07), and secure payment method (mean 2.71), discount and vouchers (3.73) barcode scanning (4.03) and location sharing (4.15). This points to conclusions of the importance of focusing on the evoke set of mobile commerce apps for Mobile Savvy, as they have reached the mature use of commerce on the mobile when it comes to cycling purchases.

Mobile Savvy competence and confidence in using mobile apps are transferred into the world of design-centric apps for cycling, with a mean of 3.35. A close inspection of design-centric apps sees equal weighting for: brand name (3.14), app brand content (2.93), aesthetically pleasing mobile application (3.14), promotional text about the app (3.87) video content (3.50) and brand logo (3.49). This equal weighting of design-centric functions is supported by the Mobile Savvy's confidence in mobile apps and point to the conclusion of focusing on the overarching design of apps to resonate with this segment.

Mobile Savvy is the second most likely segment to engage in social-centric apps through co-creation (5.64). The three factors show equal weighting: designing advertising ideas (mean 5.65) or designing new product ideas (5.71) or sharing new product design ideas with other cyclists (5.55). This segment has a small cluster who engage in co-creation, sharing their views of advertising ideas and product ideas. This is only a small sub-cluster within the Mobile Savvy segment, however, the impact can be more pronounced as this cluster shares new ideas with a wider audience.

The Mobile Savvy are adept with their use of mobile and mobile apps in daily life. This has transferred into cycling with a moderate connection for Badge of Honour and virtual worlds as they typically use Strava and Zwift. Mobile Savvy behaviours in cycling are informed with a moderate relationship for both these mobile apps, with this segment being the second highest cluster for cycling subscriptions (73.9% currently making monthly payments) and indoor cycling usage (cycling indoors with 79.3% weekly).

This comfort and confidence of using apps in daily life transfers into tool-centric mobile apps for cycling (mean 2.43) as both navigation (average mean 2.48) and data performance measure (average mean 1.81) are important due to moderate relationship with both Strava and Zwift. The Mobile Savvy have commenced the journey towards gamification with the game-mechanisms of Hofacker et al. (2016) having a moderate influence. However, gamification is only part of their motivation for engaging in cycling mobile apps with their competence and confidence of using mobile apps leading to the conclusion that both m-commerce-centric apps (mean 3.12) and design-centric apps (mean of 3.35) resonate with this segment as this cluster is mature in using mobile commerce, when it comes to cycling purchases. Finally, a small cluster of this segment connect and engage with co-creation as a second-place cluster. Whilst this sub-cluster of those engaging in co-creation is small, its impacts are pronounced as it reaches out, through sharing new ideas, to a wider cycling community.

4.7.6 Part Two – Data Visualisation for the Fully Immersed

The Fully Immersed type of cycling (see Figure 4.29) is more likely than other clusters to combine both indoor and outdoor cycling, which sees high impact connections to both high Badge of Honour for outdoor cycling and indoor cycling links with virtual worlds. The overall average weekly distance cycled by the Fully Immersed is broadly in line with the Technology Movers and Mobile Savvy segments with a mode of 75-99 (31.7%). Recreational engagement is the most frequent distance with a mode of 75- 99 miles (29.4%). Where the Fully Immersed vastly differ from other clusters is the adoption of indoor cycling, they are highly likely to engage in cycling indoors this shows a clear relationship with their attitudes towards cycling mobile apps such as Zwift (virtual worlds) which must be completed indoors. This results in most showing a commitment to indoor cycling, with most frequently stating cycling indoors 2 hours – under 3 hours (23.0%), weekly.

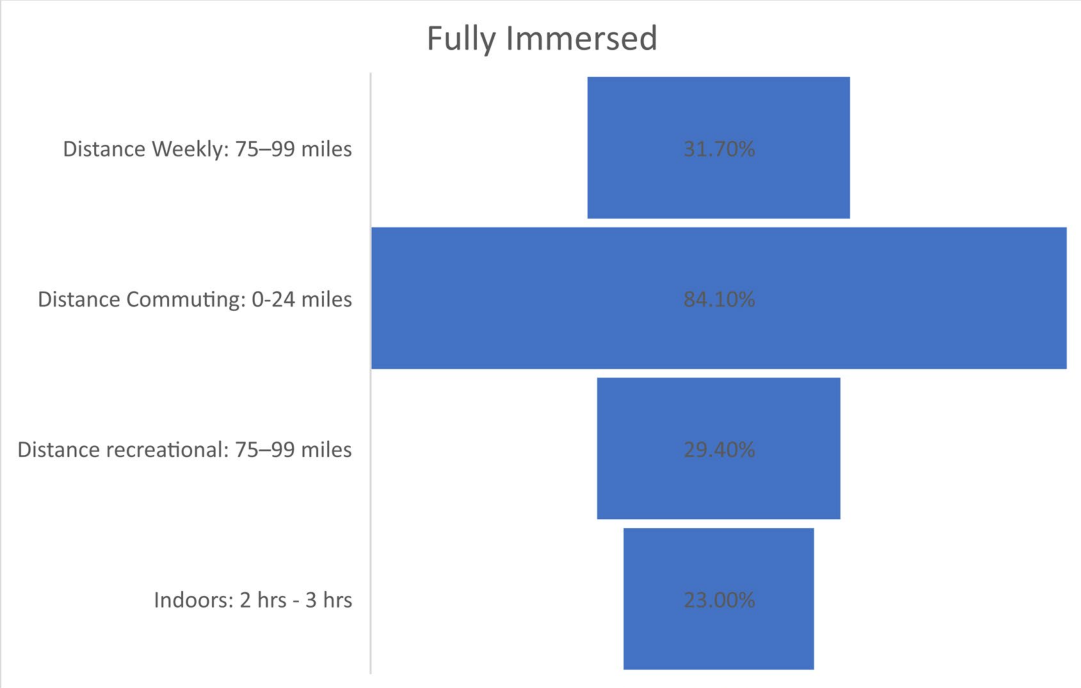


Figure 4.29 *Cycling type for Fully Immersed*

Note: Four separate questions presented above. Modal data is presented for each question, as a percentage.

This segment has fully embraced mobile engagement and mobile apps in their lives and within cycling. The segment has the highest number of apps downloaded on mobile phones which they use in daily life. The Fully Immersed have the widest use of apps, whether the functional apps (e.g. social apps 1.77, health-related apps 1.33, news-based apps 2.71, weather-based apps 1.67, utility-based apps 3.08 and mobile banking apps 1.81) to more advanced apps such as music (2.31), video (3.08) and travel (3.50). Their usage of daily apps in cycling is 58.7% which is significantly higher than the other three clusters, suggesting the use of apps is important to life daily, as they have a strong relationship with apps such as Strava and a strong relationship with apps such as Zwift. This is reflected in this segment's high engagement with cycling subscriptions with 86.5% currently making monthly payments. The Fully Immersed also show that they have embraced cycling technology, being the most likely cluster to use GPS devices to measure rides with 85.7%.

Figure 4.30 shows the motivations for cycling on the self-determined theory (Pelletier at al 1995), with averages provided for each of the five factors of motivation. The Fully Immersed are the most engaged across all five factors. This transfers into their high engagement in cycling events, with 61.9% partaking in a cycling event within the last year. An interesting observation is whilst their primary motivation is amotivated regulation, this segment is the least likely cluster to connect with (amotivated regulation) maintaining control and being competent as a cyclist. This cluster is the least comfortable with basic cycling skills and experiences, which is attributed to their high involvement and relationship with mobile apps such as virtual worlds such as Zwift.

The Fully Immersed has a strong correlation with intrinsic regulation (mean 2.61), with additional motivations split between introjected regulation (mean 2.99) and identified regulation (mean 3.44). With the enjoyment of cycling (intrinsic regulation), conflicting with feelings of guilt (introjected regulation) and conscious value of own personal behaviours (identified regulation). This segment demonstrates diversity in their motivation of cycling, leading to the conclusion that the Fully Immersed are the most motivated cluster overall reflecting in their identification with intrinsic regulation, introjected regulation and identified regulation. This is attributed to a strong connection with the Badge of Honour (Strava) and the World of Rules (Zwift), in support of these diverse motivation.

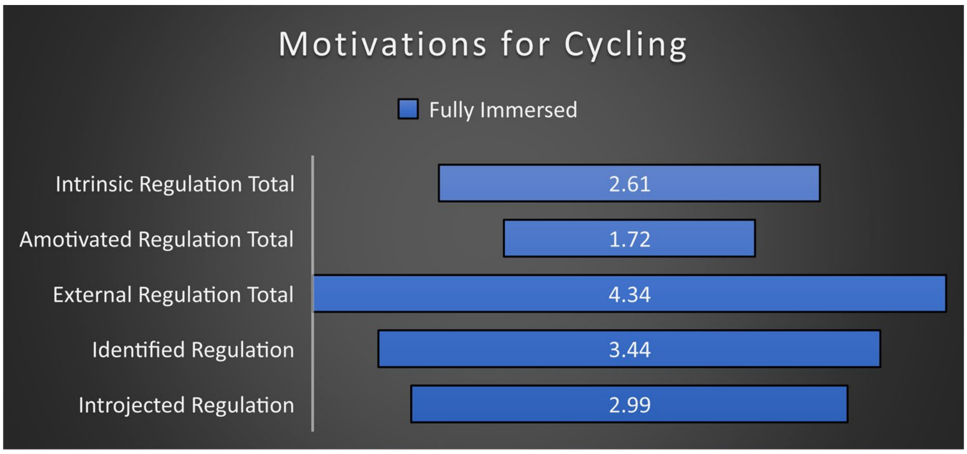


Figure 4.30: *Motivations for cycling for fully immersed*

The model of mobile app shopping (Thakur, 2016), is used to illustrate behaviours of the Fully Immersed (see Figure 4.31). This figure illustrates the rationale for mobile shopping showing a balance of stronger motivations with time filler (2.55), utilitarian (2.87) monetary experience (3.40) and social facilitation (3.33). The Fully Immersed are less likely to be motivated by self-connect (4.20) and intrinsic enjoyment 4.12, when mobile shopping. This segment is the most likely cluster to engage in mobile shopping compared to all three clusters which can be attributed to the segment fully embracing mobile and mobile apps in their lives and cycling, leading to the conclusion this immersion transfers across to mobile app shopping.

Figure 4.31: *Mobile App Shopping for the Fully Immersed*

The segment has fully embraced mobile apps for cycling and is the most engaged across all five functions of mobile apps. The Fully Immersed group's engagement with cycling mobile apps is illustrated in Figure 4.32 showing a very strong connection with tool-centric (mean 1.77), game-centric (mean 2.82), design-centric (mean 2.75) and m-commerce (mean 2.85) functions, with additionally a small part of the segment engaging in social-centric co-creation (mean of 5.07).

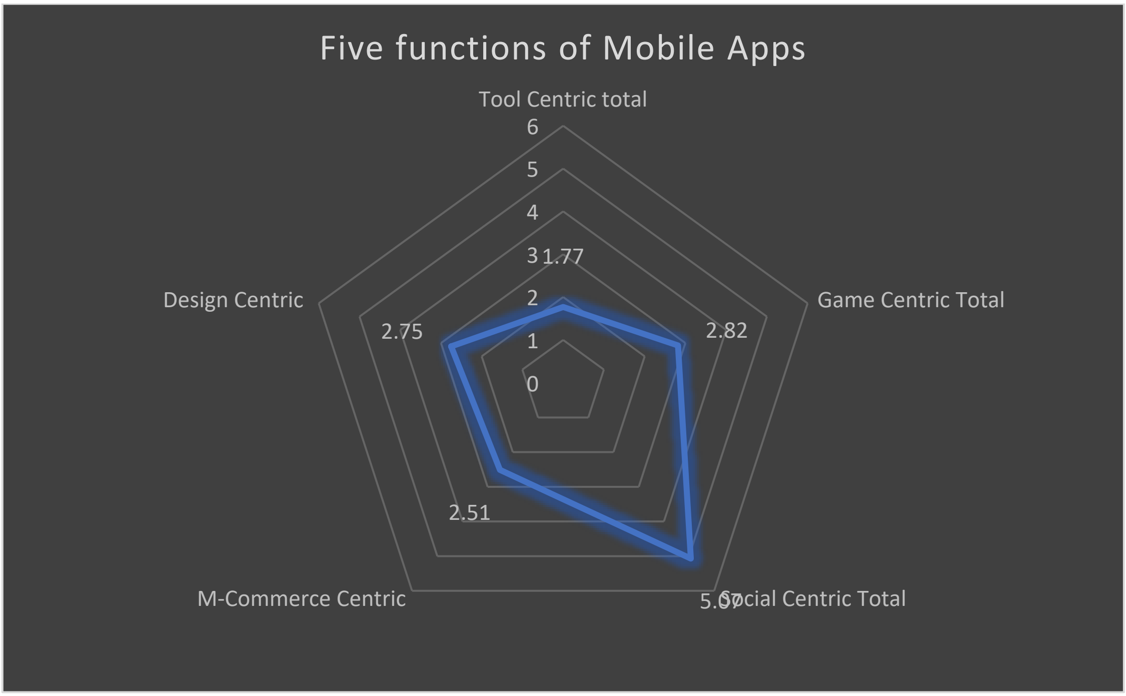


Figure 4.32: *The five functions of mobile apps in cycling for Fully Immersed*

The Fully Immersed adopt extremely high uses of tool-centric apps across all of the factors (mean 1.77) with use of mobile apps for cycling across the three factors of navigation (mean 1.65, 2.06), measuring performance (1.34,1.30,1.33). This is not surprising given engagement with Badge of Honour apps such as Strava which have a high number of features aligned to measuring performance, comparing data with previous rides. Thus, the conclusion can be drawn that th Fully Immersed find value in tool-centric factors of the mobile apps, navigation and measuring performance.

Likewise, the Fully Immersed have a high connection to game-centric functions, with an average is 2.82. This segment is consistently engaged in all the factors of gamification (Hofacker et al., 2016) for example socially interacting with others through worlds (1.81), rewards with badges, points, or leader boards (2.14), users like or commenting upon performance (1.99). This cluster has the highest connection with game-centric functions across all segments, it resonates with their motivations and engagement for cycling. This draws the conclusion that the Fully Immersed are connected with gamification, by Hofacker et al. (2016). They are highly engaged in both apps of Strava and Zwift which stresses the importance of engaging with this segment over both these mobile apps.

This segment has fully embraced mobile apps, in both daily life and within the cycling context. With such adoption of mobile apps, it is not surprising to see an average of 2.85 for m-commerce. These previous experiences of apps transfer into m-commerce as the Fully Immersed expects mobile commerce apps for the following reasons: ease of checkout (mean 2.38), convenient method of payment (mean 2.53), secure payment method (mean 2.13) and discount and vouchers (mean 3.00). This points to the conclusion that the basic needs of mobile apps of m-commerce are essential for engagement of the Fully Immersed.

Additional high engagement in mobile apps also transfers across to a design-centric significance of 2.75. The Fully Immersed place importance on all the factors for design-centric mobile apps: brand name (2.55), app brand content (2.32), aesthetically pleasing mobile application (2.63), promotional text about the app (3.19) video content (2.81) and brand logo (3.00). This indicates that consistency across all elements of design-centric mobile apps resonates with the Fully Immersed.

This cluster is the most likely cluster to engage in social-centric apps of co-creation, with a mean of 5.07. On closer inspection of social-centric apps the Fully Immersed show consistency across all factors in designing advertising ideas (mean 5.09) or designing new product ideas (5.21), or sharing new product design ideas with other cyclists (4.90).

Whilst the Fully Immersed is the most likely cluster to engage in co-creation, it is only a small proportion of the segment this resonates with, with only a small segment engaging in co-creation with additional benefits to cycling brands. As this segment is heavily involved in technology and mobile apps, they are able to share their ideas and concepts and reach wider audiences, through user-generated content.

In summary, this segment has fully embraced mobile applications, most importantly for this study in a cycling context. This results in the Fully Immersed having the strongest connection with all of the five functions of mobile apps and results in a high rate of cycling subscriptions (86.5%), as the Fully Immersed are strongly connected with Strava and Zwift. Both the Badges of Honour and the World of Rules resonate with the fully immersed, demonstrating why cycling mobile apps are so important to this cluster.

A major highlight is this that segment combines extremely high uses of tool-centric apps (mean 1.77) and high connection to game-centric (mean 2.82) functions. It leads to the conclusion that the Fully Immersed connect with gamification, it is a central motivation for their utilisation of mobile apps such as Strava and Zwift. As the Fully Immersed have adopted mobile apps as part of their daily life they expect apps to make their lifestyle easier and more convenient, which transfers across high connection with design-centric apps (2.75) and m-commerce (2.85). Finally, the Fully Immersed are the most likely to engage in co-creation, with only a small proportion it resonates with.

4.7.6 Part Two – Data Visualisation Review for All Four Clusters

The chapter has presented a cluster solution of four distinct segments with data visualisation of each as separate entities. Finally, the chapter will move to present a review and comparison of the four clusters to shine a spotlight on the distinction between these segments.

Firstly, Figure 4.33 presents the responses to the framework of five functions of mobile apps of all four clusters and presents differences of each cluster.

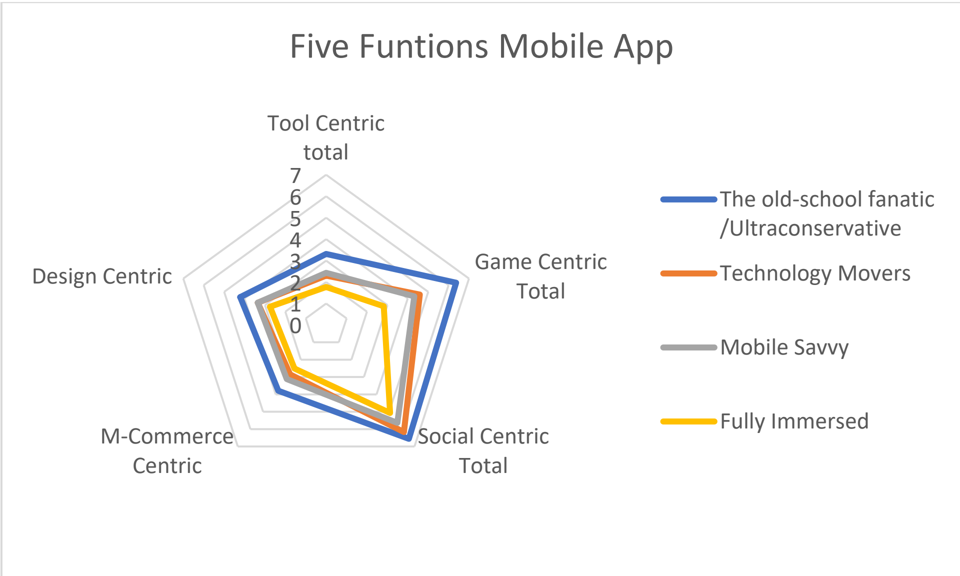


Figure 4.33: *The five functions of mobile apps in cycling for four segments*

In doing so it is important to note the level of cycling involvement across all clusters is defined as high (means from 1.28 to 1.44 for the four clusters). Therefore, clusters show insignificant variances of their level of involvement in cycling, suggesting all four clusters self-identify as a cyclist, which is not surprising given the hobby-like nature of the sport (Bloch & Bruce, 1984; Lamont & Jenkins, 2013). Whilst cycling involvement is interesting to measure and analyse the conclusion drawn is that on its own, measuring involvement in the sport is not distinct enough across the four clusters to segment audiences in cycling. However, an interesting outcome of involvement in cycling is within the different engagement in indoor cycling, across the four clusters, which is linked to cluster engagement in the mobile apps of Strava and Zwift. This is discussed in more detail later in the chapter.

Figure 4.33, shows different connections of each cluster on the five functions of mobile apps. The Fully Immersed cluster shows the most connection with all five functions whereas the Old-School Fanatic/Ultra-conservative demonstrates the least connection on all five. On closer inspection both the Mobile-Savvy and Technology Movers are broadly in line with the connections of all five functions of mobile apps. Thus, the conclusion can be drawn of how consumers' attitudes towards the Badge of Honour (Strava) and World of Rules (Zwift) have influenced the overarching connections with the five functions. For example, the Fully Immersed have embraced both Badge of Honour and the World of Rules, therefore being the most connected with all five functions. The Old-School Fanatic/Ultraconservative cluster has not embraced Badge of Honour or World of Rules and shows itself to be least likely to connect with mobile apps for cycling.

Additionally, a correlation is noted between a cluster's propensity towards the functions of mobile apps, attitudes toward technology and its adoption in cycling (for example mobile app downloads, mobile app usage, cycling subscription, indoor cycling and technology while cycling). The Fully Immersed have fully embraced technology in both daily life and cycling, whereas the Old-School Fanatic/Ultraconservatives are less likely to embrace technology in both daily life and cycling pursuits. This leads to the conclusion that all four clusters are influenced by their attitudes toward technology (Van Doorn et al., 2010; Thakur, 2016; Pansari & Kumar, 2017).

The function of mobile apps with the biggest variance across the five functions of mobile apps is game-centric. This is further evidence that the Badge of Honour (Strava) and World of Rules (Zwift) are influencing consumers' behaviours, based on which of these cycling centric mobile apps, they self-identity and connect with (Bloch & Bruce, 1984; Lamont & Jenkins, 2013). In using Strava and Zwift the study has created distinct clusters building on the platforms cycling audiences are using in order to engage and connect with the cycling community (Hofacker et al., 2016). Moreover, the distinct four clusters support the significance that Hofacker et al. (2016) placed on mobile and gamification due to imparting a sense of joy for the three clusters (Technology Movers, Mobile Savvy and the Fully Immersed) transport into a new world (Strava and/or Zwift) and accepting these values and beliefs (Slater & Rouner, 2002).

Within the data visualisation presented in Figure 4.33 the Mobile Savvy and Fully Immersed clusters are most likely to engage in social-centric apps with a focus on co-creation. Whilst a small proportion of these segments connect and engage in co-creation (O'Hern & Kahle, 2013; Sarmah, Kamboj & Rahman, 2017), the influence is more pronounced as they share the new product ideas, reaching a wider audience. Therefore, this study builds on O'Hern and Kahle's (2013) idea that a small proportion of creative consumers in this context (cycling), show an interest in sharing inventions and insights.

Attitudes towards cycling indoors see variances across all four clusters. Of interest is that this variance is linked to the level of cycling involvement and relationship with the mobile app of virtual worlds (Zwift), which links to literature on the story element of gamification (Hofacker et al., 2016; Slater & Rouner, 2002). As both Old-School Fanatic/Ultraconservative and Technology Movers do not engage in Zwift they are least likely to cycle indoors and use virtual reality apps, whereas the Fully Immersed and Mobile Savvy are more likely to cycle indoors and adopt the use of virtual reality functionality that apps such as Zwift offer. This study builds on Hofacker et al. (2016) as mobile apps are being reclassified for gamification, due to their ability to track heart rate, distance covered, and generated virtual worlds, which resonate with the Fully Immersed and Mobile Savvy clusters.

Exploration in mobile engagement of shopping apps (Thakur, 2016) is illustrated in Figure 4.34 below. Again, this presents a propensity of engagement for mobile apps for shopping that differs across the four clusters with the Fully Immersed being more likely to engage whereas the Old-School Fanatics/Ultraconservative are less likely to do so. Within the data visualisation different motivations are presented for engagement in mobile apps for shopping for each cluster based on their adoption of technology, mobile apps and cycling. This relationship furthers literature on the engagement presented by Van Doorn et al. (2010), Thakur (2016), Pansari & Kumar (2017) showing that technology adoption is connected to the propensity to which the audience will connect and the level of adoption of customer engagement.

