Animation as a Creative Tool: Insights into the Complex

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Abstract

Case studies are discussed, from Northumbria University's practice-led Centre for Design Research (CfDR) that demonstrate how visualising concepts and designs through digital animation can enable effective communication of ideas and interactions, which in turn enables creative leaps in thinking, understanding and decision-making. Animation is a tool that can unlock the comprehension into *what is and what could be.* This paper reflects on a number of collaborative projects between the CfDR and several scientific communities, demonstrating and focusing in particular on the process of visualisation, designing digital animations to communicate complex processes, ideas and interactions. An approach and understanding has been developed about how to effectively communicate potentially complex, scientific and technical concepts for the benefit of the client and the end user, in particular the lay audience whose knowledge of the subject may be limited or non-existing.

Findings indicate that the process of constructing simple digital animated stories becomes a learning process for both designer and client. Critical discussions during collaborative meetings develop shared understandings: helping clients to think more creatively about communication (appreciating the benefits of manipulating a *truth to position* to waylay contextual confusion), and making implicit knowledge belonging to the client explicit to the designer. It is important to state that this negotiation is more effective when the designer is a layperson with respect to the complex implicit knowledge of the client. During these collaborative conditions the untangling of complex ideas have achieve the *a-ha* moments in the animations' audiences.
Keywords: Design, digital animation, communication, technology, complex science, storytelling, Alias Design.

Many new businesses seek the expertise of designers and design consultants to help bring their projects to fruition. Developing technologies, in particular those that have advanced with science have increased both the range and complexity of products entering the market. As designers, we need to deliver a clear understanding of products and the experiences attached to them to potential buyers and users, as well as to inform clients' decision-making during the developmental process.

It is often the case that mind-boggling technology is contained *invisibly* within small product enclosures. From both a sales and product development point of view, it is now advantageous to communicate the 'benefits' of the product as a *pre-experience,* before the client commits to a decision about its development, or the buyer and user commits to a decision about its purchase. Components of complex technologies may be microscopic, and previously have been depicted by static illustrations, which to a point can explain something of what is happening, but often does not engage effectively with the 4th dimension: *Time*. At best, the changes over time can be illustrated through storyboarding, but this often leaves aspects like the character of certain movements poorly communicated, e.g. pace, and acceleration. A critical review of design communication tools suggests that a better means of communicating such new technologies and their subsequent processes is through moving pictures, such as animation. This suggestion supports (Cross, 2006) assertion that designers' methods of visualization are shifting in response to a more visually rich world to include a wider breadth of mediums.

The ability to simulate devices and operational situations through animation enables another level of storytelling, which not only guides audiences through new technology concepts, but also engages them on an *emotional* level. This provides the advantage of bringing product experiences, and even early concepts to life, enabling them to be critically reviewed at much earlier stages in their design evolution than might be the case through physical prototypes. Companies can also begin to educate their potential audience months in advance of anything actually being produced, through animated pre-experiences. (Parkinson, 2014) supports the belief that storytelling has the power to facilitate critical discussion around design concepts in his study of the design pitch.

The same process can be used within the companies, to make sure that everyone involved fully understands what their product experience will entail, and even how their project teams are being integrated. This management function opens up a whole different level of project communication to design teams. Animations can be used to shorten the time to that *a-ha* moment of insight for the entire team and reduce potential for misunderstanding or confusion. (Warburton, 1996) stated that 'communication is key to the design process in that it acts as a facilitator for the creative act. It is acknowledged that effective decision-making is intrinsic to an effective design process. However, if a design *thought* is inappropriately communicated, then design decisions may be made to the detriment of the future development of that design'. So, it is argued that the development and creation of animations must be managed critically from the outset.

Technology

There are many that advocate digital storytelling as an instructional tool within education (Jenkins & Lonsdale, 2007, Signes, 2010, Simondson, 2009). (Signes, 2010) in particular proclaims that digital storytelling can build digital, global and visual literacy. However, it is important to appreciate that the right tools must be used for the right jobs. On occasions, it can be argued that designers have used the latest *bit of kit*, whether software or hardware, just for the sake of it. (Warburton, 1996) raised the need to question whether 'it is appropriate to use digital technology to communicate a given design?', prompting us to question its use.

When it comes to explaining some very complex situations, digital animation may not necessarily be the first choice. For example, a physical prototype simulation may enable more effective understandings through kinaesthetic experiences of touch and play. Nevertheless, animation has become central to many communication opportunities and we now see businesses starting to

exploit the capabilities of this technology. Animated communication can range from an assembly sequence for a product with many components to a user experience attached to a product, all of which are becoming more and more commonplace during design development (in the experiences of the authors). In the case of the CfDR, the main choice of animation technology since 1990 has been Alias Design, a decision not based on its ability to produce digital animations, but due to its flexible approach to surface modelling geometric and organic forms. This was of particular importance, as design intent has to be successfully carried through from initial sketches or soft models to the end CAD result. The design team at the CfDR did not want to be hindered by the computer's surface modelling capabilities, and so the primary concern when choosing software had to take this into account. It is possible that had this not been of primary concern, different software may have been chosen, and possibly software without the ability to create animations. (Loosschilder, 1997) observed 'in concept testing, CAD offers several advantages over traditional visualization techniques […] it is easier to create concepts that are understood by consumers'. It could therefore, be rationalized that this in part could be due to an ability to create animations.

Process

As with so many other consultancies and designers, the CfDR follows a typical Staged and Gated process. Splitting the entire design process into smaller, more manageable sections allowing both the designer(s) and client(s) to absorb and reflect on each stage before agreeing to and progressing onto the next. A similar process is followed when looking at the communication of more complex or underdeveloped concepts. There is however, a need for more emphasis on what we describe as the *front end*. What occurs here is essentially a crash course period to build understanding in order to communicate stories effectively. Before designers can develop solutions, they must define what the problem is, and what it might become if unaddressed. Animation may also help in cases of

conceptual visualization, facilitating the consideration of ‘how do designers of new technologies begin when they are unsure of what they are making (the goals), what it should do (its functions), or who will use it? (user profiles),(Carroll, 1995).

The *front end* then requires the development of quick storyboards and sketch illustrations, explaining the step-by-step process that will later be animated (see figures 2, 4, 6, and 7.) This stage is an important part in the communication process, as on many occasions it has encouraged deeper conversation between the client and other members of the team. It is these initial sketch storyboards that become a starting point of negotiation to deliver an accurate depiction and a clear story. This parallels the research of (Lawson, 2006) and (Lloyd, 2000) who discovered that storytelling, taking place during verbal discussions between members of design teams, supported negotiations that ultimately led to shared-understandings. This stage is often the first time that what they know and understand has been visualized in any way, albeit in simple sketch form. It is then the animator’s job of interpreting and modifying any parts of the storyboard, adapting it in real-time to portray their understanding of their concept. In all these situations the visuals produced are creations of the animator, applying their *designer’s* imagination, employing an *artistic license* and drawing on common metaphors to convey the narrative in a more intelligible manner. (Bonnardel, 1999) observed during instances of creativity that ‘when designers had to deal with new problems which required an innovative concept (or solution) they could be inspired by familiar objects’. The very same is true here, since we are designing the *unknown*. Designers rely on experiences of everyday objects and shapes to inform the development of their sketches, and so give the viewer something tangible to engage with. Since sketching is a very quick process, several iterations can be quickly produced. (Suri, 2008) concluded that ‘evaluative or formative design research is essentially an interactive series of *learning loops*’. As the animation production

process is a much slower and more time-consuming process, not spotting misunderstandings or mistakes before this stage can have severe consequences at the *back end:* production stage, and beyond. For this reason, the sketches are re-drawn in simple vector line art. Necessary detail is added and emphasis on colour and texture introduced to give the narrative more depth. This line art is then taken into the 3D software to produce the first pass of the animation (wireframes).

Up until this point in the process, all the sketches produced have been 2-Dimensional. Re-creating the sketches in Alias Design enables them to be transformed into 3-Dimensions, giving depth and form. However, with the 4th Dimension at our disposal – *Time and movement*, the objects themselves can be animated, including the camera, by altering the viewer's line of sight around the objects. This movement becomes equally, if not more, important to the storytelling.