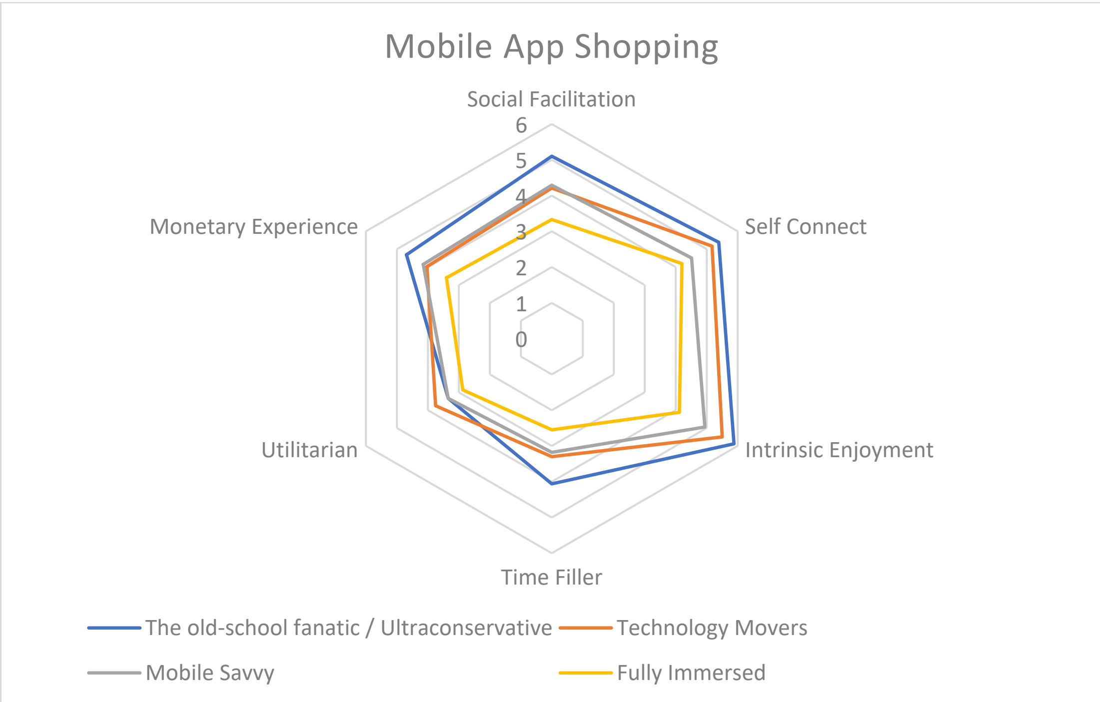


Figure 4.34: *Mobile applications Shopping Engagement for four segments*

All clusters demonstrate a propensity towards amotivated regulation (see Figure 4.35, overleaf), however, this is linked to the high cycling involvement of audiences and self-identification as a cyclist (Bloch & Bruce, 1984; Lamont & Jenkins, 2013). Looking at clusters' additional motivations draws conclusions, which are presented in the data visualisation. The Fully Immersed have the least experience of cycling (16.79 years) and also exhibit the most variety in contructs of SDT motivations. In contrast, the Old-School Fanatic/Ultraconservative has the longest engagement in cycling (25.1 years) and a primary motivation of self-identifying as a cyclist (amotivated regulation). Thus, the conclusion can be drawn that the SDT motivations of the four clusters are connected to self-identity (Bloch & Bruce, 1984; Lamont & Jenkins, 2013) and responds to Cox (2005) calls for further research on sub-cultures of cyclists.

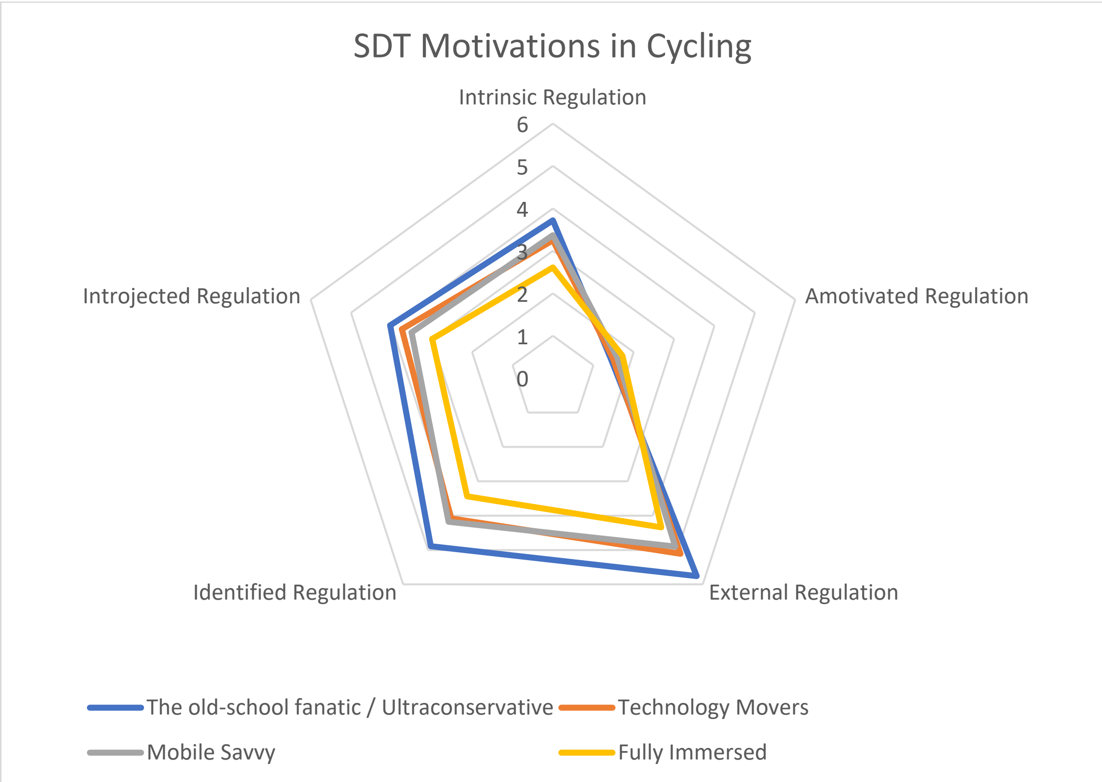


Figure 4.35: *SDT motivations in cycling for four segments*

The comparison concludes that the influence of Strava and Zwift is pronounced, not only to divide the cluster through a two-step cluster analysis, but more significantly as they are influencing consumers' behaviour in cycling (mobile app usage in cycling, cycling subscription, indoor cycling and technology while cycling). The change in behaviours results in the four clusters being distinct and significant in the following areas: game-centric apps, social-centric apps and usage of indoor cycling, which are influenced by Strava and Zwift.

4.8 Chapter Review

This chapter presents the key findings of this study, derived from the completion of both EFA and the two-step cluster solution as stage four of data collection and analysis. In doing so it confirms the validity and reliability of study, through an iterative approach process of four stages of data collection, to further evaluate the conceptual model offered within stage three of the pilot study. The EFA allowed the development and presentation of the final model (Figure 4.2), creating a sophisticated and testable model of five functions of mobile apps.

The final testable model of the five functions of mobile apps and four clusters of cycling are representative of 'serious cyclists' (Mintel, 2022) in the UK. The generalisability of the findings is attributed to simple random sampling (with all UK cyclists in groups A and B having an equal chance to participate) along with the four stages of data collection. The generalisability of the findings is validated with practical implications of the thesis being implemented within the cycling sector, along with horse racing, which demonstrates the generalisability of the findings alignment with the hobby-like nature (Bloch & Bruce, 1984; Lamont & Jenkins, 2013). Additional evidence supports the generalisability of the findings with the quote presented from two chairpersons of cycling clubs (5.11 Personal Reflection) when circulating the final survey final instrument, with both stressing the significance of the study and apps of Strava and Zwift.

A process of two-step cluster analysis was used to define a four-cluster solution as the model of best fit which supported and justified the use of two items of the Badge of Honour with mobile apps and virtual world via mobile apps, as the way to distinguish each of the clusters which resulted in four segments of cyclists (Business of Apps, 2022c; Zhao & Balugue, 2015; Hofacker et al., 2016) as follows: the Old-School Fanatic/Ultraconservative (24.2%), Technology Movers (25.6%), Mobile-Savvy (21.2%), and Fully Immersed (29.0%). In overlaying other aspects, an in-depth understanding of these segments was presented considered the attributes: cycling involvement, purchasing habits, motivations for cycling, mobile phone usage, mobile shopping, and the functions of mobile apps in cycling. An overview of these in-depth analyses for each of the four clusters has then been presented, before using data visualisation techniques to present each, which aids in identifying the management implications and the contribution of the research findings.

Finally, a comparison of each cluster draws out findings to take forward as contributions to knowledge and practice. The key findings will be discussed and taken forward to the following chapter (Chapter Five: Discussion and Conclusion). These can be summarised as:

- The strength of cycling involvement in all four clusters leads to all segments self-identifying as a cyclist due to the hobby-like nature (Bloch & Bruce, 1984; Lamont & Jenkins, 2013).
- The significance the Badge of Honour (Strava) and World of Rules (Zwift) have upon a cluster and how they are influenced by attitudes toward technology (Van Doorn et al. 2010; Thakur, 2016; Pansari & Kumar, 2017).
- Game-centric functions of mobile apps as greatest variance across all clusters as Strava and Zwift are the platforms cycling audiences are using to engage and connect with the cycling community (Hofacker et 2016)

- A small proportion of the Fully Immersed and Mobile Savvy clusters connect and engage in co-creation (O'Hern & Kahle, 2013; Sarmah, Kamboj & Rahman, 2017).
- Indoor cycling differs across all four clusters and correlates to involvement in the mobile apps of virtual worlds (Zwift), and links to the story element of gamification (Hofacker et al., 2016; Slater & Rouner 2002).

Moving on, the final chapter of the study will review the research aim before reviewing each of the six research objectives. In reviewing each of the objectives the chapter will review the literature, data collection, present the final framework of the five functions of mobile apps, and the four clusters of cyclists. The chapter then moves on to key strengths and limitations of the research, implications for future research and professional practice, alongside a personal reflection on the research journey.

Chapter Five: Discussion and Conclusions

5.0 Introduction

This chapter presents a discussion of the findings (as presented in the previous chapter) and conclusion of the study, drawing on key contributions to knowledge and practice. In addition, this chapter illustrates how research has followed an iterative process, firstly, evaluating the functions of mobile apps following multiple stages of academic literature review and secondly the four stages of data collection to facilitate the development of the five functions of the mobile apps model focused on the cycling sector.

The multiple-staged approach to this research provides a new rigorous method to cluster cycling audiences, which is a central contribution of this thesis. This chapter will firstly present the research aim and review the research objectives, before moving to a discussion of findings from the literature review and data collection leading to the presentation of the model of five functions of mobile apps for cycling. Finally, this chapter presents the four clusters of cyclists, key strengths and limitations of the research, implications for future research and professional practice, alongside a personal reflection of the research journey.

5.1 Reviewing the Research Aims and Objectives

The aim of this thesis is to contribute to the conceptualisations of the functions of mobile apps with an emphasis on cycling through the creation of a cluster of cyclists using dimensions of functions of mobile apps responding to the central research aim:

> ***Identify and develop a testable method to cluster cycling audiences based on their engagement in the functions of mobile apps and additionally their attitudes and behaviours.***

Chapter one introduced the research objectives underpinning the research as:

RO1 Critically evaluate the existing academic knowledge and implications in practice of the five functions of mobile apps.

RO2 Evaluate existing frameworks and models of motivations for participation in the sport, consumer involvement and engagement, as potential means of clustering in the cycling sector.

RO3 Conduct quantitative research to explore cyclists' perception and usage of mobile apps, of the five functions of mobile apps and the associated frameworks of involvement, motivations for sport and engagement.

RO4 Analyse primary and secondary data to develop a testable framework of the five functions of mobile apps which is appropriate for cyclists.

RO5 Apply the framework of the five functions of mobile apps alongside motivations for sport, consumer involvement and engagement, to identify distinct clusters of cyclists and draw conclusions for practice and theory.

These research objectives (ROs) will be reviewed in turn within this chapter, with RO 1 and RO2 drawing from the review the academic literature (as presented in Chapter Two) and RO3, RO4 and RO5 drawing on the findings and discussions of the multiple stages of data collection (as presented in Chapter Four). This research culminates in the generation of the model of the five functions of the mobile apps in the specific context of cycling (seen in Figure 5.1).

5.2 Existing Knowledge and Practice of the Functions of Mobile Apps (RO1)

The literature review (see Chapter Two), identified the key position of Zhao and Balugue (2015) which initially generated the five functions of mobile apps: tool-centric (features of apps due to technology such as GPS e.g. navigation), game-centric (gamification), social-centric (co-creation), m-commerce-centric (purchasing) and design-centric (mobile branding). The functions of mobile apps, concludes with gaps of the research requiring additional investigation on a case-by-case basis, acknowledged by the quote; “features included in app designs should be chosen on a case-by-case basis” (Zhao & Balugue 2015, p. 313). This provides ideal positioning of cycling for further investigation and is a key influencing factor of this resultant research.

The literature review also reviewed 50 mobile apps in the cycling sector which included two major themes for further investigation, firstly responding to Zhao and Balugue’s (2015) request for mobile apps features to be considered on a case-by-case approach. The conclusion from the 50 mobile apps review noted the following themes of tool-centric cycling apps: navigation, cycling computer/data performance, training platforms, virtual reality, and wallet of mobile apps, Table 2.4 in the literature review, with the final model (Figure 5.1) validating both navigation and cycling computer/data performance.

The remaining four items of the five functions of mobile apps are illustrated by earlier work by Zhao and Balugue (2015), however, they lack the rigor of academic underpinning. In response to this, this study has used a range of academic literature to support the remaining four functions of mobile apps (Hofacker et al., 2016; O’Hern & Kahle, 2013; McGrath & McCormick, 2012; Khajehzadeh, Oppewal & Tojib, 2014; Watson, McCarthy & Rowley, 2013; Schmitz Weiss 2013; Blazquez, 2014; Chang, Chen & Zhou, 2009).

The game-centric function of mobile apps supports the research of Hofacker et al. (2016) with the validation and inclusion of both game mechanism elements and story elements. The game mechanism element builds on Hofacker et al.’s (2016) “badging” (p.28) as it provides visual identifiers due to cyclist defining their Badge of Honour as the mobile apps of Strava. This study has developed new knowledge building on previous findings of Hofacker et al. (2016), in suggesting that the mobile app of Strava supports the creation of cycling communities, builds social collateral, and supports future interactions.

Furthemore, VR/AR Mobile apps in the cycling sector provide an evolution towards story elements of gamification, as seen within the review of the 50 mobile apps. The new immersive worlds of AR and VR with gamification at their center have seen significant growth as mobile apps (Hofacker et al., 2016), have reclassified the opportunity to track measurements such as heart rate, and distance, and create new worlds. For example, new worlds such as Zwift provide users with new acceptance of values and beliefs (Slater & Rouner, 2002).

The academic literature stresses the importance of mobile and apps being a central hub for social-centric functions and co-creation (Dube, 2012; Hudson, Huang, Roth & Madden, 2016; Kaplan, 2012; Kulkarni, 2017; Lamberton & Stephen, 2016; Lamberton & Stephen, 2015; Rashid et al., 2019; Roma & Aloini, 2019; Sterling, 2016). The empirical testing model for social-centric apps includes two of the typologies, for example the cycling consumer is willing to share opinions, inventions, and insights (O'Hern & Kahle, 2013) and the validation of co-creating and co-communicating develops theoretical knowledge of the functions of mobile apps (Zhao and Balugue, 2015), whereas the typologies of informing and pioneering are not validated.

Zhao and Balugue (2015) noted the purpose of m-commerce is to sell products, however, no items were validated within their study. Scan barcode/QR code/Vouchers and Coupons (Khajehzadeh, Oppewal & Tojib, 2014) and mobile payments (Chang, Chen & Zhou, 2009) were included in the empirically tested model. Location awareness (Schmitz & Weiss, 2013) augmented reality and virtual mirror (Adhani & Rambli, 2012; Blazquez, 2014) are not included within the final model.

Design-centric functions of mobile apps (Zhao and Balugue 2015) build on the previous study of McGrath and McCormick (2012), m-branding framework, as this was not previously tested in mobile apps. This study contributes to academic knowledge as design-centric apps are tested in all stages of data collection as: brand name (McGrath & McCormick, 2012), brand design (Harridge-March, 2006), branded logo (Rowley, 2009), and brand content (Okazaki, 2006) and shows the significance of consistency across design-centric apps. Using Zhao and Balugue's (2015) five functions of mobile, tool-centric, game-centric, social-centric, m-commerce-centric, and design-centric were illustrated as ideas/concept, however lacked data to justifying.

The literature review explored a range of theoretical concepts, (as seen in Table 2.5) presenting the functions of mobile apps (Hofacker et al., 2016; O'Hern and Kahle 2013; McGrath and McCormick 2012; Khajehzadeh, Oppewal, & Tojib 2014; Watson, McCarthy & Rowley, 2013; Schmitz Weiss 2013; Blazquez, 2014; Chang, Chen, & Zhou, 2009), requiring validation through testing with stages two and three of methods.

Mobile Apps Tool-Centric	Mobile Apps Game -Centric	Mobile Apps Social-Centric	Mobile Apps M-Commerce-Centric	Mobile Apps Design-Centric
• Navigation • Cycling Computer/Data Performance	• Game Mechanism Element • Story Element	• Co-Communicating • Co-creating	• Scan/QR/Vouchers • Mobile payment	• Brand Name • Brand Logo • Brand Design • Brand Content

Figure 5.1: Final framework of the five functions of mobile apps.

As the literature on the functions of mobile apps is in the early stages of development (Zhao and Balugue 2015), the need to drawing on such depth of literature is paramont (Hofacker et al., 2016; O'Hern and Kahle 2013; McGrath and McCormick 2012; Khajehzadeh, Oppewal, & Tojib 2014; Watson, McCarthy & Rowley, 2013; Schmitz Weiss 2013; Blazquez, 2014; Chang, Chen, & Zhou, 2009). In drawing on this wide literature the study develops a testable frameworks of the five function of the mobile apps, for the first time.

5.3 Existing Frameworks and Models Motivations for Sport, Consumer Involvement and Engagement (RO2)

Academic literature explored within Chapter Two, acknowledges segmentation as the utilisation of items/variables to divide audiences, to understand consumers' profiles and needs (Karasev, 2020) and stresses the significance, due to the growth of reactional cycling (Downward & Lumsdon, 2002; Lumsdon, 2000; Nguyen & Pojani, 2022), with literature contrasting segmentation for road vs mountain bike typologies (Brown et al., 2009; Streicher & Saayman, 2010; Cessford, 1995; Getz & McConnnell, 2011; Morey, Buchanan & Waldman, 2002). The field of motivations for engaging in cycling is ideally positioned to develop knowledge on the intrinsic and extrinsic motivations (Locke & Schattke, 2019; Frederick-Recascino & Schuster-Smith, 2003), through self-determination theory (SDT, Deci & Ryan, 1985) which is often used in sporting and leisure contexts (Ryan & Patrick, 2009; Haggar & Chatzisarantis, 2007).

Various studies investigate whether intrinsic and extrinsic motivations of the Self Determination Theory (SDT) model change behaviours when it comes to sport (Sebire, Standage & Vansteenkiste, 2009; Vansteenkiste, Niemiec & Soenens, 2010). On closer inspection of SDT in studies on cycling Brown, O'Connor and Barkatsas, (2009) acknowledges that serious leisure cyclists attached different meanings of participating in cycling within different environments. This is supported by the positional gap of Cox (2005) with further research needed to focus on sub-cultures of cyclists, beyond an oversimplistic "one size fits all" (p.5).

Academic research draws out the seminal study of the Sport Motivation Scale (SMS, Pelletier et al., 1995), with a meta-analysis comparing the SMS subscale with correlation coefficients, across 21 studies, supporting the validation and reliability of the framework. SMS is not only used in sports studies (Pelletier et al., 2013; Dwyer & Kim, 2011), but also in cycling bases studies (Schlemmer, Barth & Schnitzer, 2020; Karisman, 2022). An in-depth literature review into SDT motivations presented in Chapter Two concludes with an established framework of SMS being positioned for stages two, three and four of the methods.

Consumer involvement is acknowledged by O'Cass (2000) as a focal object (in this case cycling), placed at a prominent/key position in the consumer's life. This links well with the motivation for cycling. Using O'Cass (2000) literature on consumer involvement stresses, it is possible to conclude that the more involvement placed by the consumer on the focal point, the more likely they are to self-identifying as a cyclist leading towards enthusiasm or 'hobby-like' nature (Bloch & Bruce, 1984). Such approaches essentially relate to the work of Lamont and Jenkins (2013) "*high levels of recreation specialization, found that cycling played a central role in these peoples' lifestyles"* (p. 404).

Consumer involvement is increasingly utilised to segment/clusters audiences, as it aids in the tailoring of marketing activities (Nkurunziza et al., 2012; Reid, 2011; Ritchie, Tkaczynski & Faulks, 2010). In consulting academic research on consumer involvement within cycling it is vital to understand motivations and behaviours, as audiences, take part in cycling for different motivations or rationales (Streicher & Saayman, 2010; Ritchie et al., 2010; Kruger & Saayman, 2014; Kruger Myburgh & Saayman, 2016).

In order to understand the 'hobby-like' nature (Bloch & Bruce 1984, p.197) of cycling, Lamont and Jenkins (2013) devised the recreation specialisation model measuring the level of consumer involvement through three variables for recreation specialization: 1) behavioural dimensions 2) affective dimensions, 3) cognitive dimensions level of competency in tasks. The detailed literature review leads to the conclusions to utilise the recreation specialisation model of Lamont and Jenkins (2013) to contribute towards stage two (pre-tested) of research methods and subsequent stage three (pilot) and stage four (full-scale study).

The literature review also positions the importance of Customer Engagement (CE). In the context of this thesis CE is acknowledged as being achieved when a relationship is satisfied which includes an emotional bond (Pansari & Kumar, 2017). This takes a step beyond consumer involvement to a position in which the consumer is involved in forming that emotional bond (Bowden, 2009) through which "the object is based on inherent needs, values, and interests" (Zaichowsky, 1985, p. 342). In creating this bond, trust is the breadth of attitudes toward the brand (Pansari & Kumar, 2017), whereas commitment focuses on maintaining relationships that add value (Moorman et al., 1992). When CE creates trust and commitment, then the behaviours of purchases, referrals, influence, and feedback are exhibited by consumers (Van Doorn et al., 2010).

Research surrounding CE is acknowledged as being in its infancy (Bowden, 2009) and often results in conceptualised models (Brodie et al., 2011; Sashi, 2012; Van Doorn et al., 2010; Vivek et al 2012). Van Doorn et al. (2010) illustrates how technological advances impact the adoption of CE, as consumers are choosing the platforms to engage with the brand. As platforms influence the adoption of CE, Thakur (2016) focuses on mobile shopping taking into consideration the platforms' unique characteristics of forming an emotional bond (Pansari & Kumar, 2017). The literature review (see Chapter Two) employs Thakur's (2016) model of CE shopping on mobile, in stages two, three, and four of the method.