When working with a client, initial wireframe animations are shown to the wider project community, communicating a first realization of the concept or proposal. This enables the client to engage both rationally and emotionally with the mechanisms and their movements as the benefit-narrative of their intellectual property unfolds in front of them. When the *front end* has been managed effectively these wireframe animations show the client or project community, in sufficient detail, a preview of the core product experience story, enabling making a decision whether or not to proceed to full animation production. Full production involves the adding of textures, colours, lighting effects, and depth of field to ensure that the images are believable and comprehendible. However, when an animation is serving to explain a point in a technological development, as opposed to a finished product, the animator has to be aware of '*Truth to Position'*, (Hilton, 2002) and its *'rules for conscious honesty in communications to clients or colleagues.'* This approach involves using rendering techniques that ensure that the viewer appreciates whether

they are viewing something that is conceptual or close to production. Otherwise it can contribute to expectation management issues around work still to be completed, and time to market. In a similar way, (Kim, Yoon, Whang, Tversky, & Morrison, 2007), refer to similar situations involving text, all be it from a learning and teaching perspective. They use the term '*Seductive Details'* to describe interesting elements that aid the learning of written material, but that are actually irrelevant and only make the text more interesting and engaging. (Harp & Mayer, 1997) use the similar term '*Seductive Illustrations'*, to describe the same thing. (Garner, Brown, Sanders, & Menke, 1992) offer a further examination of this phenomenon, communicating a warning that such details can, in some instances, become highly memorable, so much so that they actually disrupt the learning and identification of other more important ideas. It is these *'Seductive Details'* that need to be carefully addressed, and used wisely to balance the *'Truth to Position'*. Rendering and illustrating in ways that are visually engaging must still convey the initial design intent or message in a clear and honest manor.

Case Studies

Carelink

The Carelink project, in 1999, (See figure 1.) required the development of a telemetric monitoring device for pacemakers. The client, Medtronic, managed this project by running a number of internal and external project teams, including contributions from IBM, IDEO, and Virdev, to deal with different aspects and components of the product.

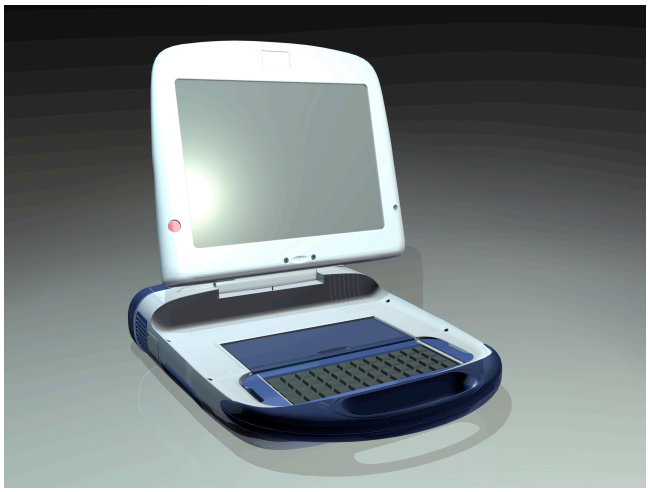

Figure 1: Medtronic Carelink – 3D rendered image.

An intermediate project review of progress highlighted the opportunity to enhance appreciation of the *big picture* and improve inter-team communication if an animation was commissioned to describe the end product, its stages of assembly, layout, and component detail. The authors used Virdev's Pro/Engineer data from their design development of the casing, by IGES data transfer, to animate the required sequences using Alias Design, Adobe Photoshop and Adobe Premiere.

It was noted that the animation enabled previously unappreciated factors to become more obvious, including: clearances, e.g. limits to PCB population height; and the distributed assembly stages requirement for easy disassembly and reassembly.

Medtronic reported that not only was the animation very effective in promoting the *big picture* and improving inter-team understanding and communication perspectives, it was found to be an effective motivator for team members. As a result, stills were taken from the animation and rendered as posters for internal display at Medtronic.

Bio Transformations

The BioTransformations project, in 2006, looked at visualizing their revolutionary process of using light activation *cloaking* technology to selectively administer treatment within the body. Originally brought to the CfDR as a series of 30+ Microsoft PowerPoint slides. The protein uncloaking process was communicated using simple geometric shapes generated from within Microsoft PowerPoint.

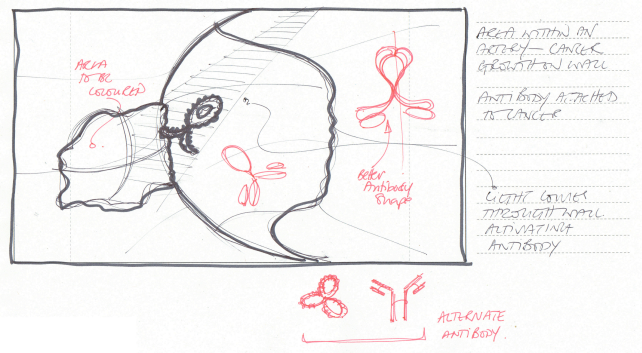

Figure 2: Bio Transformations animation:
Development sketch looking at alternate antibody designs.

Although the PowerPoint presentation included each key stage of the uncloaking process, an understanding of it was not achieved in persons viewing it for the first time, requiring each slide to be clarified at length. As a result, the client had initially been looking for an improved means of graphically communicating the process. Hewitt advised that a more suitable means of communication would be an animation of the entire protein uncloaking process, using the motion of key biological bodies to show what happens.

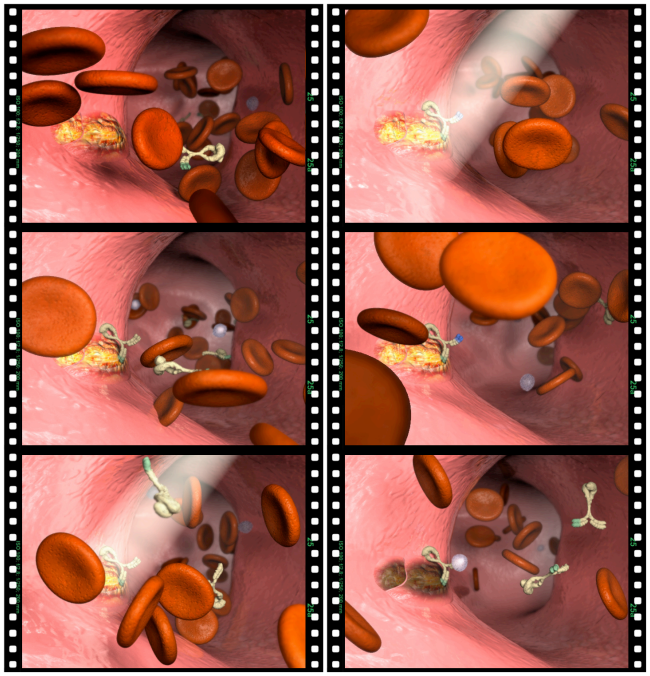

Figure 3: Bio Transformations animation.
Antibody with uncloaked binding site attached to area of infection.

The whole process was broken down into several smaller steps, the first being: gaining a full understanding of what was happening through sitting down with the client to define and sketch/note in great detail the uncloaking process. (See figure 2.) This took several iterations due to the need for the client to describe this aspect of human biology in layperson's terms.

Due to the importance of communicating this fundamental knowledge to a broad audience, Hewitt decided it was necessary to describe the process in such a way that a viewer as layperson could gain clear insight. Hence, the animation was designed to include elements that discernibly described a view from within the body so viewers could both identify and appreciate the context. For example, the introduction of red blood cells to the animation, although superfluous to the process, became intrinsic to the viewer comprehending the environment - a balance between *'Truth to Position'* and *'Seductive Details'* (see figure 3.) This may be referred to as

'representational familiarization'. The client initially struggled to accept this type of change, with its benefits taking much explaining – with the help of a series of sketch illustrations. It was only when the client saw a *preview* of the animation as a black and white wireframe that they fully understood and appreciated the benefit of the change in the approach to presentation.

The remaining stage involved rendering the entire process: adding colour, shading and adding depth of field to produce a 60 second animated sequence. The animation was shown by the client at a medical conference where it won the award for best presentation at the show.