5.4 Conduct Quantitative Research (RO3) and Test a Framework of the Five Functions of Mobile Apps (RO4)

Pursuing RO3, a four stage of data collection was undertaken due to the exploratory nature of the study (Klein & Kozlowski, 2000; Chenail, 2011; Bal, 2019; Converse & Presser, 1986; McIntyre & Hobbs, 1999; Baxter & Magoldac, 2004). As described above Stage One encompassed a review of 50 mobile apps (during October 2019, updated in

July 2022) which identified a spectrum of apps functions including: navigation, cycling computer/data performance, training platforms, virtual reality, and wallet of mobile apps. Stage two used these theses to facilitate data collection during pretesting, using an online survey instrument (between February 2020 and May 2020) which collected 69 responses collected from university cycling groups and a small number of social media groups with an interest in cycling. This data was analysed to facilitate the refinement of the survey instrument for Stage Three.

Stage Three of data collection facilitated a full-scale pilot (between October 2021 and November 2021) resulting in 108 complete survey responses. The approach to sampling was to replicate the final study sharing with a smaller number of online cycling communities and cycling clubs. Data analysis undertook an exploratory factor analysis to enable the refinement and validation of items within the survey for the five functions of mobile apps. The exploratory factor analysis (EFA) concluded with the conceptualised model of the five functions and informed Stage Four data collection for the study.

The fourth stage of data collection included the refinement and validation of the survey instrument from stage three. The survey was shared widely with cycling communities throughout the UK from December 2021 closing in March 2022; 434 respondents were obtained. Data was cleansed and analysed using EFA to further test the five functions of mobile apps. Following this, a two-step cluster analysis was undertaken to identify four distinguishable segments of cyclists through using themes of Badge of Honour (aligned to mobile app Strava) and war of rule (aligned to mobile app Zwift) (Hofacker et al., 2016).

EFA in a varimax method analysis was adopted during Stage Three and in both independent sets of data collected (Tabachnick & Fidell, 2013 and Hair et al., 2010). During Stage Three EFA analysis (n=108) resulted in the deletion of nine items from Stage Two. The conceptualisation of five functions of mobile apps measure of sampling adequacy (MSA) for the model (28 items) 0.907, being “highly desirable” (Field, 2005, p.

640) or “excellent” (Hair et al., 2010 p.136), along with Cronbach’s Alpha coefficient of 0.95. (Taber, 2018). This shows a conceptualised framework of the functions of mobile apps (28 items) is strongly supported statistically, as such is utlised in Stage Four of the full study.

Stage Four data collection utilised the EFA varimax method of analysis (Tabachnick & Fidell, 2013 and Hair et al., 2010), on the remaining 28 items from Stage Three, with 434 respondents. This resulted in the deletion of a further four items in the final conceptualised model of the five functions of mobile apps resulting in 24 items. This was statistically validated through a series of tests which showed strong support including the Bartlett’s test of Significance (Sig .000) (Hair et al., 2010). The Kaiser-Meyer Olkin (KMO) test returning a score of 0.904 being “excellent”, (Hair et al., 2010 p.136), and Cronbach’s Alpha Coefficients of 0.93 (Taber, 2018) illustrating strong relations. This results in a testable five functions of mobile apps is seen in Figure 5.1, this includes five items in tool-centric, six game-centric (Hofacker et al., 2016), three items in social-centric (O’Hern & Kahle, 2013), four m-commerce-centric (Khajehzadeh, Oppewal, & Tojib 2014; Chang, Chen, & Zhou, 2009) and six items in design-centric (McGrath & McCormick, 2012; Harridge-March, 2006; Rowley, 2009; Okazaki, 2006).

The resulting empirically tested model extends the work of Zhao and Balugue (2015) through the four stages of exploratory research as described here (Klein & Kozlowski, 2000; Chenail, 2011; Bal 2019; Converse & Presser, 1986; McIntyre & Hobbs, 1999; Baxter & Magoldac, 2004). This resultant model is supported via EFA (Hair et al., 2010) with a Bartlett’s test of significance (Sig 0.000), KMO (0.904) and Cronbach’s Alpha Coefficients (0.93) as described above. In validating the resultant framework of the five functions of mobile apps it builds on existing knowledge of literature (Hofacker et al., 2016; O’Hern & Kahle, 2013; Khajehzadeh, Oppewal & Tojib, 2014; Chang, Chen & Zhou, 2009; McGrath & McCormick, 2012; Harridge-March, 2006; Rowley, 2009; Okazaki, 2006) and applies into the new medium of mobile apps.

5.5 Five Functions of Mobile Apps to Present Four Clusters of Cyclist Aiding Practice (RO5)

The previous research objective (RO4) empirically tested the five functions of mobile apps in cycling and extends the work of Zhao and Balugue (2015). Using this framework (seen in Figure 5.1) to segment as a way to respond to the positional gap in academic research (Cox, 2005) a two-cluster analysis was deployed as a method of creating an optimal subgroup (Gelbard et al., 2007; Kent et al., 2014). Segments were created using the variables of Badge of Honour and World of Rules, supporting the significance cyclist placed on Strava and Zwift in the review of 50 mobile apps (see RO1). In addition, further support was added in the literature reviews on the game-centric functions of mobile apps with Hofacker et al. (2016) stressing the importance of "badging" as a game mechanism, providing visual identifiers being closely aligned to Strava. Whereas Hofacker et al.'s (2016) story element of AR and VR transfers users into a new acceptance of values and beliefs (Slater & Rouner, 2002), being closely aligned to Zwift, and furthers a connection between apps and the narrative of gamification.

The two variables of Badge of Honour and World of Rules were adopted for two-step cluster analysis, which are closely aligned to the immersive mobile apps of Strava and Zwift (review of the 50 mobile apps), using the Bayesian Information Criterion (BIC) method (Burnham & Anderson, 2002). This resulted in four cluster solutions, with a silhouette of 0.6 described as a good range (de Amorim & Hennig, 2015) and yielded a predictor of importance as; a Badge of Honour (0.88) and World of Rules (1.0), being defined as good (de Amorim & Hennig, 2015) along with a cluster distribution of 1.37 being defined as good (DiStefano, Zhu & Mindrila, 2009).

The four-cluster solution resulted in four distinct groups (the old-school fanatic/ ultraconservative, technology movers, mobile savvy, fully immersed), seen in the mean averages of each cluster on the two distinguishable variables (Badge of Honour and World of Rules), in Figure 5.2.

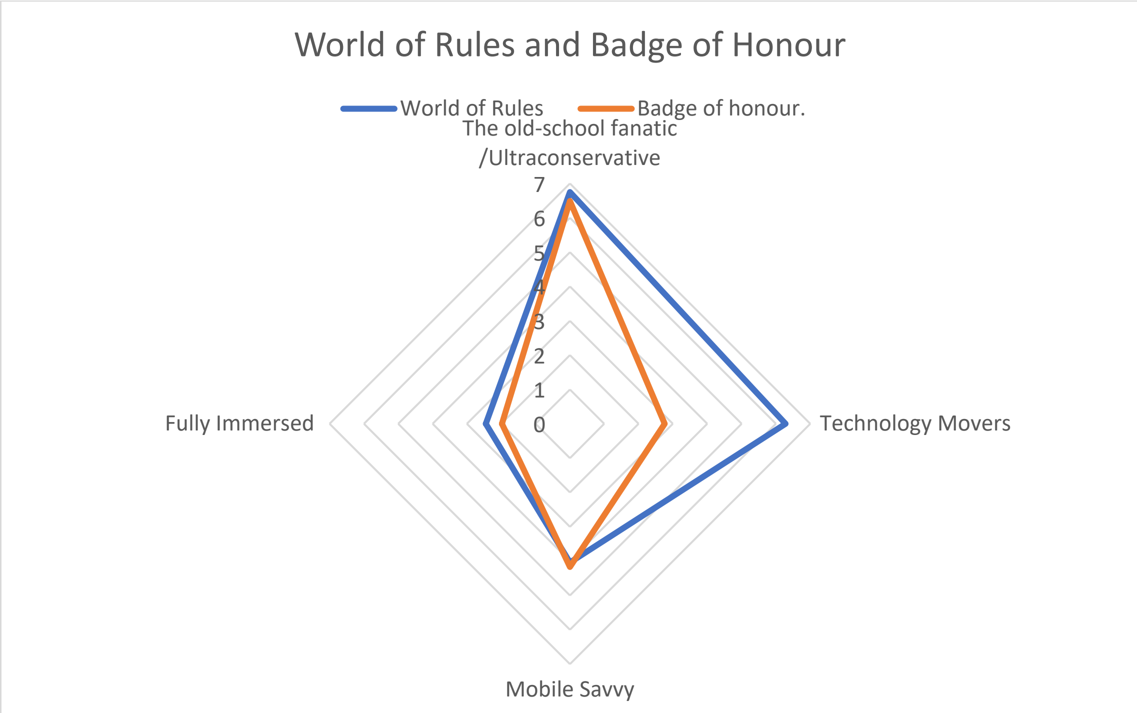


Figure 5.2: *Average means to the variables of Badge of Honour and World of Rules, used to cluster.*

The Badge of Honour (Strava) and the World of Rules (Zwift) method was used to explore two-step clusters, to present four distinct segments (see Figure 5.3) and includes major highlights of the motivations for cycling, involvement in cycling and engagement with mobile apps.

The old-school fanatic / Ultraconservative
n=105 24.2%

No connection badge of Honour (6.49)

No connection virtual world via mobile apps ((6.75)

- Longest-serving with a mean of 25.1 years
- Prefer to cycle outdoors
- Primary bike is a road, but open to diversity in the form of bike
- Least likely to use a GPS device.
- Often do not see value in having a cycling subscription.
- Mobile applications do not connect with them as means of shopping, but easy of check-out, coinvent, and secure payment does matter.
- The routine of being cycling linked to their primary intrinsic motivation.
- Primary use of mobile apps for cycling is functionality via tool-centric mobile apps.
- Gamification and co-creation do not connect.

Technology Movers
n=111 25.6%

Medium badge of Honour (2.76)

No connection virtual world via mobile apps (6.28)

- Prefer to cycle outdoors for recreation
- Primary bike being road and other choices are influenced focus to aid training & performance.
- Mobile apps used in daily life, add value.
- Bought into cycling subscriptions typically via Strava.
- M-comm fits into a primary utilitarian and utilitarian, developing towards a monetary experience & social facilitation
- Strong connection with amotivated regulation.
- Mobile apps for cycling strong relationship with tool-centric (mean 2.3) and m-commerce (mean 2.85).

Mobile Savvy
n=92 21.2%

Medium badge of Honour (4.17)

Medium connection virtual world via mobile apps (4.04)

- Strong amount of cycling indoors on a weekly basis
- Apps used on daily basis between 6-10,transfers into cycling with 90% using mobile apps daily or weekly.
- Motivations for cycling intrinsic regulation followed closely introjected regulation.
- Highly engaged in shopping through mobile apps & have different motivations, depending on context.
- High engagement in mobile apps transfers into the cycling world, across all five functions.
- The audience shows some interest in gamification through mobile apps.
- Small cluster of this segment engages in co-creation.
- Mature use of mobile commerce for cycling purchases.
- Design-centric mobile apps are all equally weighted.

Fully Immersed
n=126 29.0%

Very strong badge of Honour (1.98)

Strong connection virtual world via mobile apps (2.45)

- Least comfortable with basic cycling skills and experiences, owning to virtual experience, and least time cycling of 16.79 years.
- Combining both indoor and outdoor cycling.
- High engagement with cycling subscriptions, 86.5% currently making monthly payments.
- Strongest motivated intrinsic regulation. Secondary motivations split introjected regulation & identified regulation.
- Highest number of apps downloaded on mobile phones and daily usage. 58.7% use cycling apps daily.
- High number of motivations for mobile shopping: social facilitation, time filler, utilitarian to monetary experience.
- Highest levels of engagement in cycling apps. Extremely high usage of tool-centric elements.
- Most engaged in the social element of mobile apps. Rewards, leader boards, and badges of honor along with kudos and comments on their performance resonate.

Figure 5.3: *Four distinct segments from two step cluster, major highlights.*

A four-cluster solution using the variables of the Badge of Honour (Strava) and the World of Rules (Zwift), is the first study in cycling and sports management to adopt the use of mobile apps to segment audiences. Using mobile apps in the segment responds to the positional gap of Cox (2005). This results in the overview of each cluster presented in Table 5.3, with motivations for sport (Pelletier at al 1995), consumer involvement in cycling (Lamont & Jenkins, 2013) and engagement (Thakur, 2016). As previous studies have used motivations for cycling as a method for segmentation (Damant-Sirois & El-Geneidy, 2015; British Cycling, 2015) this study extends our knowledge about sports segmentation, as it understands the sub-cultures of cyclists (Cox, 2005) which is increasingly occurring in mobile apps.

Drawing conclusions from the four-cluster solution, Figure 5.4 shows each segment's perspective towards the five functions of mobile apps. Each cluster solution is illustrated through data visualisation (Kirk, 2016) in Chapter Four as a convenient method to digest the detailed insights (JISC, 2013) which presents marketing professionals with a critical toolkit to make informed decisions on segmentation.

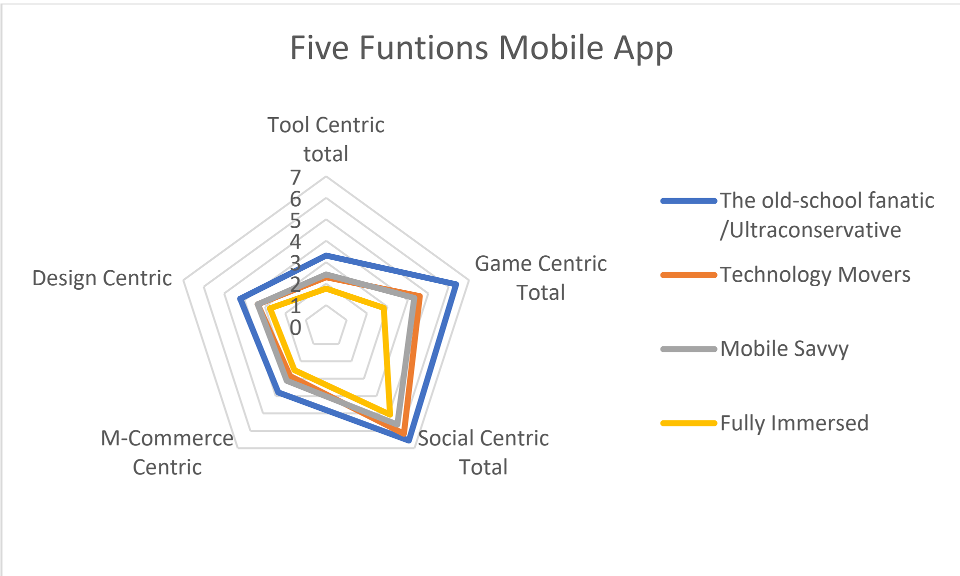


Figure 5.4: *The five functions of mobile apps in cycling for four segments*

When comparing and contrasting the four clusters, Figure 5.4 shows their propensity towards each function of the apps. Drawing conclusions at an individual cluster level, see linkages with attitudes toward technology (Van Doorn et al., 2010; Thakur, 2016; Pansari & Kumar, 2017). For example, the Fully Immersed cluster has the highest propensity to engage with all five functions, which is correlated to their high adoption of monthly subscriptions for cycling (86.5%) typically indoor cycling between 2-3 hours (23%), and high usage of cycling apps daily (58.7%) and mobile apps downloads 25-49 (mean 2.19). In contrast the Old-school Fanatic/Ultraconservative cluster demonstrates the least propensity to engage in the five functions of mobile apps which is correlated to the lowest adoption of technology through monthly subscriptions for cycling (46.7%), typically never indoor cycling (31.4%), and low usage of cycling apps daily (36.2%) and mobile apps downloads 1-24 (mean 1.68). This builds on the work of Zhao and Balgue (2015) by presenting consumer insights on each cluster’s attitudes and propensity toward the features of the mobile app. Furthermore, it builds upon academic research from Cox’s (2005) request for further knowledge of cycling sub-cultures, to present cluster segments in cycling sector mobile apps for the first time.

The conclusion on each of the four clusters is presented with their level of involvement in cycling, motivations for cycling, and engagement in mobile app shopping. Involvement in cycling between the four clusters concludes with a highly engaged audience across the four segments, supported by the self-identification of a cyclist and the hobby-like nature of the sport (Bloch & Bruce, 1984; Lamont & Jenkins, 2013). Involvement in cycling thus does not provide a meaningful way to segment audiences within the cycling market. However, understanding audiences’ motivations for engaging in cycling draws different conclusions from the various clusters, as seen in Figure 5.3.

All audiences have a propensity towards amotivated regulation motivation; this supports the findings of the nature of the high involvement of the audience self-identifying as a cyclist, in other words being a cyclist is part of their identity (Bloch & Bruce, 1984; Lamont

& Jenkins, 2013). However, it is on closer inspection of the additional layers of motivation that differences are drawn. For example, the Fully Immersed cluster is the most motivated across a variety of factors of the SDT motivations model (Pelletier at al 1995), which results in a high level of intrinsic motivation. Whereas in contrast, the Old-school Fanatic/Ultraconservative cluster's primary motivatation is amotivated regulation. Being a cyclist for the longest time (mean 25.1 years) they are motivated, by self-identity as a cyclist, which they have always been. This leads to the conclusion that motivations for cycling are connected to self-identity. For example, the Old-school clusters maintains the traditional forms of cycling whereas the Fully Immersed explores new technologies through mobile apps.

Conclusions can be drawn on adoptions of the use of mobile engagement as the cluster of the Fully Immersed engaged in various different motivations for engaging in shopping via the mobile (social facilitation, time filler, utilitarian, monetary experience, intrinsic enjoyment) whereas the cluster of Old-School/Ultraconservatives engage in mobile shopping as a functional tool, primarily motivated by time filler and utilitarian. Thus, the study draws the conclusion that all clusters' engagement in mobile shopping shows distinct motivations and there is correlation towards their adoption of technology and mobile apps in cycling (Van Doorn et al., 2010; Thakur, 2016; Pansari & Kumar, 2017). This results in the outcome of the fully immersed cluster showings high adoption of mobile apps and technology and feeling comfortable with this transfer into mobile shopping whereas the Old-School/Ultraconservatives have not made this move to the adoption to mobile shopping due to lower adoption of technology and mobile apps.

Comparing and contrasting segments leads to the identification of additional findings of the study, for example, variances in the four clusters for game-centric, social-centric functions and finally the usage of indoor cycling. This study draws further conclusions that Strava and Zwift are influencing consumers in cycling, as their propensity to engage with game-centric mobile apps of Strava and Zwift is becoming part of their self-identity as cyclists and influencing their behaviours. For example, the game of Zwift can only be played on an indoor trainer, resulting in clusters adapted to cycling indoors to partake in the in-game play.

A key academic contribution of the study to knowledge is the significance of game-centric tools in particular Strava (Badge of Honour) and Zwift (World of New Rules). Figure 5.4 visually illustrates the variance of game-centric tools across the four clusters and using these variables supports the approach to create distinct clusters, responding to Cox's (2005) call for further research on audiences of cycling, to understand the sub-cultures of cyclists. Furthermore, it draws the conclusion that Strava and Zwift have a significant influence on consumers, as audiences use these platforms to engage and connect with the cycling community (Hofacker et al., 2016).

The social-centric function of mobile apps sees the highest average mean across all four clusters, presenting findings of a relatively small segment of each cluster who engage in co-creation, with the Fully Immersed being more likely to than other clusters to engage. This is aligned with other studies (Sarmah, Kamboj & Rahman, 2017) which conclude only a small percentage of audiences engage in co-creation and provide further research potential to investigate the motivations in the context of cyclists.

The level of indoor cycling vastly differs across the four segments. The lowest engagement is witnessed among the Technology Movers Cluster (32.4% never cycling indoors) to the highest amongst the Mobile Savvy Cluster (79.3% cycling weekly indoors). This variance is attributed to the cluster's level of involvement with the mobile apps of the virtual new world (Zwift), the propensity to cycle indoors is linked to their level of engagement in AR/VR worlds. Both Old-school Fanatic/Ultraconservative, and Technology Movers are less likely to cycle indoors, attributed to not engaging in AR/VR worlds. The Fully Immersed and Mobile Savvy are likely to engage in indoor cycling, which is attributed to engagement in AR/VR mobile apps.

5.7 Recommendations for Practice

As the DBA is a professional doctorate the recommendations for industry and practice will be emphasised. These recommendations will focus on both the cycling sector and other sports and leisure sectors.

This thesis stresses the significance of mobile apps being context-specific, in line with Zhao and Balugue (2015). On reviewing 50 apps within the mobile cycling sector the themes of tool-centric functions identified the features of mobile phones as navigation and cycling computer/data performance. Specifically, the weight of importance cyclist place on the brands of Strava and Zwift as mobile apps is a central focus of other cycling brands when it comes to their marketing strategy. For the first time, this study uses both platforms to segment audiences, such is the power of influence these apps have on consumers.

Strava and Zwift are the go-to places, for consumers in cycling to hang out and engage cycling brands should attempt to leverage these platforms. For example, Strava presents an opportunity to engage audiences due to its social focus, as such cycling brands can use Strava as a platform to connect and engage with audiences, to share ideas and content. Zwift and its virtual reality present a different opportunity, for cycling brands to build up communities with regular rides, competitions, leader boards, and sharing of successes. Both Strava and Zwift should now be central pillars of cycling brands' marketing strategies. Cycling retailers such as Merlin and Wiggle CRC are lacking in their engagement in the communities of Strava and Zwift. For example, weekly rides/races on Zwift and regular challenges/competitions on Strava. In addition, these retailers could build in gamification in their own mobile apps, for example Wiggle CRC is currently merely a mobile commerce platform. Building gamification into their current mobile apps could be through activities such as Badge of Honour via purchase levels and taking part in weekly rides on Zwift or challenges/competitions on Strava.

A subsequential finding is that cyclists are heavily involved in their sport, illustrated through exhibiting behaviours, for example, monthly spending, length of time cycling and skills levels of cycling. This presents an opportunity for cycling brands such as retailers and manufacturers to utilise all four clusters as viable marketing opportunities. Whilst different cycling brands will focus on a primary cluster based on the organisation's primary objectives, marketing activities and efforts will translate across to other clusters due to their high-level involvement within the cycling sector overall. This points to the conclusion that level of involvement in cycling, is not a variable that should be used to segment audiences. A recommendation for cycling retailers such as Sigma sports is to move away from their current mobile app which has a mobile commerce centric focus. The lack of adoption of their current mobile app (currently at 1,000 downloads on Google Play), indicates that it would benefit from developing additional features that are more social centric (e.g. sharing experiences of cycling) tool-centric (e.g. navigation and GPS commuter data) and game-centric (e.g. regular rides on Zwift) to develop a community within the mobile app with a range of involvement levels in cycling.

The high level of penetration of subscription cyclists is an interesting discovery from the research findings. The research discovered 73.39% (n=434) have a monthly subscription for cycling-based apps. In the time frame to complete the study, additional brands (e.g. Strava and Wahoo) have entered this market space or changed their offering to be more focused on a monthly/annual subscription. A recent example following Zwift's recent round of capital investment has seen the launch of hardware with an entry level smart turbo trainer, targeted towards a new market segment. A recommendation for Zwift is to maintain a focus on the core audiences (Fully Immersed) to develop additional features of the mobile apps and use this round of capital investment to develop further software features. Maintaining this focus on this audience to develop features in the field of gamification will maintain this audience's high engagement in monthly subscriptions. An additional recommendation is the potential to engage the small segment with an interest in co-creation. Those in the cluster of the Fully Immersed wanting to engage in co-creation could be presented with the community to share ideas for new developments of Zwift, vote on the new software ideas and finally be presented with kudos for those innovative ideas that are adopted.