Mitochondria

This project, in collaboration with Newcastle University's Wellcome Trust Centre for Mitochondrial Research, involved explaining the process of transplanting pronuclear material from a fertilized egg containing abnormal mitochondria to one with healthy mitochondria - preventing any genetic disease being passed on from mother to child.

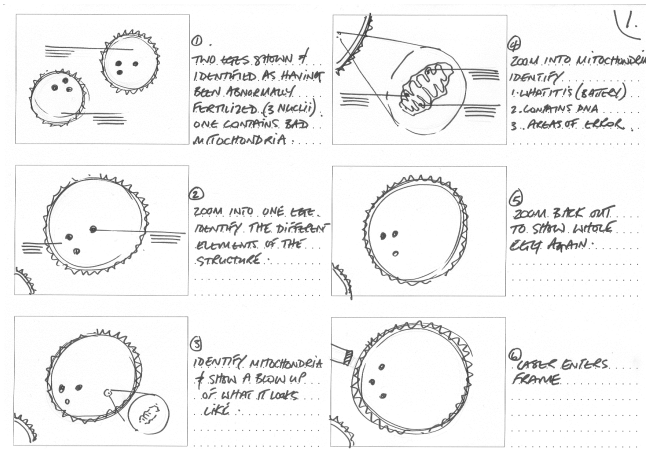

Figure 4: Mitochondria animation.
Initial sketch storyboards with annotations describing action and camera movement.

Currently this transplantation process is a lab-based procedure. The animated sequence illustrated the identification of abnormal mitochondria and the removal of DNA material from one egg, transplanting it into a new egg containing healthy mitochondria. It acts as an educational tool to promote the understanding and effects of mitochondrial disease. From initial discussions with experts at Newcastle University, the sequence was storyboarded in sketch form, translating the scientific knowledge into an interpreted piece of communication more accessible by a varied audience. (See figure 4.)

Discussions around these sketches allowed for changes in the sequence to be updated in real-time, making sure that the narrative of the story was accurate for the target audience (scientists in the field of mitochondrial disease, along with patients suffering from the disease and their family members). Due to the vast difference in level of knowledge between these two groups, several iterations of sketch storyboarding were necessary before it was possible to deliver an effective and engaging message.

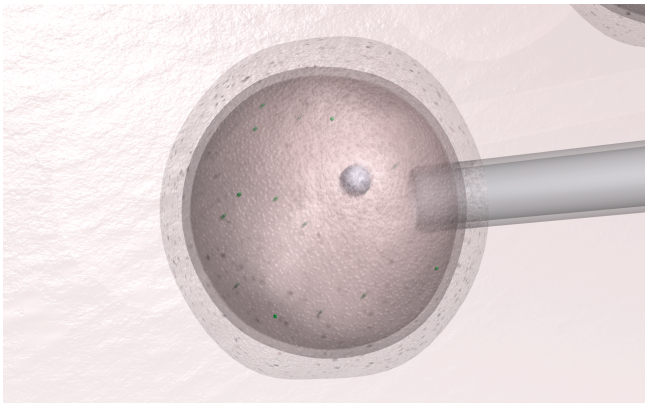

Figure 5: Mitochondria animation.
Nuclear DNA removed from donor egg containing abnormal mitochondria.

Through employing a high level of contextual detail in the initial 3D animated models, it was decided a more simplistic approach would effectively focus the viewer on the core points. Too much scientific detail and viewers could be distracted from the sequence being described, so *artistic license* was taken to portray the narrative in a more intelligible manner, eliminating the viewer's need for a scientific background, (see figure 5). The animation sequence was seen as such a success that several variants were discussed addressing alternative procedures.

QuantuMDx

The latest project in the series of animations was in collaboration with QuantuMDx, a young and vibrant medical company, developing a hand-held portable diagnostic unit. They required publicity of their product's technology allowing for both internal and external communication of its potential.

Owing to the vast complexity in the technology, there was again the necessity for several meetings acting as points of negotiation to deliver an accurate story. However, even after initial sketch storyboarding, (see figure 6.) there was, in this instance, a degree of division between team members as to the correct procedure, and the level of complexity required to communicate the benefits.

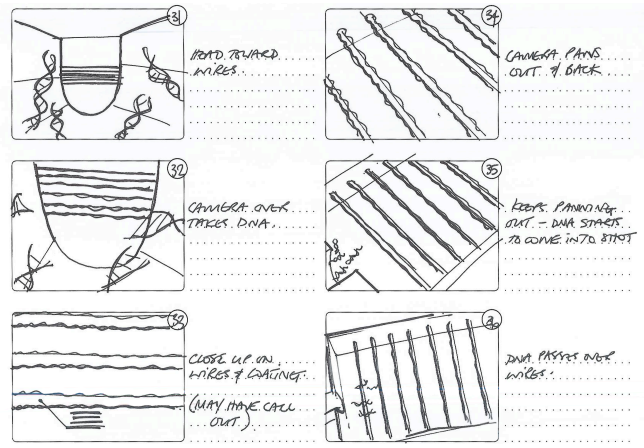

Figure 6: QuantuMDx animation.
Initial sketch storyboards with annotations describing details and camera movement.

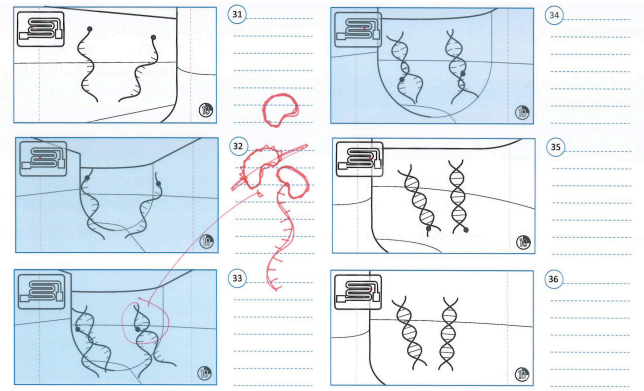

Figure 7: QuantuMDx animation. Revised storyboards, prior to 3D wireframe preview.

This became apparent only after illustrations were presented, as each member considered, from their own perspective that they knew what was happening. Once again, the sketch storyboarding (see figure 7) proved essential to the narrative development; every minute detail was discussed at length. Visuals were created immediately so that each team member could agree designs simultaneously. This *real-time* synthesis of ideas developed the scripting of the animation, allowing for the inclusion of details that, at first, had been deemed unnecessary. Nevertheless, transferring these sketch storyboards into a wireframe animation identified further comprehension

difficulties. These would not necessarily have become apparent without the aid of the animation. Further meetings fine-tuned the story allowing the animation to be fully rendered (see figure 8). A video game camera technique - first person perspective - was used to improve the user's interpretation of the journey in relation to their surroundings. This produced a larger than life experience, positioning the viewer in the heart of the product. Using visual effects like tone, colour, and depth of field focused the viewer's attention on key aspects so the final result became visual more enlightening.

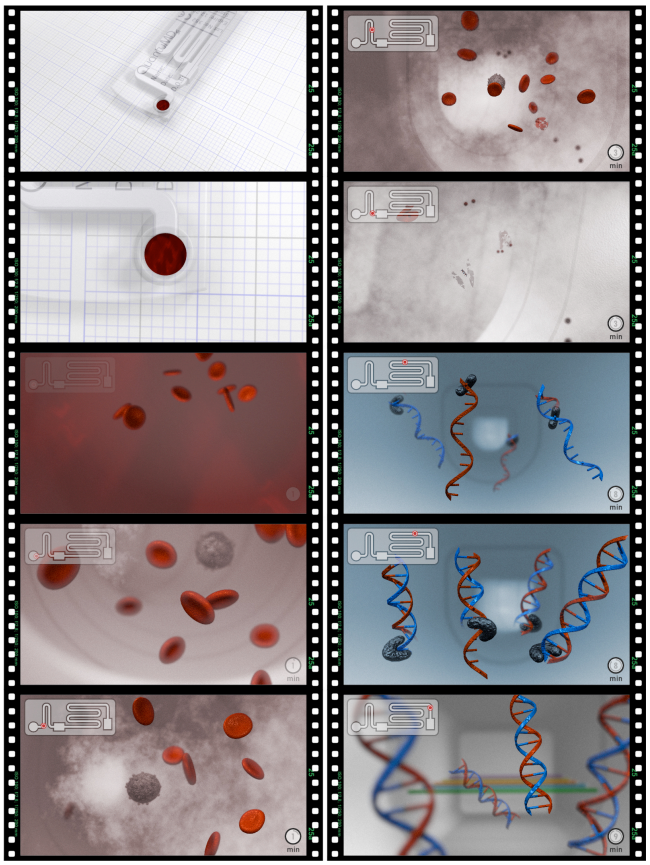

Figure 8: Quantum Animation. Final Version, DNA entering analysis chamber (ITV.com, 2012).