The importance of sharing a value proposition that is targeted towards a particular cluster of the study is vital to success, understanding the motivations of this audience will lead to the development of mobile apps that are in-tune with the audience's expectations. Cycling brands such as Strava and Zwift have an array of data on audiences that is not always freely available on open market sources. Not all cycling brands have such a luxury position to capture big data. Findings from this thesis present businesses with the significance of mobile apps for consumers for the first time plus new opportunities for them to explore their own marketing strategy. An example of such an organisation is a local cycling retailer with whom I have shared the initial findings of the study and who has already endorsed and supported the output, whilst adopting a persona from the research.

This study has developed a model of the functions of mobile apps (see Figure 5.1) within cycling and presents marketing professionals with practical guidelines for each cluster and what they are looking for when it comes to mobile apps (see Figure 5.3). The development of the four distinct clusters with a high level of understanding of their motivations for sport, involvement in cycling, and their attitudes towards customer engagement in mobile shopping. A recommendation for Strava is to adopt additional understanding of motivations for cycling, into their data collection. Understanding motivations of cyclist allows for targeted and personalised messages to encourage engagement in cycling. Additionally, the data on motivations would allow Strava to develop additional features of their mobile apps, targeted towards the most significant motivation types.

The method of becoming immersed into mobile applications within the cycling sector was the starting point of understanding for the study. Cycling audiences want to ‘hang out’ in various mobile applications for their interest in cycling. Marketing professionals need to be appreciative, as to which mobile applications cyclists are using moving forward as the sector is evolving at a fast pace. Moving forward cycling brands should capture audience attitudes toward mobile apps, in a similar way as they would collect other segmentation data. Collecting consumers’ attitudes towards mobile apps means they can respond to changes in consumer preferences over time. It would also allow further focus on current marketing activities. For example, should data point to the Fully Immersed Cluster it would allow deploying additional marketing resources into the platform of Zwift. Additional new mobile apps will present new opportunities, for example a recently launched app called Link My Ride offers the ability to develop social rides based on local communities. Cycling brands such as retailers and fitness apps need to aware of these new entrants and should they be the new place to ‘hang out’, then building the new app into their marketing strategy.

This study is also transferable to other sectors, for example the sports sector and other leisure sectors. In particular, sectors that have a “hobby-like” (Bloch & Bruce, 1984) nature offer similarities to cycling, as this allows a connection to the high level of consumer involvement. Other sectors could use mobile applications to segment and divide audiences; this would require an immersive approach to understanding mobile applications within these sectors. For example other sectors that might adopt mobile apps to segment audiences in high involvement areas such as golf, festivals or arts. Following the approach used in this thesis, the starting point would be to review mobile applications as context pertaining to the particular sector is vital (Zhao & Balugue. 2015). The methodological approach of this study to review mobile applications and then refine them, based on five functions of mobile apps presents opportunities for new models to be created for each sector of study. Once this model of the five functions is created and a two-step cluster is perfectly suited to divide based on mobile applications adoption. The approach is already of interest to organisations based within the horse racing sector that are currently investigating the approach that has been adopted within the study.

In order to aid the practical examples of utilising clustering for cycling audiences on their engagement in mobile apps, Table 5.1 distils the key practitioner takeaways. These crucial practical takeaways provide distinct benefits and justifications as to who should be targeted and why. In drawing out these distinct benefits, additional evidence is drawn from each cluster, along with presenting a central contribution to practical knowledge of the thesis. For the first time, mobile apps are not only being used to cluster audiences but in order to understand the attitudes and behaviours and inform marketing strategies of mobile apps.

Contributions toward practice	**Explanation**	**Examples and Actions**
The growing significance of mobile apps such as Strava and Zwift. The importance placed on such platforms by consumers, with 73.39% of subscription cyclists paying monthly or annually.	Cycling retailers must adopt Strava and Zwift in their marketing communications activities. Currently, big retailers such as Merlin and Wiggle CRC have not adopted Strava and Zwift as part of their digital marketing activities. Presenting an opportunity for the big retailers to engage and connect with audiences with the locations of Strava and Zwift, where they are hanging out.	The biggest online retailer in the UK for cycling is Wiggle CRC, which should seek opportunities to engage audiences of communities through Strava and Zwift – through a partnership. In using the platform of Zwift, Wiggle CRC could adopt the use of weekly virtual reality rides and races, in order to simulate and engage in this community. Additionally, in stimulating this community, Wiggle CRC should adopt the of use of Strava to share success with badges and kudos (developing both challenges and competitions) presented on their weekly Zwift rides. This would result in the opportunity to connect and engage with an audience with a focus on the fully immersed cluster, as it presents an ideal opportunity to communicate a range of indoor cycling products and services. For example; indoor cycling trainers and accessories, as well as indoor cycling clothing.

The level of involvement in cycling is highly supported by monthly spending, length of time cycling and skill levels.	The level of involvement across all variables was extremely high due to the hobby-like nature of cycling (Bloch & Bruce, 1984; Lamont & Jenkins, 2013). This thesis draws the conclusion that clustering audiences on their level of involvement in cycling provides no distinguishable benefits. This thesis concludes with four clusters and adopts the use of mobile apps as the method to segment. In using mobile apps to segment, for the first time, the study expands existing knowledge of involvement and results in presenting four clusters that are viable and opportunities for different retailers and manufactures. An essential element is to identify the positioning of each of the clusters in order to respond to attitudes and beliefs.	The four distinguished clusters present opportunities for manufacturers and retailers to focus their strategic digital marketing decision. For example, the Fully Immersed, given their lack of experience in the mechanical operations of a bike, present an ideal opportunity for independent retailers to focus on maintenance servicing and repairs. The local physical bike shop is positioned to communicate, through primarily Zwift and Strava, their offerings regarding servicing to respond to the requirements of maintaining both their indoor and outdoor bikes. The Fully Immersed cluster is the most engaged in the social elements of mobile apps and the local bike shop could also adopt the use of Strava in order to tap into their attitudes towards leader boards, rewards and kudos and comment on performance. This would then amplify the local bike shops' social media reach towards this fully immersed community and other clusters such as Mobile Savvy. Whereas, in contrast, online retailers such as Merlin are ideally positioned to focus on the Old-School Fanatic/Ultra Conservative with bike components, as the other most comfortable mechanically updating and making changes to bikes. With this confidence in maintaining bikes, along with the diversity in the forms of bike ownership, the Old-School Fanatic/Ultra Conservative are the most confident at buying bike components and fitting themselves. As this cluster is most likely to cycle outdoors, and this being the longest serving linking towards their primary motivation of cycling of intrinsic motivation in market activities would resonate with this audience.
The core benefit sought from clusters on mobile apps is tool centric, social-centric and	The thesis identifies the core benefits that clusters seek when it comes to the adoption of mobile apps and cycling context. The	The high-end retailer of Sigma Sports currently has a lack of adoption of their mobile app with 1,000 mobile apps on Google Play. The lack of adoption of mobile apps could be attributed to the M-Commerce focus.

game- centric.	research concludes with the mobile app functions of tool-centric, social-centric and game-centric as the most important to focus activities and time upon. Retailers and manufacturers who lack the adoption of mobile apps should focus on these core benefits that are sought, in particular, there also may be opportunities to partner with organisations such as Strava to integrate the core benefits of tool-centric, social-centric and game-centric.	Sigma Sports would benefit from developing additional features for its mobile app. In developing these additional features, the focus should be on social-centric, for example sharing of cycling experiences, tool-centric for example navigation or performance data and game-centric for example regular rides on Zwift. As the development of mobile apps has become more mature, developing additional features is increasingly becoming more cost-effective. This presents an opportunity for Sigma Sport to focus mobile app development on the core benefits saught from all clusters. In developing these core benefits of mobile apps Sigma has an opportunity to engage audiences based on their preferences. Driving communications towards the mobile app raises the awareness and profile of the core benefits and attracts audiences to adopt the new app.
Mobile app development in cycling moving forward.	The thesis concludes that new innovations and development of mobile apps will be led by the clusters of the Fully Immersed and Mobile Savvy. Both of these clusters see behaviours of adoption of technology innovation through; mobile, mobiles apps, and cycling technologies. This resulted in both clusters demonstrating a high usage of cycling subscriptions and this makes ideal cluster to target mobile apps moving forward.	As both the Fully Immersed and Mobile Savvy are highly engaged with indoor cycling links towards VR such a Zwift, this sector is primed for technological advancements for further innovation. For example, the development of virtual reality headsets with Apple recently launched for the first time. Alternatively, another example of such a technological innovation on the horizon is Heart Rate Variability (HRV), which determines intervals between heart beats, known as RR-interval. Both of these technology developments present opportunities for Zwift to develop in gameplay to be a much more immersive experience of the virtual worlds for both clusters of the Fully Immersed and Mobile Savvy. Additionally, HRV presents an opportunity for Strava to analyse data on performance with greater levels of accuracy and insight along with visual method, for example, a recovery rate score for a day. Other technological advancements will come, and the research contributes towards practice

		with the clusters of Fully Immersed and Mobile Savvy showing high engagement in technology enhancement for cycling. The clusters of the Fully Immersed and Mobile Savvy both demonstrate a high engagement with social-centric mobile apps, thus presenting opportunities for app development. For example, currently, an under-explored opportunity is the ability for mobile apps to develop experiences such as relationships with cycling clubs, the development of core cycling skills and organise the social elements of a group ride or activities. Whilst other platforms, such as social media stimulate such activities, for example cycling clubs from a range of methods such as WhatsApp groups, e-mail circulation, social media pages. As both clusters of the Mobile Savvy and the Fully Immersed are highly engaged with mobile apps in a cycling context, it's primed as an opportunity to develop such experiences. However, if developing new apps, the significance of integrating the existing key player of Strava, due to the app's high penetration with these two clusters.
Saturation of subscription-based mobile apps.	The thesis discovered a 73.39% of cyclists have a monthly subscription for cycling-based mobile apps. There is a caution of market saturation, whilst apps such as Strava currently reposition their pricing strategy, with prices increasing in all its geographical markets. Caution is needed for new mobile existing and new mobile apps, as innovation is required to business models. The default model of the subscription has seen exceptional growth which is the conclusion of the	In developing mobile apps moving forward the need to respond to unique propositions. Mobile apps need to resolve new challenges for cyclists and consider a different business model. A perfect example is a mobile app focusing on sports nutrition. Currently, no mobile app presents a solution to both hydration and nutrition. A mobile app resolves the nutrition and hydration problem for cyclists and should connect to a GPS head unit, to present advice on how and when to intake food and fluids presenting a new opportunity for the marketplace. In developing this mobile app rather than using a monthly subscription, a commercial relationship could be created with sports nutrition companies, selling directly through this mobile app aiding consumers' convenience. A cluster perfectly

	findings. However, other sectors such as those of wider health and fitness add evidence, at some point in time, that natural saturation will be reached on this monthly subscription model (Marketing Week, 2017).	suited towards such a nutrition app is the technology movers, as mobile apps for cycling are used by 90% on a daily or weekly basis, with mature adoption of mobile commerce for cycling purchases.
Integration of mobile apps moving forward.	The thesis identities the design-centric function of mobile apps is an expectation from all clusters, figure 4.33. The cluster expects ease of use and a convenient app that aligns with the brand. As mobile apps in cycling sees mergers and acquisitions, along with the expansion of new mobile apps integration through the design centric function of mobile apps is an expectation of clusters.	Mobile apps such as Wahoo X, have recently acquired a number of other mobile apps. Following these acquisitions, they are all branded under an overarching Wahoo identity. However, each individual app is currently operating in isolation resulting in vast differences in the user experience which are adopted from the original mobile. One of the significant findings of the study, for the first time, is the creation of design-centric functions of mobile apps. With the development of the framework (Figure 5.1) these design-centric apps identified m-branding as of central importance for all clusters. Wahoo X, thus needs to integrate consistency of the design-centric function across the variety of apps, in order to ensure consistency across the various apps that have been acquired. This recommendation will extend to other technology companies as they expand through additional acquisitions and mergers or expansion of new marketing opportunities with the development of new mobile apps.
Recommendation from Zwift to focus on a core cluster of fully immersed.	The discovery that Zwift's rapid expansion in the technology business, following capital investment. This rapid expansion requires diversion into new markets geographically and/or new market opportunities in terms of clusters. This is seen in a recent launch of an entry-level smart turbo trainer targeted towards	This expansion of new target markets to satisfy capital investment, growth and expansions is common in technology and additional health and fitness sectors. However, a key element of subscription-based businesses such as Zwift is to maintain a regular customer base – as this drives profitability to the subscription business model. This sector of AR and VR has seen a rapid expansion of other competitors in cycling. Whilst Zwift dominates the market with a first mover advantage, the importance of continuously

	new segments such as the technology movers.	developing features of the app with the cluster of the Fully Immersed at the centre. As the cluster is the most engaged in Zwift designing features such as gamification in order to maintain the audience's high engagement in monthly subscriptions, is essential. These elements of gamification might result in features such as badges of honour that focus on competitive nature, specialist kits and bikes for those engaged in the platform for the longest time frames. Additionally, as there is a small segment of the Fully Immersed interested in co-creation Zwift, could develop this community. In developing this community of co-creation Zwift would allow a small (opted-in) audience to partake and create new developments of software, allowing the community to then vote with kudos on these new ideas. In stimulating the small audience of the fully immersed wishing to engage in co-creation, it is also amplified by sharing through social channels to a wider audience. The key reasoning is to draw on the benefit of the Fully Immersed cluster, to form a deeper relationship towards the VR platform of Zwift, and maintain a high engagement of monthly subscriptions.

Table 5.1: *Key practitioner takeaways.*

5.8 Contribution to Knowledge

The thesis contributes to knowledge in two key areas; developing a testable framework through the five functions of mobile apps and for the first time demonstrating in sport marketing the relevance of mobile applications to segment audiences.

The first significant contribution of the study is the conceptualisation of the five functions of mobile apps seen in Figure 5.1 (i.e. tool-centric, game-centric, social-centric, m-commerce-centric, and design-centric). This builds and empirically tests the five functions of mobile app development in a previous study by Zhao and Balague (2015) for the first time in the context of cycling. The study, therefore, provides contribution to knowledge with the creation of the five functions model, which is empirically tested to demonstrate its rigour.

The study's second contribution is to segmentation and sport marketing by proving the relevance of mobile applications as a segmentation criterion in high involvement categories. For the first time in a sport marketing and segmentation context, the study has adopted mobile apps to segment audiences, in addition to developing an in-depth understanding of each of these clusters and their usage, adoption of mobile and mobile apps. The empirical model includes tool-centric apps of navigation and cycling computer/data performance that are important in the cycling sector, supporting the notion of a hobby-like nature (Bloch & Bruce, 1984; Lamont & Jenkins, 2013) contributing to the knowledge of reviewing apps on a case-by-case bases (Zhao & Balague, 2015).

The game-centric function of mobile apps supports the research of Hofacker et al. (2016) with the validation and inclusion of both game mechanism elements and story elements. This study contributes by building on previous findings by Hofacker et al. (2016) with the inclusion of game mechanism elements (Strava's mobile app through "badging") and validating the importance of cycling mobile apps as they build communities, developing social collateral and supporting future interactions. The virtual world mobile apps (such as Zwift) validate the story element of Hofacker et al. (2016) as accepting new values and beliefs of the new world (Slater & Rouner, 2002).

The empirical testing of the model contributes to knowledge for social-centric apps, validating two typologies of O'Hern and Kahle (2013), co-creating and co-communicating, as small segments of cyclists are willing to share opinions, inventions, and insights (O'Hern & Kahle, 2013). In turning to, m-commerce-centric functions the empirically tested model included both scan barcode/QR code/Vouchers and Coupons

(Khajehzadeh, Oppewal & Tojib, 2014) and mobile payments (Chang, Chen & Zhou, 2009). Finally, the study contributes to academic knowledge as design-centric apps are supported in all stages of data collection as brand name (McGrath & McCormick, 2012), brand design (Harridge-March, 2006), branded logo (Rowley, 2009), and brand content (Okazaki, 2006).

The thesis has developed the academic knowledge of five functions of mobile apps as proposed by Zhao and Balugue (2015), empirically testing a framework. At the point at which the research commences, all five functions of mobile apps posited by Zhao and Balugue (2015) are at rudimentary stages of development. The thesis has taken a multi-stage exploratory approach to test these five concepts, with EFA supporting the instrument measuring the five functions. The step forward in academic understanding is significant and for the first time provides a critical tool for the five functions of mobile which both digital marketing academics and professionals are able to adopt.

This study has extended knowledge, for the first time using mobile apps to segment audiences within sport management and cycling (Lamont & Jenkins, 2013). A significant step is taken forward in academic understanding of the sub-culture of cyclists (Cox 2005) in using mobile apps to cluster, supported by their significant growth and adoption in the review of 50 apps. The multi-stages of research supported the notion of Strava game-mechanism elements, (Hofacker et al., 2016) and Zwift story elements (Hofacker et al., 2016; Slater & Rouner, 2002) being highly influential with four clusters providing distinct differences of segments.

Additionally, the study contributes to a level of insight into each of these clusters including the level of involvement in cycling, customer engagement, motivation of SDT and finally the functions of mobile apps. This level of understanding of audiences in cycling builds on existing research in transportation (Ton & Duives, 2021; Wardman Hatfield & Page, 1997), and motivations for cycling (Downward & Lumsdon, 2002; Lumsdon 2000;

Nguyen & Pojani, 2022) and develops new knowledge in the under-explored research of cyclists on mobile apps, engagement in mobile apps, and the five functions of mobile apps in a cycling context.

5.9 Strengths and Limitations of the Study

A strength of the study is informed by the collection of data across four stages, generating additional layers of rigour to the study.

- Stage one reviews 50 mobile apps in cycling and responds to a call for context-specific research when it comes to apps and was used to inform the second stage.
- Stage two of pre-testing refined the conceptualisation of the five functions of mobile apps.
- Stage three utilised EFA, to reduce the number of items and justify the remaining items for the conceptualisation of the model of the five functions of mobile apps.
- Stage four again used EFA to test the inclusion of the items within the final model of the five functions of mobile apps, in the context of cycling apps.

The strength of the thesis is therefore the development and refinement of the framework for the first time of the functions of mobile apps, in the context of cycling and sports studies.

Moreover, the nature of exploratory research requires multiple stages and multiple perceptions of investigation (Converse & Presser, 1986; McIntyre & Hobbs, 1999; Baxter & Magoldac, 2004). One of the strengths of the thesis is the evolution of academic research to support the five functions of mobile apps. Whilst Zhao and Balague (2015) identified the five functions of mobile apps with a review of 100 branded apps, the focus of the review was merely a description of these functions, with no empirical findings or qualitative data collected.

This thesis used multiple lenses of theory and research to explore the five functions of mobile apps, before conceptualising them into models for testing, giving depth and rigour to the exploration. Additionally, the lenses of research for understanding clusters draw on a range of academic themes of consumer involvement in cycling (Lamont & Jenkins, 2013), SDT motivations for sport (Pelletier at al 1995), and customer engagement (Thakur, 2016). Therefore, a key strength of this study is the breadth of literature that was utilised to conceptualise the framework of the five functions of mobile apps. This breadth of literature was vital in meeting the research objectives due to the infancy stages of the five functions of mobile apps. Without using a breadth of literature and transporting existing theory into mobile apps the framework of the five functions and mobile apps would not be tested.

A further strength lies in the creation of a four-cluster using the influence of mobile apps in the cycling sector for the first time. This shines a light on the importance of mobile apps within this sector, as an area of growth and expansion within the last decade. The rapid pace of growth in mobile apps in the sector is highlighted in the innovative method of data collection, in reviewing 50 mobile apps. Thus, the strength of the study develops themes of mobile apps in cycling within the sector, for further investigation.

All studies exhibit limitations. Three key limitations have been identified within this study. The first is the self-selection criteria of identity as a cyclist that are utilised when completing the survey instruments. The sample exhibits a high level of involvement in cycling, with a mean of 1.36, identifying themselves as a cyclist, resulting in what can be described as a highly engaged audience, which is not surprising given the 'hobby nature' (Bloch & Bruce, 1984). Whilst this high level of involvement in cycling is acknowledged as a limitation of the study, the sample selection shared the instrument, through a range of channels of cyclist groups, in order to capture a range of levels of commitment to the sport. An additional finding from the study is thus self-identification of cyclists is high through all four clusters, as each is committed to being involved in the sport.

A further limitation is the scope of study, with further research on the model of the five functions of mobile apps, utilising confirmatory factor analysis (CFA) and structural equation modelling (SEM). In using CFA and SEM, the modeling requires additional data collection and further support for the empirical findings of the model for the five functions of mobile apps. As with any study a scope needs to be defined and parameters create aims and objectives. However, the conceptualised framework of the five functions of mobile apps provides further research opportunities, post-doctorate.

The final limitation is in fact a confine of the study, with the field of mobile apps in cycling being one fiercely competitive for both cycling and technology companies. This is exhibited by Wahoo's recent acquisitions of RGT app (Smythe, 2022), or Zwift's $450 million series C funding (Reuters Staff, 2020). In the creation of new opportunities and markets that mobile apps present, the momentum of change is consistently evolving. Changes within mobile apps within cycling have occurred over the course of the study as things consistently evolved, an example is Strava moved from a free offering for most features to a monthly subscription for the most popular feature such as segments. This thesis has consistently been mindful of these adaptations and changes and updated the review of the 50 mobile apps, with the final review conducted in July 2022. Thus, a limitation of the study is need for further research at later timeframes, as mobile apps evolve in the sector.

5.10 Recommendations for Future Research

This thesis offers three primary opportunities for future research. Firstly, additional research would be beneficial in the area of the five functions of mobile apps with further statistical methods to further test the model, such as confirmatory factor analysis and structural equation modelling. With further investigation into the outputs such as; satisfaction, loyalty, and post-purchase behaviours, of the five functions of mobile apps being ideally positioned for further research. In exploring loyalty and post-purchase behaviour, further investigation would develop additional knowledge as to how mobile apps informed consumer behaviours. Particularly of interest to cycling would be loyalty following the purchase of an annual or monthly subscription to a mobile app.

Secondly, investigation within a cycling context would be the exploration of further research into mobile apps based on other segmentation of variables such as gender. This route of investigation could provide a further understanding of how gender influences cyclist motivations and their utilisation of mobile apps. As cycling is heavily male-dominated in terms of participation, it would be interesting to see variances that exist between males and females for their adoption of mobile apps and cycling alongside their motivations in order to see if there was any correlation/relationships between genders.

Finally, the methodological approach using exploratory research to investigate five functions of mobile apps provides further research potential in additional sectors, both sports and leisure activities, where involvement for the consumers is high and adopt the use of mobile apps to segment audiences. This could be of particular relevance in areas where the mobile app is dominantly placed in influencing consumers' attitudes, for example travel and other sports such as horse racing.

5.11 Personal Reflection

Reflecting on my own experiences over the course of the doctorate is particularly important, as I would self-identify as a cyclist. My first love of the bike came when a child, as it was a sense of freedom and movement. However, my high level of involvement in the cycling sector started 12 years ago, when I became a regular and highly committed cyclist. As my level of engagement in cycling has expanded, over a period of time, I am now immersed in the community.

Identification of my own cluster results is described as Old-school Fanatic/ Ultraconservative as I do not partake in the usage of mobile apps of Strava or Zwift. In order to overcome the bias of the research, I have not utilised mobile applications for cycling, while I have downloaded these in order to understand the functions and features that exist. I have refrained from entering any monthly subscriptions or in other words maintained a low commitment toward mobile apps in cycling. An additional rationale for not committing to mobile apps in cycling is my overzealous nature for analysing data when it comes to performance. My experiences in cycling and other sports are very much around enjoying the moment of the sport, rather than over-analysing Strava segments or trying regularly to improve these times.

With a previous background in industry, the health sector was one I spent a significant time within. This shaped my interest in sports, physical activity, health, and well-being. The opportunity to utilise this pre-experience, alongside my interest in mobile apps was the rationale for undertaking this study. This affords many opportunities to engage in the cycling community, for example, engaging with a local cycling organisation to regularly sense check the scope of the study.

When it came to conceptualising the five functions of mobile apps, constantly checking in with the cycling community was paramount, due to the nature of the evolution of mobile apps in cycling evidenced in the strengths and limitations of the study (Section 5.9). Regularly checking with the cycling community was important for; the usage of mobile phone apps for cycling, overlaying the four clusters with real cyclists, and regular updates on what was occurring in the sector. In addition, checking in kept research grounded in practical application, as required by the professional doctorate route.

A particular strength of the study is evidenced by the cycling community commenting on how important Strava and Zwift are; often feedback when sharing the study stressed how vital these two apps were to cyclists and that they cannot live without them. In particular, this is evidenced by an extract of an e-mail from the chairpeople of two cycling clubs, who volunteered this of their own accord:

Cycling Club One Chairperson:

> "Zwift we had in our club during the lockdowns and the use of 'discord' which helped to keep us all connected. A core of at least 30 have very quickly become experienced in the use of new technology and use it to race, ride socially and more. Zwift has been an amazing game which has helped to keep a core group of riders very fit during the winter plus connected when we had all the Covid restrictions. I know other cycling clubs locally and in Scotland have had similar experiences and in fact used the technology to greater extent than the XXX[1] cycling club have."

Cycling Club Two Chairperson:

> "I like many others at XXX[1] cycling club use both Strava and Zwift apps extensively. Both are great tools to track my progress along with keeping me motivated. Zwift allows me to better maintain my fitness due to poor weather and to better manage my time around family commitments. Strava allows me to challenge my monitor the performance of speed and distance. I also enjoy my bit of recognition and competition from both apps, such as goals, trophies, queen/kings of mountains. Many like me at XXX[1] cycling club are addicted to Strava, Zwift and our mobile phones."

[1] XXX donates redacted information

The initial findings of the thesis have been shared with a local cycling organisation and have provided supporting endorsements to this novel approach of segmenting audiences in the cycling sector. The organisation has stressed the significance of using Strava and Zwift as the mechanism to segment audiences. In presenting the four clusters as an overview the organisation can identify customers that fit these typologies.

Post-doctorate I look forward to working further with this organisation to investigate how the four clusters impact commercial benefit. In addition, the horse racing sector, through a large organisation, has held outline discussions of research findings and is exploring the implications of mobile apps within this racing sector.

5.12 Conclusion

This chapter concludes the thesis which has explored the research objective:

> ***Identify and develop a testable method to cluster cycling audiences based on their engagement in the functions of mobile apps and additionally their attitudes and behaviours.***

It offers conclusions on how the study contributes to academic knowledge and as part of a requirement of the professional doctorate, provides practical recommendations.

The study offers a significant step forward in academic understanding with the testing of the five functions of the mobile apps framework. The study has uncovered the significance of mobile apps for cyclists, evident in a review of 50 mobile apps, along with 73.39% undertaking a monthly subscription (n=434). It is evident from the study the previous conceptualisation of the five functions of mobile apps was in its infancy (Zhao & Balugue, 2015). In order to understand the relevance of the five functions, the study adopted a multi-stage method of data collection in order to test the model within the context of cycling.

The application of EFA over two stages of the data collection on the five functions of mobile apps results in the model being empirically tested. This model has then been utilised to divide audiences in the cycling context, adopting a two-step cluster analysis resulting in a four-cluster solution which presents insights on involvement in cycling, SDT motivations to cycling and engagement in mobile shopping.

The key contribution of the thesis is therefore two-pronged with the development of the five functions of the mobile app model and using mobile apps to segment insight into cycling audiences. These outcomes respond to further calls for academic knowledge, whilst also aiding application for marketing professionals.

Firstly, in developing five functions of the mobile apps model, marketing professionals are provided with a critical tool to understand consumers' perspectives of apps. Each of the functions of mobile has its own features that resonate with audiences. For example, tool-centric functions of mobile apps in cycling focused on navigation and cycling computer/data performance as audiences look for such features. The consumer's perspectives of game-centric functions of mobile apps are influenced by game mechanism elements which are closely aligned to Strava's Badges of Honour, whereas the story element is more closely aligned to Zwift under and the immersive world of virtual reality. An additional example is social-centric features focused on relatively small audiences moving towards co-creating and co-communicating. Mobile commerce is established and is an expectation of consumers as they feel confident in using scan barcodes, QR codes, vouchers and coupons, and mobile payments. Finally, design-centric apps stress the importance of consistency for consumers across brand name, brand design, branded logo, and brand content.

In creating the critical tool of the functions of the mobile apps, practitioners and academics are presented with the features of mobile apps consumers wish to engage with. In understanding these features mobile apps practitioners are better placed to respond to consumers and adopt mobile apps to segment audience in high involvement categories. The research addresses an existing gap in the literature by testing the model and expanding understanding of the features consumers want when utilising mobile apps for cycling (Zhao & Balugue, 2015; Cox, 2005).

Secondly, a key contribution outcome is derived from utilising mobile apps to segment audiences, using two mobile apps, Strava (Badge of Honour) and Zwift (World of Rules), to create four distinct clusters. Creating these four clusters aids the understanding of cycling audiences, with visual data presentation of the characteristics of each, which considers their involvement in cycling, motivations for cycling, and attitudes towards mobile shopping. These cluster solutions provide marketing professionals with distinct audiences and respond to an academic call for further research to aid understanding of consumer segments within cycling (Cox, 2005).

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Appendices

Appendix 1 Review of cycling mobile apps and the tool-centric functions they utilises.

App/Downloads for App Stores	Mobile Payment	Tool-Centric Features	Tool Centric Functions
Strava Andriod: 50 M +	Free model, along month subscription or £8.99 for extra features	Strava is social mdeai platform that tracks rides with GPS, join challenges, share photos from your activities, and follows friends **Free Features** Activity Recording Device Support Social Network Beacon on Phones Beacon on Devices **Premium Features** Route Planning Segment Competition Training Dashboard HR & Power Analysis Advanced Metrics Goal Setting Training Log Compare Efforts Personal Heatmaps Partner Perks	• Training Platforms • Cycling Computer/Data Performance • Navigation
Training Peaks Andriod: 1 M +	Free very basic model, along month subscription £17.99 for extra features	Tools and coaching service for endurance athletes Popular platform tracks athlete data performance Gives you access to the advanced training	• Training Platforms

		schedule. Able to see coaches' comments and develop training plans Integrated with indoor training. TrainingPeaks is the Official training software supplier to British Triathlon	• Cycling Computer/Data Performance
Santander Cycles app from Transport for London Andriod: 500k +	Free	For regular users of the London cycle hire scheme. The app plots a cycle-friendly route to a Cycle hire docking station, telling you how many bikes and spaces there are on an easy-to-follow map. Access to your Cycle Hire account details and recent journeys.	• Navigation • The suite of mobile apps
Wattson Blue Andriod: 1k +	Free model, along month subscription or £3.99 for extra features	Wattson Blue is a training app with a focus on recovery. Often used by elite student athletes to monitor their training and recovery regime. Uses OURA ring or your metrics from Apple Health to record heart rate variability. Changes in variable heart rate suggest overtraining, oncoming illness. App logs your sleep, nutrition, and pairs with Strava to monitor your training load. Generates charts of activity and recovery levels over time.	• Cycling Computer/Data Performance • Training Platforms

VONCRANK Andriod: 500k +	Free to download – variable service / repair costs	On-demand app connects users with a network of qualified, approved mechanics who will meet at desired location to fix or service your bike.	• Navigation • The suite of mobile apps
Bike Computer - Cycling Tool Andriod: 1 M +	Free (premium version also available)	Uses your phone as a cycling computer, collects in-ride and out-ride: distance, time, average speed, max speed, elevation, temperature and heart rate Syncs with Strava.	• Cycling Computer/Data Performance
Wahoo X Andriod: 1M+ Three Apps under Wahoo; Wahoo X, Wahoo SYSTM, Wahoo RGT	$14.99 monthly or $129.99 annually	Wahoo X combines access to Wahoo SYSTM and Wahoo RGT. Wahoo RGT offers users ride simulations of real-world climbs rather than in virtual worlds like on Zwift. Wahoo SYSTM is an indoor training app, ride simulations of pro race finales, location feature, ride along to videos of real-world roads. Wahoo SYSTM acquired Sufferfest which is for dedicated athletes who follow a structured training plan, also done outdoors. Bespoke training schedule following Four Dimensional Power Profile (4DP).	• Cycling Computer/Data Performance • Training Platforms • Virtual Reality
ViewRanger Andriod: 5M+	Free, with additional map functional being in-app purchases based on	The app allows experts and enthusiasts alike to add and plans routes, anywhere in the world. Users can buy premium maps through in apps	• Navigation

	credits.	purchases provided by the Ordnance Survey. The app offers versatility: use it for road riding and mountain biking, but also for walking and hiking.	
Cyclemeter Andriod: 110k+	Annual payment £8.99	This comprehensive fitness app utilises the GPS functions of Apple devices (watches and phones) to create a host of statistics to help log and improve cycling performance: speed, time, distance and has workouts to follow.	• Cycling Computer/Data Performance
Garmin Connect Andriod: 10M+	Free (requires compatible Garmin device)	Garmin's Connect software provides a link mobile device and Garmin GPS device to share data, such as maps and ride performance. The connection work both ways, with a compatible Garmin GPS able to display weather data, food intake and notifications on the Garmin GPS. Data from the Garmin device goes into the mobile device, giving a range of ways to display the performance: charts, graphs, maps. LiveTrack lets friends follow progress online, compete in weekly challenges, compare Strava sgements and wirelessly upload activities.	• Navigation • Cycling Computer/Data Performance • Training Platforms
Map My Ride by under Armour Andriod: 10M+	Free model, along monthly subscription for $5.49 for extra	The app records data from your ride, including distance, speed, elevation, and a detailed route. All of this can be	• Navigation

	features	uploaded to the Map My Ride for detailed analysis and sharing with other users,. Like Strava, Map My Ride also includes timed sections, called Courses, where attempt to set the fastest time.	• Cycling Computer/Data Performance • Training Platforms
Fill That Hole Andriod: 10K+	Free	Fill That Hole app allows reporting tarmac carbuncles. Created by national cyclists charity Cycling UK, ta plain-looking but highly functional app allows reporting the location of potholes, and forwarded onto the local authority for attention. Also add a photo of the offending crater.	• Navigation • The suite of mobile apps
100 Greatest Cycling Climbs Andriod: 1K+	£4.99	App of the best-selling book, 100 Greatest Cycling Climbs, enables the user to locate and ride all of the hills featured in the popular publication. Info and stats are presented for each climb, and riders can see how they measure up against other cyclists as the app links to Strava's segment KOMs	• Navigation • Cycling Computer/Data Performance • The suite of mobile apps •
Bike Gear Calculator Andriod: 10K+	A free version, with £1.99 One-off payment giving more advanced edition.	Allows comparing gear ratios on your bike to optimise your set-up. There are numerous variables that can be input, including tire width, wheel size, and crank length as well as the more obvious number of teeth on your	• Cycling Computer/Data Performance

		chainset and cassette.	
Bike Hub Cycle Journey Planner Andriod: 100K+	Free	Bike Hub Cycle Journey Planner will plot a route from your selected start and finish points with preferences on using roads, cycle paths and permitted paths. Choose a range of routing options from quickest route to quietest route or avoid hills ‘ App is UK only at present and uses mapping from cyclestreets.net. Also a function to find bike shops in the locality.	• Navigation
BBC Weather Andriod: 10M+	Free	Weather plays a big part in any cyclist’s life. Few cyclists don’t check the weather forecast before leaving on a ride, so can select the right clothing along knowing what conditions in for. BBC Weather app is simple and relatively accurate.	• The suite of mobile apps
St John Ambulance First Aid For Cyclists Andriod: 1k+	Free	St John Ambulance app guides through first aid treatment for a range of common cycling-related injuries, can treat yourself or others at the roadside. App deals with a very wide range of injuries, giving step-by-step advice and diagrams, plus it tells you what to do in a serious emergency.	• The suite of mobile apps

My Virtual Mission Andriod: 100K+	£20.99 for 1 year	My Virtual Mission allows to set an ultimate goal and then work towards it. For example, decide that over a few months going to cycle the same distance as the land ends to John O'Groats. Set ups a virtual journey on the app, every time cycle (or run) plots the distance on a map of virtual journey. Goal-setting and motivational tool. Also set up a long-distance ride for charity fund-raising, with the app tracking how much is raised.	• Cycling Computer/Data Performance • The suite of mobile apps
Zwift Android 1M+	£12.99 per month	Turbo trainer and device compatible with the app, riders across the world ride with or race each other inside the virtual world of Zwift. Training tool, built-in workouts and training plans, Zwift promotes social interaction and uses badges of honour to develop in game play	• Cycling Computer/Data Performance • Training Platforms • Virtual Reality
The Road Bike Manual Android: 1K+	£2.99 One-off payment	The Road Bike Manual details workshop tasks for your bike, with videos and images to illustrate key steps.	• The suite of mobile apps
Google Maps Android: 10B +	Free	Google Maps uses real time GPS navigation for bike-friendly routes and exploring local areas. Audio turn-by-turn instructions when riding	• Navigation

		Maps can be downloaded and used without mobile connection	
Komoot Android: 10M +	Free Trail then £29.99 for open access to all maps.	Komoot uses the open-source OpenStreetMap database and allows you to plan road, MTB and gravel rides as well as commute. Komoot tries to choose the most efficient route, taking into account bike-friendly a road or path is, as well as your fitness. Whilst on route, it will provides speed, distance travelled, and distance remaining and allows easy route changes. Also check out other route recommendations in your local area.	• Navigation • Cycling Computer/Data Performance
First Aid by British Red Cross Android: 500K +	Free	App uses range of videos, quizzes and step-by-step advice, helps learn how to deal with common first aid emergencies, as well as being an invaluable reference when things go wrong. All the information is stored on the phone, so access when no data connection.	• The suite of mobile apps
Trail Forks Android: 1M +	Annual cost £24.99	App has more than 161,000 trails around the world and includes conditions reports, live tracking, and even points of interest, such as bike shops. The maps are	• Navigation

		downloaded onto device for offline use. The app also has an emergency info function that will generate exact GPS coordinates and the name of the nearest trail.	
Relive Android: 10M +	£6.99 a month	Using ride data from Strava, Garmin Connect, Map My Ride relive generates a 3D video flyover of your ride, The moving map shows progress over the route, pinpoints where hit your top speed and the elevation profile, as well as any photos taken.	• The suite of mobile apps
Bikemap Android: 1M +	Free or additional feature £29.99 a year.	Bikemap app that offers route planning, navigation, real-time updates. The app's real-time updates allow to alert other Bikemap users to problems encountered during a ride. Archive of more than seven million user-generated routes, route collections and in-app ride stats. Bikemap Premium service, opens up additional mapping options, including cycling-friendly map layers and 3D views of your planned routes, offline navigation.	• Navigation • Cycling Computer/Data Performance
Ride with GPS Android: 1M +	Monthly subscription £7.99	GPS navigation plans routes in great detail, and navigate and record rides.	• Navigation

		Voice navigation, downloaded maps and cue sheets, modify routes on the go, imbed point of interest	
OS Maps Android: 1M +	Monthly cost £4.99	Database of the whole UK on your mobile device. Plot and record rides on the app, more cycling-focused alternatives make it a better research tool for us two-wheeled explorers. The map overlays allow seeing terrain, snap to path gives an enjoyable/safe route.	• Navigation
Elite HRV Android: 100K +	Free or £4.59 for more advanced features	Elite HRV app provides a way to track your heart rate variability (HRV). HRV data used for monitoring recovery and training loads Need a compatible Bluetooth heart rate monitor, such as a Polar H10 heart rate strap Also paid tiers, which offer more advanced insights and readiness information.	• Training Platforms
Rouvy Android: 100K +	£14.99 monthly	Rouvy is an indoor cycling app offering real-life routes and augmented-reality courses to ride Rouvy uses video recordings of real roads and combines with elevation data to provide an interactive riding experience. App also generates animated 3D riders.	• Virtual Reality

		Approximately 2,036,020km of route films to 'ride' on	
MyWindsock Android: 10K+	Free or premium features from £9.99 monthly	MyWindsock, mobile-compatible web app that pulls weather data and overlays a heat map of where likely to encounter head, cross and tailwinds over a Strava segment or ride.	• The suite of mobile apps
FLARE Android: 100K +	Free or £19.99 yearly additional features	A safety cycling app that offers features: incident detection, incident prevention, by alerting other road users to your whereabouts, and near-miss reporting. If a user is involved in an incident, Flare sents a emergency contacts so help can arrive quickly. Partnered with What3Words and St John Ambulance in the UK. **Price:**	• Navigation • The suite of mobile apps
CYCLEGO Android: 100K +	£35.99/~£43.65 yearly for premium)	CycleGo app is virtual training at home, hop on an exercise bike and select the workout. Audio voice guidance motivates, music adapted to the workout -, on-screen informationl pedaling speed, resistance level, standing/ seated, jumps/ sprints. Essentially a group cycling class at home.	• Cycling Computer/Data Performance • Training Platforms

		Personalised cycling plans are available if you upgrade and greater workout customisation is also offered.	
EatMyRide Android: 5K +	Free or additional features for £5.99 a month	EatMyRide creates a custom menu to eat based on your route, physiology and culinary predilections. Sends notifications to a compatible Garmin, remind to eat at precisely timed intervals, App's free plan covers both nutrition and drinking plans. Full subscription version cover to a include your breakfast, lunch and customise for your type of ride (endurance, interval, race, etc) or average HR/Power.	• Cycling Computer/Data Performance • The suite of mobile apps
BKool Android: 100K +	Free membership offers access to 12 routes only . a full monthly subscription is £7.99.	App offers virtual reality rides in groups and individual rides. Track personal goals as you choose a route, workout, velodrome, or FTP test option. Also lots of group challenges and competitions.	• Virtual Reality • Training Platforms
Tacx Training Android: 500K +	Cost: Free / €9.99 monthly (Premium) / €13.99 monthly or (Premium HD)	Tacx Training app features films of real-life roads such as Mont Ventoux and the Paterberg, training plans, customisable workouts and the ability to replicate own routes from GPS data. The free service allows users to create custom workouts, analyse training data and ride to two demo films.	• Training Platforms • Virtual Reality

		Premium or Premium HD subscription access the full library of videos and training plans or import your own GPS data. Only compatible with Tacx smart trainers.	
Link My Ride Android: 5K +	Free riders signing up individual, Club is £240 a year	Networking tool for cyclists, allows users to connect with other riders in their area to enable them to organise social rides. Post details of completed activities, such as the specificity of the level.	• The suite of mobile apps
Trainer Road Android: 100K +	£19.99 monthly	Allows you to plan and schedule rides and recommends different workouts based on current fitness ability. Use data adapt training plans	• Cycling Computer/Data Performance • Training Platforms
Fulgas Android: 50K +	£13.99 per month	Create and race your avatar on selected real-world routes from around the world. Ride with ,or against, friends in a pre-set private group or on any route. Uses AR Provides training plans	• Cycling Computer/Data Performance • Training Platforms • Virtual Reality
Cycle streets Android: 100K +	Free	Plot a route from your selected start and finish points with preferences on using roads, cycle paths and permitted paths. Choose quickest route to quietest route or	• Navigation

		avoid hills ‘ Feature that finsd bike shops in the locality.	
MyWhoosh Android: 5K +	Free	Take part in global e-sports events, through a virtual world. Multiple community-driven features mean there is a ride starting every 15 minutes with financial incentives for single or team events. Includes training plan for world leading coaches	• Cycling Computer/Data Performance • Training Platforms • Virtual Reality
Kinomap Android: 500K +	£10.49 per month	Connects user to a range of different tracks from around the world, creating, hosting and sharing rides in AR world. Includes training plans and coaching	• Cycling Computer/Data Performance • Training Platforms • Virtual Reality
Peleton Android: 1M +	£12.99 per month	Offers live and on-demand classes with complete workout options from meditation and yoga to a walk/run on the gym treadmill and cycling on the spin bike. See real-time metrics while on the move.	• Cycling Computer/Data Performance • Training Platforms
Breakaway Android: 500K +	£3.49 per month	Benchmarks assessment of ride history to discover ranking and give guidance on how to train and where to focus.Virtual coaching from cycling pros at quarterly workshops.	• Cycling Computer/Data Performance • Training Platforms

Xert EBC Android: 1K +	£8.99 per month	Workouts are optimised and adjusted to individual with no fitness tests required. It's a training platform all about power data. Athletes are encouraged to coach themselves and helps coaches to guide others.	• Training Platforms
Virtual Cycling World Android: 10K +	Monthly HD £4.99, 4K £7.99	Stream over 140 cycling scenery videos from all over the world. The AR environment share videos of real life rides	• Virtual Reality •
MotoSumo Android: 1K +	£18.99 per month	Live and on-demand cycling sessions with fitness data and interactive features using only a smartphone. Tracks metrics such as cadence, power and heart rate.	• Cycling Computer/Data Performance • Training Platforms

Note the Android is approximate downloads on 19/12/22, taken from the Android Store.

However IOS figures not available from open-ended creditable source.

Appendix 2 Approval of ethics

Research Ethics: Your submission has been approved - Kirk Dodds - Outlook - Work - Microsoft Edge

about:blank

Delete | Archive | Report | Reply | Reply all | Forward | Read / Unread | Categorise | Flag / Unflag | Assign policy | Print

Research Ethics: Your submission has been approved

EthicsOnline@Northumbria
To: Kirk Dodds
Cc: David Hart

Sun 01/03/2020 08:05

Dear Kirk Dodds,

Submission Ref: 22960

Following independent peer review of the above proposal*, I am pleased to inform you that **APPROVAL** has been granted on the basis of this proposal and subject to continued compliance with the University policies on ethics, informed consent, and any other policies applicable to your individual research. You should also have current Disclosure & Barring Service (DBS) clearance if your research involves working with children and/or vulnerable adults.

* note: Staff Low Risk applications are auto-approved without independent peer review.

The University's Policies and Procedures are here

All researchers must also notify this office of the following:

- Any changes to the study design, by submitting an 'Ethics Amendment Form'
- Any incidents which have an adverse effect on participants, researchers or study outcomes, by submitting an 'Ethical incident Form'
- Any suspension or abandonment of the study.

Please check your approved proposal for any Approval Conditions upon which approval has been made.

Use this link to view the submission: View Submission

Appendix 3 Stage 4 Final Survey Instrument

Cyclists views to mobile apps

Page 1: Study overview

Thank you very much for agreeing to participate in this survey. With project title of: Utilise a cluster analysis to generate segments of cyclist to understand their motives and involvement and motives for using mobile apps.

The information provided by you in this questionnaire will be used for research purposes. It will not be used in a manner that would allow identification of your individual responses.

Anonymized research data will be archived to make them available to other researchers in line with current data-sharing practices.

Ethical consent has been provided by the University of Northumbria to conduct this research and agreeing to take part within the questionnaire you are providing informed consent. Should you wish to withdraw consent at any time then please email: kirk.dodds@northumbria.ac.uk

Informed consent

The investigator has explained to me the nature of the study, and what is required from me. They have given me a debrief sheet providing me with their contact details. I understand I am free to withdraw from the study at any time, without having to give a reason for withdrawing, and without prejudice. I agree to provide information to the investigator and understand that my contribution will remain anonymous and confidential. I also consent to the retention of this data under the condition that any subsequent use also is restricted to research projects that have gained ethical approval from Northumbria University. *
Required

- Yes
- No

1 / 30

Page 2: About your cycling interest

Please indicate your level of agreement with the following statements concerning your participation in cycling. Place a single tick in each row. * Required

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree
Cycling is an important part of my life	☐	☐	☐	☐	☐	☐	☐
Cycling is one of the most enjoyable things I do	☐	☐	☐	☐	☐	☐	☐
I organise a lot of my life to fit around my cycling commitments	☐	☐	☐	☐	☐	☐	☐
I like other people to recognise me as a cyclist	☐	☐	☐	☐	☐	☐	☐

For how many years have you been a regular cyclist? * Required

Please enter a whole number (integer).

On average, how many recreational rides do you go on each week? * Required

Please enter a whole number (integer).

How many non-competitive cycling events (e.g. supportive) have you participated in during the previous 12 months? * Required

Please enter a whole number (integer).

How many bikes do you currently own? * *Required*

Please enter a whole number (integer).

Please identify the five bike styles you most prefer from the list below. Having identified these 5 styles **please tick 1 next to the most preferred down to 5 to the least preferred.** * *Required*

	1	2	3	4	5
Road bike	☐	☐	☐	☐	☐
Hybrid /Utility	☐	☐	☐	☐	☐
Touring/Trekking	☐	☐	☐	☐	☐
Hardtail XC mountain bike	☐	☐	☐	☐	☐
Folding bike	☐	☐	☐	☐	☐
Sportive/Audax bike	☐	☐	☐	☐	☐
Performance racing bike (e.g Time trail)	☐	☐	☐	☐	☐
Cyclocross Bike	☐	☐	☐	☐	☐
Gravel bike	☐	☐	☐	☐	☐
Full Suspension	☐	☐	☐	☐	☐
E--Bike	☐	☐	☐	☐	☐
BMX	☐	☐	☐	☐	☐
Single Gear	☐	☐	☐	☐	☐

Are you a member of any of the following? Select as many as apply. * *Required*

- ☐ British Cycling
- ☐ Cycling UK
- ☐ British Triathlon
- ☐ Other professional cycling body

☐ None

Are you a member of a cycling or triathlete club? * *Required*

◯ Yes
◯ No

Page 3: Cycling Involvement

On average, how far in **distance** do you cycle outdoors each week? * *Required*

- 0 - 24 miles
- 25 - 49 miles
- 50 - 74 miles
- 75 - 99 miles
- 100 miles +

On average, how far in **distance** do you cycle outdoors each week for commuting? * *Required*

- 0 - 24 miles
- 25 - 49 miles
- 50 - 74 miles
- 75 - 99 miles
- 100 miles +

On average, how far in **distance** do you cycle outdoors each week for recreation? * *Required*

- 0 - 24 miles
- 25 - 49 miles
- 50 - 74 miles
- 75 - 99 miles
- 100 miles +

On average, how much **time** do you spend cycling **indoors** per week? * *Required*

- Zero
- Fewer than 30 minutes
- 30 minutes - under 1 hour
- 1 hour - under 2 hours
- 2 hours - under 3 hours
- 3 hours - under 4 hours
- 4 hours +

Please indicate your agreement with the following statements. Place a single tick in each row

	Extremely competent	-	-	-	Not competent at all
I am able to perform basic mechanical tasks (e.g., change a flat tire, adjust gears and other components)	☐	☐	☐	☐	☐
I am able to safely ride in a "bunch" of cyclists	☐	☐	☐	☐	☐
I am able to take sharp corners at speed	☐	☐	☐	☐	☐

Please indicate your level of agreement with the following statements concerning cycling, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row. * *Required*

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree
I regularly read cycling magazines to keep up to date with cycling	☐	☐	☐	☐	☐	☐	☐
When making cycling based purchases, the brand is important	☐	☐	☐	☐	☐	☐	☐
I regularly visit websites to keep up to date with cycling	☐	☐	☐	☐	☐	☐	☐
When making cycling based purchases, the performance of a product is important	☐	☐	☐	☐	☐	☐	☐

I regularly watch online videos to keep up to date with cycling	☐	☐	☐	☐	☐	☐	☐
I regularly watch cycling races (e.g. highlights or live)	☐	☐	☐	☐	☐	☐	☐
When making cycling based purchases, the price of a product is important	☐	☐	☐	☐	☐	☐	☐

On average, how much do you spend on cycling each **month**? ✱ *Required*

Please select no more than 1 answer(s).

- ☐ £0-£24
- ☐ £25-£49
- ☐ £50-£74
- ☐ £75-£99
- ☐ £100-£124
- ☐ £125-£150
- ☐ £150-£174
- ☐ £175-£199
- ☐ £200-£299
- ☐ £300-£399
- ☐ £400-£499
- ☐ £500 +

Please indicate your level of agreement with the following statements concerning the purchase of cycling equipment, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row. ✱ *Required*

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree

I generally buy through online branded stores such as Wiggle	☐	☐	☐	☐	☐	☐	☐
I generally buy through online independent cycling retailers such as a local bike shop	☐	☐	☐	☐	☐	☐	☐
I generally buy through offline branded stores such as Evans	☐	☐	☐	☐	☐	☐	☐
I generally buy through offline independent cycling retailers such as a local bike shop	☐	☐	☐	☐	☐	☐	☐

When out cycling, do you use any of the following devices, to measure your performance? Select as many as apply. * *Required*

- ☐ GPS cycling computer (e.g. Garmin and Wahoo)
- ☐ GPS enabled watch (e.g. Garmin forerunner or Apple watch)
- ☐ Mobile phone
- ☐ Activity device with non GPS (e.g. Fitbit)
- ☐ None
- ☐ Other type of device

If you selected Other, please specify:

Do you currently have any cycling-based subscriptions such as Strava Summit or Zwift? * *Required*

- Have none
- Currently, subscribe and making monthly payments
- Currently subscribe and making monthly however, I plan to cancel within 6 months
- Using a free trial cycling subscription and plan to carry on monthly payments
- Using a free trial cycling subscription and plan NOT to carry on monthly payments
- Previously used a monthly cycling subscription but have now canceled

Page 4: Why do you participate in cycling?

Please indicate your level of agreement with the following statements concerning reasonings for cycling, **using a scale of correspond exactly to does not correspond at all** Place a single tick in each row.
* *Required*

	Correspond exactly	-	-	Correspond moderately	-	-	Does not correspond at all
For the pleasure, I feel in living exciting experiences	☐	☐	☐	☐	☐	☐	☐
For the pleasure, it gives me to know more about cycling, the sport that I practice	☐	☐	☐	☐	☐	☐	☐
I used to have good reasons for doing sports, but now I am asking myself if I should continue doing it	☐	☐	☐	☐	☐	☐	☐
For the pleasure of discovering new training techniques	☐	☐	☐	☐	☐	☐	☐

I don't know anymore; I have the impression that I am incapable of succeeding in cycling	☐	☐	☐	☐	☐	☐	☐
Because it allows me to be well regarded by people that I know	☐	☐	☐	☐	☐	☐	☐
Because, in my opinion, it is one of the best ways to meet people	☐	☐	☐	☐	☐	☐	☐
Because I feel a lot of personal satisfaction while mastering certain difficult training techniques	☐	☐	☐	☐	☐	☐	☐
Because it is absolutely necessary to do cycling if one wants to be in shape	☐	☐	☐	☐	☐	☐	☐
For the prestige of being an athlete	☐	☐	☐	☐	☐	☐	☐

Because it is one of the best ways I have chosen to develop other aspects of myself	☐	☐	☐	☐	☐	☐	☐
For the pleasure, I feel while improving some of my weak points	☐	☐	☐	☐	☐	☐	☐
For the excitement, I feel when I am really involved in the activity	☐	☐	☐	☐	☐	☐	☐
Because I must do sports to feel good about myself	☐	☐	☐	☐	☐	☐	☐

Page 5: Why do you participate in cycling?

Please indicate your level of agreement with the following statements concerning reasonings for cycling, **using a scale of correspond exactly to does not correspond at all** Place a single tick in each row.
✱ *Required*

	Correspond exactly	-	-	Correspond moderately	-	-	Does not correspond at all
For the satisfaction, I experience while I am perfecting my abilities	☐	☐	☐	☐	☐	☐	☐
Because people around me think it is important to be in shape	☐	☐	☐	☐	☐	☐	☐
Because it is a good way to learn lots of things which could be useful to me in other areas of my life	☐	☐	☐	☐	☐	☐	☐
For the intense emotions that I feel while I am doing cycling that I like	☐	☐	☐	☐	☐	☐	☐

It is not clear to me anymore; I don't really think my place is in cycling	☐	☐	☐	☐	☐	☐	☐
For the pleasure that I feel while executing certain difficult movements	☐	☐	☐	☐	☐	☐	☐
Because I would feel bad if I was not taking time to do it	☐	☐	☐	☐	☐	☐	☐
To show others how good I am at cycling	☐	☐	☐	☐	☐	☐	☐
For the pleasure that I feel while learning training techniques that I have never tried before	☐	☐	☐	☐	☐	☐	☐
Because it is one of the best ways to maintain good relationships with my friends	☐	☐	☐	☐	☐	☐	☐

Because I like the feeling of being totally immersed in the activity	☐	☐	☐	☐	☐	☐	☐
Because I must do cycling regularly	☐	☐	☐	☐	☐	☐	☐
For the pleasure of discovering new performance strategies	☐	☐	☐	☐	☐	☐	☐
I often ask myself; I can't seem to achieve the goals that I set for myself	☐	☐	☐	☐	☐	☐	☐

Page 6: Views on your mobile phone

Which brand of smartphone do you own? * Required

- Apple
- Alcatel
- Doro
- Google
- Honor
- Huawei
- Lenovo
- Motorola
- Nokia
- Oppo
- Samsung
- Sony
- None
- Other

If you selected Other, please specify:

Approximately, how many mobile applications are currently downloaded onto your phone? * Required

- 1-24 applications
- 25-49 applications
- 50-74 applications
- 75 + applications

On average, how many mobile apps do you use on daily basis? * Required

- 1-5 applications

- 6-10 applications
- 11-15 applications
- 16-20 applications
- 21-25 applications
- 26 + applications
- None

Please indicate on the scale below how often you use various types of mobile apps. **Using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree
I use social media mobile apps (e.g. Facebook, Instagram)							
I use gaming mobile apps (e.g. Angry Birds, Candy Crush)							
I use education mobile apps (e.g. Google classroom, Khan Academy)							
I use health and fitness mobile apps (e.g. Strava, Fitbit)							
I use shopping mobile apps (e.g. Amazon Shopping)							
I use mobile apps for utilities (e.g. bills)							

I use lifestyle mobile apps (e.g. apps that facilitate your manner/style of living)	☐	☐	☐	☐	☐	☐	☐
I use business mobile apps (e.g. Microsoft Teams, Slack)	☐	☐	☐	☐	☐	☐	☐
I use music mobile apps (e.g. Spotify)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for news (e.g. BBC News)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for the weather (e.g. BBC Weather)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for reading/listening to books (e.g. Audible, Amazon Kindle)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for video streaming (e.g. BBC iPlayer)	☐	☐	☐	☐	☐	☐	☐
I use travel mobile apps (e.g. Airbnb, British Airways)	☐	☐	☐	☐	☐	☐	☐
I use entertainment mobile apps (e.g. apps that you use for pleasure)	☐	☐	☐	☐	☐	☐	☐
I use mobile banking apps (e.g. bank apps)	☐	☐	☐	☐	☐	☐	☐

How often do you use **cycling** mobile apps? ✱ *Required*

- Every Day
- At least once a week
- At least once a month
- Once every three months
- Once every sixth months
- Once a year
- Never

Page 7: Views on mobile shopping

Please indicate your level of agreement with the following statements concerning your participation in mobile shopping, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree
I bring up things I have seen on applications in conversations with other people	☐	☐	☐	☐	☐	☐	☐
Mobile applications often give me something to talk about	☐	☐	☐	☐	☐	☐	☐
I use things from mobile applications in discussions or arguments with people I know	☐	☐	☐	☐	☐	☐	☐
Mobile applications provide an intimate shopping experience	☐	☐	☐	☐	☐	☐	☐
Nobody is watching me to comment on my shopping when I am using a mobile device	☐	☐	☐	☐	☐	☐	☐
Browsing a mobile application is like a treat for me	☐	☐	☐	☐	☐	☐	☐

Browsing a mobile application improves my mood	☐	☐	☐	☐	☐	☐	☐
I like to sit back and unwind by using a mobile application	☐	☐	☐	☐	☐	☐	☐
I like to browse the mobile device when I am taking a break	☐	☐	☐	☐	☐	☐	☐
I like to browse the mobile device when I am traveling	☐	☐	☐	☐	☐	☐	☐
I browse the mobile device when having nothing else to do	☐	☐	☐	☐	☐	☐	☐
Mobile applications give me good product information	☐	☐	☐	☐	☐	☐	☐
Mobile applications help me make good purchase decisions	☐	☐	☐	☐	☐	☐	☐
Mobile applications provide information from other users that help me make good purchases	☐	☐	☐	☐	☐	☐	☐
Mobile applications help me save money	☐	☐	☐	☐	☐	☐	☐

Mobile applications give me better deals	☐	☐	☐	☐	☐	☐	☐
Mobile applications give exclusive time-bound offers	☐	☐	☐	☐	☐	☐	☐

Page 8: Mobile apps in the cycling context

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row. * *Required*

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree
It helps me with the planning of cycling route(s)	☐	☐	☐	☐	☐	☐	☐
It helps make suggestions on the best route of travel	☐	☐	☐	☐	☐	☐	☐
It helps me find new locations to explore on the bike	☐	☐	☐	☐	☐	☐	☐
It provides me with a method to measure the performance of my ride (distance/speed/average)	☐	☐	☐	☐	☐	☐	☐
It helps me to review and compare my previous performance (e.g. segment data and leader boards)	☐	☐	☐	☐	☐	☐	☐
It helps me review my cycling performance of a ride (e.g. heart rate, cadence and power)	☐	☐	☐	☐	☐	☐	☐
It helps me socially interact with others through virtual reality worlds (e.g. Strava / Zwift)	☐	☐	☐	☐	☐	☐	☐

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree
It helps me to achieve rewards with badges, points, or leader boards	☐	☐	☐	☐	☐	☐	☐
It helps me when others like or comment on my badges (e.g. Kings or Queens of Mountains/Course Records/Local Legends)	☐	☐	☐	☐	☐	☐	☐
It helps me when other users like or comment upon my performance	☐	☐	☐	☐	☐	☐	☐
It helps when a mobile app transports me into a new world with its own rules	☐	☐	☐	☐	☐	☐	☐
It helps me to be part of the story as a character	☐	☐	☐	☐	☐	☐	☐
It helps me to the lead take in the story	☐	☐	☐	☐	☐	☐	☐

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree

I am able to share design and creative ideas of advertising with cycling companies	☐	☐	☐	☐	☐	☐	☐
I am able to share new product design ideas with cycling companies	☐	☐	☐	☐	☐	☐	☐
I am able to share new product design ideas with other cyclists/communities	☐	☐	☐	☐	☐	☐	☐

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree
It helps me if I can use discount vouchers or coupons	☐	☐	☐	☐	☐	☐	☐
It helps me if a mobile app has an easy checkout	☐	☐	☐	☐	☐	☐	☐
It helps me if a mobile app uses bar code scanners or QR codes	☐	☐	☐	☐	☐	☐	☐
It provides me with convenient location sharing (e.g. check-in with a retail store)	☐	☐	☐	☐	☐	☐	☐
It provides me with convenient methods of payment	☐	☐	☐	☐	☐	☐	☐

It helps me if I can use secure payment methods	☐	☐	☐	☐	☐	☐	☐

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree
It helps to see a well-known brand name	☐	☐	☐	☐	☐	☐	☐
It helps to review the short promotional text about the app	☐	☐	☐	☐	☐	☐	☐
It helps if an aesthetically pleasing mobile application is provided	☐	☐	☐	☐	☐	☐	☐
It helps to see a cycling logo that resonates with me	☐	☐	☐	☐	☐	☐	☐
It helps to see a good range of content	☐	☐	☐	☐	☐	☐	☐
It helps me when videos are included	☐	☐	☐	☐	☐	☐	☐

Page 9: About you

Please state your gender (Please tick one box): * *Required*

- Female
- Male
- Non-binary/ third gender
- Prefer to self-describe
- Prefer not to say

Please state your age (Please tick one box): * *Required*

- 18–24
- 25–34
- 35–44
- 45–54
- 55–64
- 65 -74
- 75+

Which of the below best describes your **work status**? (Please tick one box): * *Required*

- Working as employee - full-time
- Working as an employee - part-time
- Self-employed or freelance
- Government-sponsored training scheme
- Retired
- Unemployed- actively looking for work
- Unemployed – not actively looking for work
- Long term sick or disabled
- Looking after home or family
- Student
- Other

Which of the below best describes your **highest** level of education? (Please tick one box): * *Required*

- I have no formal qualifications
- O Levels / CSEs / GCSEs / Foundation Diploma
- A Level / AS Level / VCEs / Higher Diplomaa
- NVQ Level 2 / City and Guilds Craft / BTEC Diploma / RSA Diploma / Equivalent
- Apprenticeship
- NVQ Level 3 / Advanced GNVQ / City and Guilds Advanced / BTEC National / Foundation Degree / Equivalent
- Bachelor Degree (e.g. BA, BSc)
- Higher Degrees (e.g. Masters, Doctorate)
- My qualifications are from outside the United Kingdom

Please state what part of the United Kingdom you currently live in? (Please tick one box): * *Required*

- East Midlands
- East of England
- London
- North East England
- North West England
- Northern Ireland
- Scotland
- South East England
- South West England
- Wales
- West Midlands
- Yorkshire and the Humber

What is your estimated annual income? (Please tick one box): * *Required*

- Under £10,000
- £10,001 - £20,00
- £20,001 - £30,000
- £30,001 - £40,000

- £40,001 - £50,000
- £50,001 - £75,000
- £75,001 - £100,000
- £100,001+
- Prefer not to say

Page 10: Final page

Thank you for taking the time to complete this survey. The results are vital in the completion of my doctoral thesis. Should you have any questions then please contact: kirk.dodds@northumbria.ac.uk

Appendix 4: Stage 3 Survey Instrument

Cycling and mobile applications

Page 1: Study overview

Thank you very much for agreeing to participate in this survey. With project title of: Utilise a cluster analysis to generate segments of cyclist to understand their motives and involvement and motives for using mobile apps.

The information provided by you in this questionnaire will be used for research purposes. It will not be used in a manner which would allow identification of your individual responses.

Anonymised research data will be archived in order to make them available to other researchers in line with current data sharing practices.

Ethical consent has been provided by the University of Northumbria to conduct this research, and agreeing to take part within questionnaire you are providing informed consent. Should you wish to with draw consent at any time then please email: kirk.dodds@northumbria.ac.uk

The investigator has explained to me the nature of the study, and what is required from me. They have given me a debrief sheet providing me with their contact details. I understand I am free to withdraw from the study at any time, without having to give a reason for withdrawing, and without prejudice. I agree to provide information to the investigator and understand that my contribution will remain anonymous and confidential. I also consent to the retention of this data under the condition that any subsequent use also be restricted to research projects that have gained ethical approval from Northumbria University. * *Required*

- Yes
- No

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Page 2: Cycling Involvement

On average, how far in **distance** do you cycle outdoors each week? * *Required*

- 0 - 24 miles
- 25 - 49 miles
- 50 - 74 miles
- 75 - 99 miles
- 100 miles +

On average, how far in **distance** do you cycle outdoors each week for commuting? * *Required*

- 0 - 24 miles
- 25 - 49 miles
- 50 - 74 miles
- 75 - 99 miles
- 100 miles +

On average, how far in **distance** do you cycle outdoors each week for recreation? * *Required*

- 0 - 24 miles
- 25 - 49 miles
- 50 - 74 miles
- 75 - 99 miles
- 100 miles +

On average, how much **time** do you spend cycling indoors per week? * *Required*

- Zero
- Fewer than 30 minutes
- 30 minutes - < 1 hours
- 1 hour - < 2 hours
- 2 hours - < 3 hours
- 3 hours - < 4 hours
- 4 hours +

Please indicate your agreement with the following statements, **using a scale of extremely competent to not competent at all**. Place a single tick in each row.

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	Extremely competent	-	-	-	Not competent at all
I am able to perform basic mechanical tasks (e.g., change a flat tire, adjust gears and other components)	☐	☐	☐	☐	☐
I am able to safely ride in a "bunch" of cyclists	☐	☐	☐	☐	☐
I am able to take sharp corners at speed	☐	☐	☐	☐	☐

On average, how much do you spend on cycling each **month**? ✱ *Required*

Please select no more than 1 answer(s).

- ☐ £0-£24
- ☐ £25-£49
- ☐ £50-£74
- ☐ £75-£99
- ☐ £100-£124
- ☐ £125-£150
- ☐ £150-£174
- ☐ £175-£199
- ☐ £200-£299
- ☐ £300-£399
- ☐ £400-£499
- ☐ £500 +

Please indicate your level of agreement with the following statements concerning the purchase of cycling equipment, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row. ✱ *Required*

	Strong agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree	Strongly disagree

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I generally buy through online branded stores such as Wiggle	☐	☐	☐	☐	☐	☐	☐
I generally buy through online independent cycling retailers such as a local bike shop	☐	☐	☐	☐	☐	☐	☐
I generally buy through offline branded stores such as Evans	☐	☐	☐	☐	☐	☐	☐
I generally buy through offline independent cycling retailers such as a local bike shop	☐	☐	☐	☐	☐	☐	☐

Page 3: Views on your mobile phone

Which brand of smart phone do you own? * Required

- Apple
- Alcatel
- Doro
- Google
- Honor
- Huawei
- Lenovo
- Motorola
- Nokia
- Oppo
- Samsung
- Sony
- Other
- None

Approximately how many mobile applications have you currently downloaded onto your phone? * Required

- 1-24 applications
- 25-49 applications
- 50 – 74 applications
- 75 applications +

On average how many mobile apps do you use on daily basis? * Required

- 1-5 applications
- 6-10 applications
- 11-15 applications
- 16-20 applications

- 21-25 applications
- 26 applications +
- None

Please indicate on the scale below how often you use varies types of mobile apps. **Using a scale of very frequently to very infrequently.** Place a single tick in each row.

	1 - Very frequently	2	3	4	5	6	7- Very infrequently
I use social media mobile apps (e.g. Facebook, Instagram)	☐	☐	☐	☐	☐	☐	☐
I use gaming mobile apps (e.g. Angry Birds, Candy Crush)	☐	☐	☐	☐	☐	☐	☐
I use education mobile apps (e.g. Google classroom, Khan Academy)	☐	☐	☐	☐	☐	☐	☐
I use health and fitness mobile apps (e.g. Strava, Fitbit)	☐	☐	☐	☐	☐	☐	☐
I use shopping mobile apps (e.g. Amazon Shopping)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for utilities (e.g. bills)	☐	☐	☐	☐	☐	☐	☐

I use lifestyle mobile apps (e.g. apps that facilitate your way/style of living)	☐	☐	☐	☐	☐	☐	☐
I use business mobile apps (e.g. Microsoft Teams, Slack)	☐	☐	☐	☐	☐	☐	☐
I use music mobile apps (e.g. Spotify)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for news (e.g. BBC News)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for weather (e.g. BBC Weather)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for reading/listening to books (e.g. Audible, Amazon Kindle)	☐	☐	☐	☐	☐	☐	☐
I use mobile apps for video streaming (e.g. BBC iPlayer)	☐	☐	☐	☐	☐	☐	☐
I use travel mobile apps (e.g. Airbnb, British Airways)	☐	☐	☐	☐	☐	☐	☐
I use entertainment mobile apps (e.g. apps that you use for pleasure)	☐	☐	☐	☐	☐	☐	☐

I use mobile banking apps (e.g. bank apps)	☐	☐	☐	☐	☐	☐	☐

How often do you use **cycling** mobile apps? ✱ *Required*

- ○ Every Day
- ○ At least once a week
- ○ At least once a month
- ○ Once every three months
- ○ Once every sixth months
- ○ Once a year
- ○ Never

Page 4: Mobile apps in the cycling context

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row. * *Required*

	Strongly agree	-	-	-	-	-	Strongly disagree
It helps me with the planning of cycling route(s)	☐	☐	☐	☐	☐	☐	☐
It helps make suggestions on the best route of travel	☐	☐	☐	☐	☐	☐	☐
It helps me find new locations to explore on the bike	☐	☐	☐	☐	☐	☐	☐
It provides me with a method to measure the performance of my ride (distance/speed/average)	☐	☐	☐	☐	☐	☐	☐
It helps me to review and compare my previous performance (e.g. segment data and leader boards)	☐	☐	☐	☐	☐	☐	☐
It helps me to follow training plans	☐	☐	☐	☐	☐	☐	☐
It helps me review my cycling performance of a ride (e.g. heart rate, cadence and power)	☐	☐	☐	☐	☐	☐	☐
It allows me into a virtual reality world	☐	☐	☐	☐	☐	☐	☐
It helps me socially interact with others through virtual reality worlds (e.g. Strava / Zwift)	☐	☐	☐	☐	☐	☐	☐

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It helps support my interest of cycling (e.g. weather forecast or bike maintence guides)	☐	☐	☐	☐	☐	☐	☐

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	-	-	-	-	-	Strongly disagree
It helps me to achieve rewards with badges, points, or leader boards	☐	☐	☐	☐	☐	☐	☐
It helps me when others like or comment on my badges e.g. Kings or Queens of Mountains/Course Records/Local Legends	☐	☐	☐	☐	☐	☐	☐
It helps me develop my skills of cycling	☐	☐	☐	☐	☐	☐	☐
It helps me when other users like or comment upon my performance	☐	☐	☐	☐	☐	☐	☐
It helps when a mobile app transports me into a new world with its own rules	☐	☐	☐	☐	☐	☐	☐
It helps me to be part of the story as a character	☐	☐	☐	☐	☐	☐	☐

It helps me to the lead take in the story	☐	☐	☐	☐	☐	☐	☐
It helps me to use in game data (e.g. heart rate)	☐	☐	☐	☐	☐	☐	☐

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	-	-	-	-	-	Strongly disagree
I am able to share my opinions with fellow cyclists	☐	☐	☐	☐	☐	☐	☐
I am able to see online products reviews including the views of others	☐	☐	☐	☐	☐	☐	☐
I am able to share content about cycling that helps others	☐	☐	☐	☐	☐	☐	☐
I am able to share design and creative ideas of advertising to cycling companies	☐	☐	☐	☐	☐	☐	☐
I am able to share new product design ideas to cycling companies	☐	☐	☐	☐	☐	☐	☐
I am able to share new product design ideas to other cyclists/communities	☐	☐	☐	☐	☐	☐	☐

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	-	-	-	-	-	Strongly disagree
It helps me if I can use discount voucher or coupons	☐	☐	☐	☐	☐	☐	☐
It helps me if a mobile app has an easy checkout	☐	☐	☐	☐	☐	☐	☐
It helps me if an mobile app uses bar code scanners or QR codes	☐	☐	☐	☐	☐	☐	☐
It provides me with convenient location sharing (e.g. check-in with a retail store)	☐	☐	☐	☐	☐	☐	☐
It provides me with convenient methods of payment	☐	☐	☐	☐	☐	☐	☐
It helps me if an mobile app lets me overlay products into a real world situation (e.g. overlay new bike on myself)	☐	☐	☐	☐	☐	☐	☐
It helps me if I can use secure payment methods	☐	☐	☐	☐	☐	☐	☐

The following section looks at your reasons for using cycling apps. Please indicate your level of agreement with the following statements, **using a scale of strongly agree to strongly disagree.** Place a single tick in each row.

	Strongly agree	-	-	-	-	-	Strongly disagree
It helps to see a well known brand name	☐	☐	☐	☐	☐	☐	☐
It helps to review the short promotional text about the app	☐	☐	☐	☐	☐	☐	☐
It helps if an aesthetically pleasing mobile application is provided	☐	☐	☐	☐	☐	☐	☐
It helps to see a cycling logo that resonates with me	☐	☐	☐	☐	☐	☐	☐
It helps to see a good range of content	☐	☐	☐	☐	☐	☐	☐
It helps me when videos are included	☐	☐	☐	☐	☐	☐	☐

Page 5: Final page

Thank you for taking the time to complete this survey. The results are vital in the completion of my doctoral thesis. Should you have any questions then please feel free to contact: kirk.dodds@@northumbria.ac.uk

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Appendices 5 - In depth Four Cluster Analysis
Group 1 (24.2%). The old-school fanatic / Ultraconservative
No/limited connect with a badge of honor with mobile apps and no/limited transfer into a new virtual world via mobile apps.

Cycling involvement
This group is the least likely to see cycling as an important part of their life, (with a mean of 1.44 and a percentage of 112.5%) along with being the least likely segment for cycling to be one of the most important things they do (with mean of 1.55 along with a percentage of 113.14%). In addition, this segment is unlikely to organise life around their cycling commitments (mean of 2.38 and percentage of 116.10%)), along with the least likely segment for others to recognise them as cyclists (mean 3.09 and percentage of 142.40%). It is interesting to note this segment is the longest in terms of a number of years 25.1 years of cycling, along with the group most likely to go on the greatest number of rides within a week with the most frequent being 4 rides in a week 32.4%, demonstrating a long commitment. Whilst the road bike is this segment preference of bike (mean 1.69), however, diversity in the type of bikes ridden is seen with means of 2.19 for a hardtail, touring 3.06, cross 2.70, gravel 2.60 and full suspension 2.6, showing their openness to utilise different forms of bikes when compared to other segments. This group is most likely to be members of the triathlon club with 50.5%.

When it comes to the reasoning for riding it's most likely to be recreational, with the most frequent distant being 75- 99 miles (24.8%), and this group is least likely to cycle indoors with the most frequent stating never cycling indoors (31.4%). The segment is the most comfortable with cycling involvement with means for basic mechanical repairs of 1.57, comfortable riding as a bunch as 1.54, and corning at speed being 1.80, all being higher than any other segment again highlighting their length of involvement in cycling. When collecting research on the cycling sector and products they prefer a mixture of both online websites (mean of 2.73) and cycling magazines (mean of 3.92) and are the group least likely to be influenced purely by brand (mean of 3.10), but instead performance the product (1.72) and price (2.20) being of importance. Their average spending per month is the lowest of any group with the most frequent being £0-24 with 24.8%, with most of this coming through online big chains (mean of 2.45). They are the group least likely to use GPS devices to measure rides, with 71.4% stating they use such devices. Their usage of cycling-based subscriptions is significantly less likely than any other group, with only 46.7% currently making monthly payments being lower than other groups.

Motivations for cycling
This segment's primary motivation for taking part in cycling is amotivated regulation. They are least likely to question why the carry-on cycling on all the four variables: (1) have good reasons for cycling (1.46), (2) impression of being capable of succeeding in cycling (1.30) (3) clear place of cycling (1.22), challenging of achieving goals set themselves (1.79). The primary motivation can be attributed to the routine of cycling for the longest period of any group in time, additionally supported by the typical secondary motivation of this group. The typical secondary motivation for this segment is intrinsic regulation with mean scores including: the pleasure of exciting experiences (2.30), pleasure of knowing more about cycling, (3.54), mastering certain difficult training techniques (3.88), improving my weak points (3.91), excitement being really involved in the activity (2.54), the experience of perfecting my abilities (3.40), intense emotions doing cycling (3.64) executing certain difficult movements (4.22) immersed in the activity (2.88).

Mobile phone and mobile applications
The segment is the most likely to own an Apple phone with the most frequent category of 57.1%. They have the least number of mobile apps downloaded on their phone, with

1-24 applications being the most likely (with a mean of 1.68) and use the least number of apps on daily basis with only between 1-5 applications (mean of 1.73) compared to other segments. Whilst mobile app downloads are limited, the apps they are likely to use are: social apps (mean of 2.61) health-related apps (mean of 2.79), news-based apps (mean of 3.12), weather-based apps (1.90), and mobile banking apps (mean 2.70). This limited use of mobile applications transferred in cycling-based apps, with the smallest group using cycling apps every day with a frequency of 36.2%.
This group is the least likely group to engage in mobile shopping via mobile applications. Their primary motivation for using mobile apps for shopping as a time filler means scores of using a mobile device: when taking a break (4.13) when traveling (4.24), when having nothing else to do (3.80). The secondary motivation for using mobile applications for shopping is utilitarian with means scores for good product information (4.15) good purchase decisions (4.33) and providing information from other users informs good purchases (4.29) not showing a strong relationship. However, this segment obtains no intrinsic enjoyment from mobile shopping on applications. Intrinsic enjoyment does not resonate with this audience with means scores of: mobile applications being a treat (6.23), improving their mood (6.09) and using mobile applications to unwind (5.31).

Cycling mobile applications
This group is using mobile apps for functional purposes when it comes to tool-centric, such as for planning a route (mean of 2.79), measuring their performance on rides (mean 2.32), or comparing previous performance of rides (means 2.92). They are unlikely to be engaged in the social nature of cycling mobile apps and as unlikely to interact through virtual worlds (mean of 4.60). They are segmented to least impacted by gamification with both rewards of badges having a mean of 5.78 and others comment on their own badges having a mean of 5.58. This lack of interest in gamification is supported further by transport into virtual worlds (mean 6.82) being parts of the story in the virtual world (mean 6.84) and leading the story in virtual worlds (6.61). They also are the segment the least likely to engage in co-creation with cycling brands through mobile apps, with not wanting to share advertising ideas (mean 6.61) new product ideas with cycling companies (mean 6.61) or new product ideas with cyclist/cycling communities (mean 6.47). The segments are not significantly influenced by mobile commerce when it comes to cycling-based applications when compared to the other three groups. However, elements of mobile commerce influence easy check out (mean 3.58) convenient method of payment (mean 3.81), and secure payment method (mean 3.32). The elements of design-centric when it comes to mobile applications are less significant with this segment than compared to others. However, both brand name (mean 3.90), brand content (mean 3.73) are given equal weighting, were as the brand logo (4.58) plays less importance when it comes to mobile commerce through applications.

Demographic
They are typically male at 83.8%, and least likely to be female 16.2%. Typically, their age is 55-64 (36.2%), work full time (56.2%), with a higher degree (39.0%), located in the East of England (21.0%), and have the least income of any of the segments £20,000-£30,000 (17.1%)

Highlights – The old-school fanatic / Ultraconservative

- Longest-serving mean of 25.1 years, demonstrating a long commitment.
- Prefer to cycle outdoors, with the primary bike is a road but open to diversity on the form of bike
- Least likely to own GPS devise and often do not see value in having cycling subscription.

- The routine of being a cycling link to their intrinsic motivations with a primary being about maintaining control and being competent as a cyclist (amotivated regulation) and secondary focused on an interest and enjoyment of cycling (intrinsic regulation)
- Mobile applications do not connect with them as means of shopping, but easy of check out, coinvent, and secure payment do matter.
- They use cycling mobile apps for utility purposes such as planning routes, measuring performance, or comparing previous rides.
- Gamification and co-creation do not connect, however they engage in the social channels of mobile apps in the cycling world.

Group 2 (25.6%) – Technology Movers

A medium badge of honor with mobile apps and No/limited transfer into a new virtual world via mobile apps.

This group is the second-highest segment to see cycling as an important part of their life, (with a mean of 1.36 and a percentage of 106.25%) along with being the second-highest segment for cycling being one of the most important things they do (with mean of 1.38 and percentage of 100.73%). In addition, this segment is very likely to organise life around their cycling commitments (mean of 2.16 and percentage of 105.37%), along with being the segment to recognise them as a cyclist (mean 2.48 and percentage of 114.29%). This segment is the second-longest in terms of length, with a mean a number of 18.42 years of cycling. The most frequent number of rides in a week is 4 with 27.9% being lower than other segments. It's interesting to note this segment has moderated interest in cycling events, with 46.8% taking part in one or more events in the last year. The road bike is this segment's preference of bike (mean 1.68). The road bike influences the others forms of bike ridden, with means of 2.88 for supportive, performance bikes such as time trail 2.64, cross 2.58, and gravel 2.72. Given all these additional bikes have linkages to the road bike in that they are all in the format of drop handlebars, it stresses the significance of the road bike.

When it comes to the reasoning for riding it's most likely to be recreational, with the most frequent distant being 75 - 99 miles (30.6%), and in fact are the group least likely to cycle for commuting with only 12.6% using bike to travel work. This group is typical not cycling indoors with the most frequent stating never cycling indoors (32.4%). The segment is comfortable with cycling involvement with means for basic mechanical repairs of 1.70, comfortable riding as a bunch as 1.54, and corning at speed being 1.88, all being broadly in line with other segments. When collecting research on the cycling sector and products they preferred online websites (mean of 2.60) and when compared to being the least likely sector to utilise cycling magazines (mean of 3.92). The group typically is influenced by price with a mean of 2.05, and the least likely segment to be influenced by pure performance with a mean of 1.81. It is interesting to note the second-highest group influenced by watching cycling whether highlights or live impacting cycling-related purchases mean of 2.66.
Their average spending per month is in line with the other three groups with the most frequent being £24-£49 with 26.1%, with a strong amount of this coming via online big chains (mean of 2.23) being the second highest, however it's interesting to note their support for an independent bike shop in a person being the second strongest of any segment with mean of 3.41. They are group second likely to use GPS devices to measure rides, with 80.2% stating they use their device. Their usage of cycling-based subscriptions is broadly in line with cluster three, with only 71.2% currently making monthly payments being lower than other segments.

Motivations for cycling
This segment's primary motivation for taking part in cycling is instructive regulation.

With mean scores for the following as: the pleasure of exciting experiences (2.06), excitement of being really involved in the activity (2.10), immersed in the activity (2.48), the pleasure of knowing more about cycling, (3.09), mastering certain difficult training techniques (3.45), improving my weak points (3.30), the experience of perfecting my abilities (3.10), intense emotions doing cycling (3.14) executing certain difficult movements (3.95). It is interesting to note there is no significantly strong secondary motivations for cycling, however, introjected regulation is the second strongest with mean scores: cycling makes feels good about themselves (3.45) and feel bad if not taking the time to cycle (3.60), must do cycling regularly (3.58), cycling to stay in shape (4.33). With such a strong connection with instructive regulation, the segment is motivated by the internal motivation of the interest, enjoyment, and inherent satisfaction of cycling.

Mobile phone and mobile applications

Typically, the segment is are likely to own an Apple phone with the most frequent category of 49.5%, however interesting to note that this is the lowest of any group so other forms of mobile ownership are higher. The group is second highest in terms of mobile apps downloaded on their phone, with 1-24 applications being the most likely (mean of 1.94), however, the amount of a mobile applications does not transfer to daily app usage, with only between 1-5 applications (mean 1.85) when compared to other segments. The types of mobile applications they typically use included: social apps (mean of 1.86) health-related apps (mean of 1.49), news-based apps (mean of 2.71), weather-based apps (1.70), and mobile banking apps (mean 2.11) all showing strong signs of daily use. Whilst the secondary regular use is shopping apps (mean 3.49), utility apps (mean of 3.54), and video apps (3.54). This strong use of mobile applications in their daily tasks, transfers into cycling-based apps, with the group being the second-highest on the daily use of cycling apps every day with a frequency of 47.7%.

This segment feels comfortable with the use of mobile applications, most noticeability for two purposes utilitarian and additional monetary experience. The primary motivation for using mobile applications for shopping is utilitarian with means scores for good product information (3.68) good purchase decisions (3.83) and providing information from other users informs good purchases (3.74). The secondary motivation of mobile application shopping is attributed to monetary experience with mean scores of: saving money (3.67) access to deals (3.92), and exclusive time-bound deals (4.51). It's also interesting to note this segment's enjoyment of social interaction with the use of mobile applications, as they are the secondary likely segment to connect with social facilitation. With mean scores of social facilitation: bring up apps within a conversation (3.77), mobile apps giving something to talk about (4.50), using mobile applications in discussions or arguments with people (mean 4.37).

Cycling mobile applications

This group is using the tool-centric purpose of mobile apps not only for navigation (means 2.15 and 2.77) but significantly for data performance (measure performance of rides 1.50, compare the performance of previous rides mean 1.62, review more advanced data on my cycling performance of a ride 1.82). In addition, they are the second strongest segment influenced by the game-centric mobile applications (socially interact with others through virtual reality worlds 2.66, rewards with badges, points, or leader boards 3.14, users like or comment upon my performance 2.62). However, this interest of the social features of mobile applications does not transfer into the adoption into social-centric in terms of mobile apps with means the following: being part of the story in the virtual world (mean 6.30) and leading the story in the virtual worlds (6.29), being the second-lowest among all the segments. This segment does not resonate with co-creation with cycling brands through mobile apps, with not wanting to share advertising ideas (mean 6.30) new product ideas with cycling companies (mean 6.29) or new product ideas with cyclist/cycling communities (mean 5.94). The money experience of mobile shopping of segments comes through in terms of mobile commerce, with the influence of easy check out (mean 2.87), convenient method of payment (mean 2.91), and secure payment method (mean 2.19) all being identified as a significant reason for embracing mobile commerce's. The elements of design-centric for mobile applications are significantly important with this segment when compared to others. In terms of design-centric, the functions that resonate with this segment are: brand name (mean 3.05), app brand content (mean 2.82) aesthetically pleasing mobile application (2.99). However, it's interesting to note, that less typically influenced by: promotional text about the app (3.98), application logo (3.66), and promotional videos of mobile applications (3.60) when compared to others segments.

Demographic
They are typically male with 73.0%, however, this segment has most females with 27.0%. Typically their age is 45-54 (33.3%), work full time (56.6%), with a higher degree (41.4%), located in the North East (27.0%), and has an income of £50,000-£75,000k (23.4%)

Highlights – Technology Movers

- Second longest time of cycling mean of 18.42 years, who see cycling as an important part of their life and results in them organising elements of life around cycling (mean of 2.16) and recognising themselves as a cyclist (mean 2.48).
- Prefer to cycle outdoors for recreation, with the primary bike being road and other bike choices are influenced by this focus to aid training and performance.
- They buy cycling products through online website (mean of 2.60) via online big chains (mean of 2.23) however they are likely to use independent bike shops in person (3.41)
- Using mobile apps in daily life and seeing value in them, they have also bought into cycling subscriptions typical via Strava.
- They are already comfortable using mobile applications in daily life and their mobile commerce fits into primary utilitarian and secondary monetary experience and they developing towards a social facilitation
- The primary motivation for cycling is a strong connection with instructive regulation and being interested in and enjoyment of cycling. With no significant secondary motivation.
- They use cycling mobile apps as a strong relationship with performance lead of cycling along with social sharing of their own and others' performance.
- Gamification and co-creation do not connect.
- Their comfortable with mobile applications along with fitting into the money experience of mobile commerce. They expected easy, convincing secure payment when making cycling purchases via mobile apps.

Group 3 (21.2%) - Mobile Savvy

A medium badge of honor with mobile apps and medium transfer into a new virtual world via mobile apps.

Cycling involvement
The segment thirdly likely group to have cycling involvement in their lives through four questions: an important part of their life, (with a mean of 1.38, percentage of 107.81%), cycling being one of the most important things they do (with a mean of 1.42, percentage 106.65%), organise life around their cycling commitments (mean of 1.42, percentage 106.65%) and recognise them as a cyclist (mean 2.82, percentage 129.95%). This segment is the second shortest length of time with a mean of 18.25 years. It's interesting to note the number of bikes this segment owns is higher than any other group with a mean of 4 bikes (23.9%), with a particular focus on road bikes (mean of 1.52) being the second highest across of segments. With regards to other

bike forms of ownership, there are only two types of bikes that show strong weighting hybrid (mean 2.96) and full suspension (mean 2.59) both being higher than any other segment. This highlights diversity in the forms of bike ownership.

They are most likely to undertake 4 rides weekly with 29.3% stating this. When it comes to the reasoning for riding its most likely to be recreational, with the most frequent distant being 50 - 74 miles (33.7%), however, it is interesting to see this is the segment most likely to cycle for commuting purposes, with 17.4% commuting by bike weekly to work. There is a real mixed bag on their usage of indoor cycling, with a strong amount of cycling indoors weekly (79.3%) and only 20.3% never using indoors on weekly basis. They are the second most comfortable group when it comes to basic mechanical repairs at 1.66, however, the last segment for feeling comfortable riding as a bunch is 1.66, and the second least comfortable when corning at speed is 1.98.

When collecting research on the cycling sector and products the group's preference for online websites (mean of 2.73) whereas cycling magazines (mean of 4.17) as less influence on this group. When making cycling-related purchases performance is the most important attribute with a mean of 1.66, with price being second with a mean of 2.02, and thirdly the importance of brand with a mean of 2.83. They are jointly the second highest in terms of average monthly spend of £25-£49 with 26.1%, with most of this coming through online big chains (mean of 2.45) and being the group least likely to spend via chains instore (mean 5.00). The segment's use of GPS devices to measure rides, is broadly in line with the other two segments, with 79.3% stating they use such devices. However, it's interesting to note they are likely to use other electronic devices to monitor their cycling performance, with the highest use of both GPS watches 43.5% and mobile phones 39.1% when compared to other segments. Their usage of cycling-based subscriptions is significantly, and the second-highest compared to other segments, with 73.9% currently making monthly payments.

Motivations for cycling

This segment's typical primary motivation for taking part in cycling is intrinsic regulation. The mean scores of: the pleasure of exciting experiences (1.97), the pleasure of knowing more about cycling, (3.07), mastering certain difficult training techniques (3.28) improving my weak points (3.41), excitement of being really involved in the activity (2.63), intense emotions doing cycling (3.40), executing certain difficult movements (3.95) immersed in the activity (2.77), perfecting my abilities (3.08) and develop other aspects of myself (3.55). Whilst the pull of the first reason for motivations of is particularly strong of intrinsic regulation it is further supported by their secondary of introjected regulation and feelings of guilt. The following means for introjected regulation: when cycling feel good about self (3.38), cycling keeping in shape (3.76), feeling bad if not taking time to cycle (3.51), must cycle regularly (3.33).

Mobile phone and mobile applications

The segment is the second least likely to own an Apple phone with 51.1% and instead own different phone brands. They have a higher number of mobile apps downloaded on their phone, with 24-49 applications being the most likely (mean of 1.91), and use the second-highest number of apps on daily basis with only between 6-10 applications (mean 1.97) compared to other segments. There mobile app usage likely to use are: social apps (mean of 2.28) health-related apps (mean of 1.85), apps for shopping (mean of 3.57), music apps (mean of 2.71)news based apps (mean of 2.88), weather-based apps (2.00) and mobile banking apps (mean 2.47), utility apps (mean of 3.86), video-based apps (mean of 3.88) The use of mobile application transferred in cycling based apps, with over 90% using mobile apps daily or weekly being extremely high. This group is likely to group to engage in mobile shopping via mobile applications, however, their primary motivation for using mobile apps for shopping as a time filler with means scores of using mobile devices: when taking a break (3.07) when traveling (3.39), when having nothing else to do (3.09) all being close together in terms of means. However, its interesting to note the primary and additional motivations for mobile shopping through apps are close in terms of mean scores. The secondary motivation for using mobile applications for shopping is utilitarian with means scores for good product information (3.26) good purchase decisions (3.47) and providing information from other users informs good purchases (3.30). The territory motivation of mobile application shopping is attributed to monetary experience with mean scores of: saving money (3.95) access to deals (4.04), and exclusive time-bound deals (4.46). The segment is used to using mobile apps and thus has different motivations for shopping depending on the context.

Cycling mobile applications
This group is using mobile apps for tool-centric purposes such as navigation such as planning a route (mean of 2.22), suggestions on the best route (mean of 2.75), and finding new locations to explore on the bike (means of 2.71). Along with using it for measuring performance by means of: measuring the performance of my ride (mean of 1.76) comparing previous performance on leader boards (1.93), review more advanced data on my cycling performance of a ride (1.75). The segment connects with the social elements of cycling apps, with a mean of 2.72 likely to interact through virtual worlds.

They are segmented to mixed views when it comes to gamification with both rewards of badges having a mean of 3.83 and others comment on their own badges having a mean of 3.70, showing some interest in mobile apps with gamification. The social-centric tools of the story element of the game mechanism (mean of 5.00) and aesthetic element (mean of 5.16) see this group be the first to move from completely disagreeing, again showing further movement toward gamification. This is also supported by being the first segment to move from completely disagreeing to co-creation with cycling brands through mobile apps, with wanting to share advertising ideas (mean 5.65) new product ideas with cycling companies (mean 5.72), or new product ideas with cyclist/cycling communities (mean 5.55), with a small cluster of this segment want to engage in co-creation. With the segment using mobile apps across a variety of shopping motivations this transfers over within the segment using of mobile apps for cycling-based commerce being needs being diverse. This results in elements of mobile commerce that influence, discount vouchers (mean of 3.73) easy check out (mean 2.99) convenient method of payment (mean 3.07), and secure payment method (mean 2.71) all pointing towards a mature use of mobile commerce when it comes to cycling purchases. The elements of design-centric mobile applications again are equal-weighted in terms of influence with means of brand name (mean 3.14), promotional app text (mean of 3.87), app logo (mean of 3.49), brand content (mean 2.93), and video content with the app (3.50), showing a variety of confidence in using commerce via mobile apps.

Demographic
They are typically males with 81.5%, and least likely to be female at 18.5%. Typically their age is 45-54 (34.8%), work full time (57.6%), with a higher degree (32.6%), located in the North East of England (23.9%) and fairly even spreads over the income levels, however, the average income is £50,0001- £75,000 (18.5%)

Highlights - Mobile Savvy
- Highest number of bikes ownership with a mean of 4 bikes (23.9%)
- Primary bike ownership is road bikes (mean of 1.52), only two types of bikes ownership strong we hybrid (mean 2.96) and full suspension (mean 2.59)
- Most likely to cycle for commuting purposes, with 17.4% commuting by bike weekly.
- Strong amount of cycling indoors on weekly basis (79.3%).

- GPS for bike ownership in line with other segment's at 79.3%, but highest use of GPS through other means with watches at 43.5% and mobile phones at 39.1% for cycling purposes.
- Second highest use of cycling -subscriptions, with 73.9% currently making monthly payments. They into cycling subscriptions typical through badges of honors such as Strava and virtual worlds such as Zwift.
- Second highest number of apps used on daily basis between 6-10 (mean 1.97) and this strong use transfers into cycling with 90% using mobile apps daily or weekly.
- Motivations for cycling are particularly strongly aligned with intrinsic regulation and the enjoyment of cycling, supported by their secondary of introjected regulation and feelings of guilt/pleasure.
- Highly engaged in mobile shopping through mobile apps and have different motivations for shopping depending on the context. A primary motivation for using is time filler, closely followed by secondary utilitarian and territory of monetary experience.
- High engagement on mobile apps transfers into the cycling world with high usage of tool-centric functions for navigation, measuring performance, and social interactions.
- The audience shows some interest in gamification through mobile apps.
- A small cluster of this segment wants to engage in co-creation.
- A mature use of mobile commerce when it comes to cycling purchases.
- All elements of design-centric mobile apps are equally weighted in terms of influence with show confidence in using mobile commerce

Group Four (29.0%) – Fully Immersed

A very strong badge of honor with mobile apps and strong transfer then into a new virtual world via mobile apps.

They see cycling as a central element of life and are the most engaged in terms of cycling involvement when compared to other segments. This is seen across the four questions on cycling involvement having the lowest means: an important part of their life, (with a mean of 1.28, 100%), cycling being one of the most important things they do (with a mean of 1.37, 100%), organise life around their cycling commitments (mean of 2.05, 100%), others recognising them as a cyclist (mean 2.17, 100%). Despite this level of cycling involvement, it's interesting to note this segment is the shortest in terms of the number of years 16.79 years of cycling, being significantly less than the longest segment by 8.31 years. This level of commitment sees this segment seconded place when it comes to the number of rides within a week with the most frequent being 4 rides in a week 29.4%, demonstrating committed involvement in cycling. There are likely to own the least number of bikes, with the highest amount being one with 24.6%. This single bike is likely to be a road bike with the lowest mean of any group being 1.48. This typical single bike ownership is noted with higher means than any segments across: hybrid 3.72, performance 3.17, cycle cross 2.95, full-suspension 3.30, touring 3.47. However, its interesting to note this segment is most likely to use other bikes such as: e-bike 3.47 folding bike 2.75, and supportive 2.75. This group are most likely to be to take part in cycling events, with 61.9% have taken part in an event within the last year

When it comes to the reasoning for riding outdoors it's most likely to be recreational, with the most frequent distant being 75- 99 miles (29.4%). This group is by far the most likely to cycle indoors with the most frequent stating 2 hours - under 3 hours cycling indoors (23.0 %), being significantly longer in weekly time than another segment. The segment is the least comfortable with cycling skills and experiences with means for basic mechanical repairs of 1.80, comfortable riding as a bunch as 1.54, and corning at speed being 2.03, all being higher than any other segment, however, they are equal first for feeling comfortable riding as a bunch as 1.54. Given the involvement as cycling being a central element of their life, is interesting to note there influenced by a wide array of elements when conducting research on cycling-related products with lower means than other segments on the following: online website (mean of 2.25) and cycling magazines (mean of 3.81) influenced by brand (mean of 2.59), performance the product (1.62) and price (2.03). This level of involvement when making cycling purchases is also seen in this segment having the highest average spend per month with the most frequent being £24-£49 with 28.6%. Their preference for cycling purchases is online through big chains (mean of 2.09) being the strongest of any segment, in addition, their second preference is offline independent cycling stores with a mean of 3.33. They are the group most likely to use GPS devices to measure rides, with 85.7% stating they use such devices. Their usage of cycling-based subscriptions is significantly higher than any other group, with 86.5% currently making monthly payments.

Motivations for cycling
This segment's motivations are stronger than any other segment, which links to high levels of cycling involvement. Their primary motivations for taking part in cycling shows a strong correlation with intrinsic regulation with mean scores: the pleasure of exciting experiences (1.82), the pleasure of knowing more about cycling, (2.51), and mastering certain difficult training techniques (2.67). improving my weak points (2.40), excitement being really involved in the activity (1.78), the experience of perfecting my abilities (2.25), intense emotions doing cycling (2.56) executing certain difficult movements (3.47), learning new training techniques (3.42) immersed in the activity (1.93). When it comes to the secondary motivations split between introjected regulation and identified regulation. When it comes to introjected regulation mean scores are noted as cycling makes feel good about themselves (2.67), feel bad if not taking time to cycle (3.16), must do cycling regularly (2.78), cycling to stay in shape (3.37). However, identified regulation means: developing other aspects of myself (2.83), being useful in other areas of my life (3.49), the best way to meet people (3.70), and maintaining good relationships with my friends (3.74). This segment has diversity in the motivation of cycling.

Mobile phone and mobile applications
The segment is the most likely to own an Apple phone with the most frequent category of 54.%. They have the greatest number of mobile apps downloaded on their phone, with 25-49 applications being the most likely (mean of 2.19), and use the greatest number of apps on daily basis with only between 6-10 applications (mean of 2.09) compared to other segments. Whilst mobile app downloads are high and they have heavily engaged a wide array of mobile apps on regular basis: social apps (mean of 1.77) health-related apps (mean of 1.33), shopping (mean of 2.82), business purposes (mean of 3.59), music (mean of 2.31), news-based apps (mean of 2.64), weather-based apps (1.67), video-based apps (mean of 3.08), travel-based apps (mean of 3.50), entertainment-based apps (mean of 3.87), and mobile banking apps (mean 1.81). This high among of both numbers and usage of mobile applications is transferred in cycling-based apps, with most using cycling apps every day with a frequency of 58.7% - the highest of any segment.
This high use of mobile apps transfers into this group are the most likely group to engage in mobile shopping via mobile applications. This leads to a high number of motivations for engaging in mobile shopping. For example, they are the only segment that uses mobile shopping for social facilitation with means scores of: bring up applications in conversations with other people (mean of 2.86), mobile applications something to talk about (mean of 3.57), and mobile applications in discussions or arguments with people (mean of 3.57). The strongest means are seen as the motivation of time filler with means scores of using a mobile device: when taking a break (2.69) when traveling (2.60), and when having nothing else to do (2.37). The

second-highest motivation for using mobile applications when shopping is utilitarian with means scores: good product information (2.80) good purchase decisions (2.87) and providing information from other users informs good purchases (2.93). The territory motivation of mobile application shopping is to monetary experience with mean scores: saving money (3.25) access to deals (3.67), and exclusive time-bound deals (3.67). It's interesting to note this segment does not resonate with either self-connect (means 4.17 and 4.22) or intrinsic enjoyment (means of 4.72, 4.20, and 3.45) of mobile application shopping.

Cycling mobile applications

This segment is highly engaged in cycling apps across the board. Firstly, with extremely high usage of tool-centric elements of mobile apps for planning a route (mean of 1.65), suggestions on the best route (mean 2.06), finding new locations to explore on the bike (means 1.98), measuring the performance of rides (means 1.34), compare the performance of previous rides (mean 1.30), review more advanced data on my cycling performance of a ride (mean 1.33) and finally socially interact with others through virtual reality worlds (mean 1.81). This high level of engagement in tool-centric transfers across to social-centric with the segment being the most engaged in the social element mobile apps with means scores of : achieve rewards with badges, points, or leader boards (means 2.14) and likes or comments upon my performance (mean 1.99) so this segment have a strong connection game mechanism element of social media. However, whilst the segment is the most likely to engage in story elements and aesthetic elements of mobile apps with mean scores of: transports me into a new world (mean of 4.06) and being part of the story as a character (mean of 4.27). This segment is the most likely to engage in co-creation with cycling brands through mobile apps, with not wanting to share advertising ideas (mean 5.09) new product ideas with cycling companies (mean 5.21) or new product ideas with cyclists/cycling communities (mean 4.90). However, it's clear to see this is only a very small part of the segment that wishes to be engaged in co-creation. The segments are most influenced by mobile commerce when it comes to cycling-based applications when compared to the other three groups. This results in all elements of mobile commerce resonating with this segment seen with means of: easy check out (mean 2.38) convenient method of payment (mean 2.53), discount vouchers (mean of 3.00), and secure payment method (mean 2.31). location-based (mean 3.50) and using bar codes (3.42). The elements of design-centric of mobile applications are most significant in this segment when compared to others. This is seen with all elements of design-centric showing importance to this segment: brand name (mean 2.55), promotional app text (mean of 3.19), app logo (mean of 3.00), aesthetically pleasing mobile application (mean 2.63) brand content (mean 2.32) and video content with an app (2.81).

Demographic

They are typically male with 74.6%, with being female with 25.4%. Typically, their age is 45-54 (34.9%), work full time (67.5%), with a higher degree (37.3%), located in the East of England (19.8%), and have the least income of any of the segments £20,000-£30,000 (16.7%)

Highlights - Full Immersed

- Cycling is a central element of life, despite being the shortest in terms of number of years 16.79 years involved in cycling skills and experiences
- Likely to own one bike, which is likely to be a road bike (mean 1.48)
- Most engaged in taking part in events with 61.9% have taken part in event cycling events in the last year.
- Least comfortable with basic cycling skills and experiences, owning to virtual experience, and least time cycling.

- Product research on cycling is influenced by websites (mean of 2.25) and cycling magazines (mean of 3.81). With equal weighting of the brand (mean of 2.59), the performance of the product (mean of 1.62), and price (mean of 2.03).
- High level of involvement when making cycling purchases, highest average spend per month with most frequent of £24-£49 with 28.6%. With strongest relationship towards online through big chains and then offline independent cycling stores.
- Combining both indoors and outdoors cycling. Outdoors recreational, with the most frequent distant being 75- 99 miles (29.4%). They are significantly more likely than other groups to cycle indoors most frequently stating between 2 hours - under 3 hours (23.%).
- The outdoor cycling links to the badge of honor through the high use of apps such as Strava, were as the indoors links to virtual worlds and high use of apps such as Zwift.
- Most likely to use GPS devices to measure rides, with 85.7% stating they use such devices.
- High engagement with cycling subscriptions, 86.5% currently making monthly payments.
- Strongest motivated segment, a strong correlation with intrinsic regulation. Secondary motivations split between introjected regulation and identified regulation, show diversity towards the motivation of cycling.
- Highest number of apps downloaded on mobile phones and daily usage. They also use the widest array (from music to video) of mobile apps for regular use.
- This daily use of apps is important when it comes to cycling apps, with 58.7% using cycling apps daily.
- Most likely group to engage in mobile shopping via mobile applications, with a high number of motivations for engaging from social facilitation, time filler, utilitarian to monetary experience.
- Highest levels of engaged in cycling apps across the board for all five functions of mobile apps.
- Extremely high usage of tool-centric elements, across the three areas of navigation, measuring performance, and social interactions.
- Most engaged in the social element of mobile apps. Rewards, leader boards, and badges of honor along with kudos and comments on their performance resonate showing the importance of the game mechanism.
- Most likely to engage in co-creation with cycling brands through mobile apps, it’s only a very small part of the segment who wish to partake.
- Influenced by mobile commerce when it comes to cycling-based applications, it’s just expected that it’s easy, convenient and easy and secure to pay, and effective to process.
- So used to mobile apps, they expect all element of design-centric to be consistent.

Appendix 6 — Dimensions of customer engagement. Source: Adapted from Pansari and Kumar 2017

Related Constructs	Definition	Operational definition	Relationship to customer engagement (CE)
Customer involvem ent	A person's perceived relevance of the object based on inherent needs, values, and interests (Zaichowsky 1985, p 342)	Zaichowsky (1985) provides a 20-item scale. Some of the items of the scale reflect the importance, relevance, value, excitement, appeal, want, and benefits of the product. These items are measured as a 7-point semantic differential scale. The reliability of this scale exceeds 0.90. Other scales to measure involvement are Putrevu and Lord (1994); Kim and Lord (1991).	Involvement is viewed as motivating the customer to seek information that may be used to manage and moderate any potential risk inherent in the decision-making process (Delgado-Ballester and Munuera-Aleman 2001). This would occur before the customer makes a purchase. CE includes the customer purchases and other indirect effects.
Customer experienc e	It is holistic in nature and involves the customer's cognitive, affective, emotional, social and physical responses to the entity, product and service (adapted from Verhoef et al. (2009).	Gentile (2007) identifies 6 factors for CE – sensorial, emotional, cognitive, pragmatic, lifestyle, and relational – measured these with a four-point scale. Other scales measuring experience are Olson et al. (1995); Froehle and Roth (2004); Klaus and Maklan (2011).	Customer experience is a cognitive measure that is an outcome of the firm's actions and may not include the actions of the customer toward the firm. However, CE is a measure of the customers' actions toward the firm.
Customer satisfactio n	A judgment that a product or service feature, or the product or service itself, provided (or is providing) a	Bruner et al. (2001) suggest a generalized set of 12-item scales measuring various aspects of the purchase and use of the product and	If a customer is satisfied with a product or service then he may buy the product/service again. However, if the customer is engaged with the firm, he would go beyond purchases and provide

Related Constructs	Definition	Operational definition	Relationship to customer engagement (CE)
	pleasurable level of consumption-related fulfillment, including levels of under- or over fulfillment (Oliver 1997, p. 13).	service with a high average reliability of over 0.9. Other scales to measure satisfaction are Spreng and Mackory (1996) (Spreng et al. (1996)	referral, talk about the brand on social media, and provide feedback to the company, all of which are components of CE
Customer loyalty	A favorable attitude toward a brand resulting in consistent purchase of the brand over time (Assael, 1992).	Mittal (1994) provides a 3-item scale measuring consumers preference to a few brands and limiting their purchases to the same. It is measured using a 5-point Likert scale and the reliability of this scale is 0.76. Other scales for measuring customer loyalty are Bettencourt (1997) and Zeithaml et al. (1996)	Loyalty measures only repeated purchase transactions of the customer and focuses only on the revenue of the firm. CE focusses on four different behaviors of customer (purchases, referrals, influence, and feedback). Further, CE goes beyond the revenue of the firm and looks at overall firm profits.
Customer trust	Willingness to rely on an exchange partner in whom one has confidence (Moorman et al. (1993), (p. 82).	Garbarino and Johnson (1999) develop a scale for consumer trust which measures confidence in quality and reliability, perceptions of risk and variability. They use a 5-point Likert scale to measure the items.	Trust is the breadth of the attitude toward the brand, which is embedded in CE in the form of enhanced purchases, referrals, and word-of-mouth.
Customer commitm ent	An enduring desire to maintain a valued relationship (Moorman et al., 1992 p. 316).	Garbarino and Johnson (1999) (develop a scale for commitment which captures the identification with the company, psychological attachment, concern	Commitment is the depth of the attitude toward a brand, which is embedded in the CE framework in the form of spending more resources (time and money).

Related Constructs	Definition	Operational definition	Relationship to customer engagement (CE)
		with long-term welfare, and loyalty. They use a 5-point Likert scale to measure the items.	
Customer brand value	The differential effect of a customer's brand knowledge, brand attitude, brand purchase intention, and brand behavior on his or her response to the marketing of a brand (Kumar et al., 2015).	Kumar (2013) provide a scale that reflects brand awareness, image, trust, affect, loyalty, advocacy, purchase intention, and price premium. Each of these measures is measured on a 1–10 scale. The reliability of the scale items exceeded over 0.80 (Kumar et al., 2015)	

Appendix 7 - Review of Academic literature for Customer Engagement Adapted from Pansari Kumar 2017

Study	Type of firm	Attitude-based	Behavior-based	Conceptual/empirical	Definition	Comments/remarks
Bowden (2009)	B2C	Yes	Yes	Conceptual	A psychological process that models the underlying mechanisms by which customer loyalty forms for new customers of a service brand as well as the mechanisms by which loyalty may be maintained for repeat purchase customers of a service brand.	Satisfaction, calculative commitment for new customers, involvement and trust for existing customers, affective commitment, and brand loyalty are the various measures used to explain the process of CE.
Van Doorn et al. (2010)	B2C	No	Yes	Conceptual	Customers' behavioral manifestation toward a brand or firm, beyond purchase, resulting from motivational drivers such as word-of mouth activity, recommendations, helping other customers, blogging, writing reviews.	Valence, form/modality, scope, nature of impact, and customer goals are the dimensions of the CE framework.
Brodie et al. (2011)	B2C	Yes	No	Conceptual	A psychological state that occurs by virtue of interactive, cocreative customer experiences with a focal agent/object (e.g., a brand) in focal service relationships. It occurs under a specific set of context	Illustrates the conceptual domain of CE through service dominant logic.

Study	Type of firm	Attitude-based	Behavior-based	Conceptual/empirical	Definition	Comments/remarks
					dependent conditions generating differing CE levels; and exists as a dynamic, iterative process within service relationships that cocreate value. CE plays a central role in a nomological network governing service relationships in which other relational concepts (e.g., involvement, loyalty) are antecedents and/or consequences in iterative CE processes. It is a multidimensional concept subject to a context- and/or stakeholder-specific expression of relevant cognitive, emotional, and/or behavioral dimensions.	
Vivek et al. (2012)	B2C	Yes	Yes	Conceptual	The intensity of an individual's participation and connection with the organisations offerings and activities initiated by either the customer or organisation.	Value, trust, affective commitment, word-of-mouth, loyalty, and brand community involvement are consequences of customer engagement.
Hollebeek (2011)	B2C	Yes	Yes	Conceptual	The level of customers' motivational, brand-related, and context-dependent state of	Cognitive, emotional, and behavioral activity are the components of

Study	Type of firm	Attitude-based	Behavior-based	Conceptual/empirical	Definition	Comments/remarks
					mind characterized by specific levels of cognitive, emotional, and behavioral activity in brand interactions.	the customer brand engagement
Kumar et al. (2010)	B2B & B2C	Yes	Yes	Conceptual	(1) Customer purchasing behavior, whether it be repeat purchases or additional purchases through up-selling and cross-selling (corresponding to Customer Lifetime Value [CLV]). (2) Customer referral behavior as it relates to the acquisition of new customers through a firm initiated and incentivized formal referral programs (extrinsically motivated; corresponding to Customer Referral Value [CRV]).(3) Customer influencer behavior through customers' influence on other acquired customers as well as on prospects [CIV]).(4) Customer knowledge behavior via feedback provided to the firm for ideas for innovations and improvements, and contributing to knowledge development (extrinsically or intrinsically motivated; corresponding to	Customer Lifetime Value, Customer Referral Value, Customer Influence Value, and Customer Knowledge Value are the components of the CE framework.

Study	Type of firm	Attitude-based	Behavior-based	Conceptual/empirical	Definition	Comments/remarks
					Customer Knowledge Value [CKV]).	
Kumar and Pansari (2015)	B2B & B2C	No	Yes	Empirical	Same as Kumar et al. (2010)	