Discussion

The power of digital animation as a tool for insightful experiences had started to become apparent to Hilton since the early 90's, through the CfDR's first major design and animation project for Johnson and Johnson, and viewer responses to the complex mechanics behind a simple packaging solution. Working alongside Hewitt since the late 90's has enabled joint enquiry into developing approaches for animating insights into complex problems and opportunities, for clients, colleagues, and their product or service users.

(Hilton, 2002) explained, 'in the absence of actual product or even adequate prototypes, animation is often the most appropriate aid'. In Hewitt's experience, it was the use of *artistic license* in the Bio Transformations animation that marked a key turning point in the thinking and use of animations, both from an educational and communicative point of view. However, without the knowledge and benefit of inter-team insights, produced from the Carelink animation, the shift in thinking may never have transpired. This was a result of the conscious act of looking at the whole picture from a more removed point of view, not just responding to a client's wishes verbatim, that creating an animation facilitated. This observation supports the idea that design is a social process, where communication (and in particular storytelling) can play a vital role (Lloyd, 2000) and (Carroll, 1995).

The CfDR took a *leap of faith* in starting to propose alternative perspectives and suggesting additional material to the client's initial briefings. Clients were often sceptical at first, possibly viewing this as an attempt by the animators to build cost into the project. However, the animator's conviction that these alternatives would provide more effective ways of communicating the mechanics and processes involved, supported through storyboarding and wireframe previews,

succeeded in opening up creative discussion which better informed decision-making, and promotion of the intellectual property. It comes to be appreciated by those involved in this process that creativity and effective decision-making at the *front end* serves to reduce *down line* costs.

Since the animator cannot be expected to understand all aspects of science there is often a learning curve associated with the start of a new project. While this might be seen as something of a frustration with some new clients, they soon realize this *learning through questioning* is crucial to the process of considering the target audience and how best to facilitate moments of insight from them, supporting the assertion of (Parkinson, 2014) that storytelling can stimulate critique that in turn supports the design process.

Through experience, the animators have learned that involving more of the project community in the development process created a better understanding of the whole picture. Each individual had his or her own understanding of the science and its benefits to share and question. The project community's potential to balance the quantity and quality of information involved also had the benefit of highlighting potential for mis-communication and differences in opinion, which could then be tackled openly in the process, enabling the designer/animator to extract the key points necessary to convey the required story. Acting as a facilitator between the different team members, the animator sounds out, and visually defines, what people see, think, and do. (Moggridge, 2008) described how 'design thinking can help with the messy and challenging problems posed by the complexity of design contexts […] Complex design problems, such as systems or services, will be better tackled by a team of people from varied backgrounds, harnessing intuitive processes, but collaborating so that the output from the *shared mind* is more productive than the sum of the

individual contributors.' This became true for QuantuMDx, contributing to its successful portrayal of the technology being used.

Nevertheless, even with an effective process, not all components will be straightforward to manage. Finding appropriate ways of enabling clients to make their tacit knowledge explicit is quite a challenge for the animator, so that they may then transpose that insight into an intelligible series of visuals that bind the whole narrative together. Commonly this is dealt with by inviting the client to *show us* the problem, or process, in the easiest way they can. Basic drama techniques of *show and tell*, facilitating *kinaesthetic learning*, can often prove useful, enabling the client(s) and the animator to creatively reach new perspectives on the subject matter.

Another component of this process of animating stories of benefit is critical review. We have to question why we are choosing to design or animate in a particular way. What are the driving factors? At some level it is in part down to the experience of the animator knowing implicitly that certain things will or will not work. (Suri, 2008) explained this as 'the *Role of Intuition* [defined] in innovation projects – particularly those that are more radical in scope – discovery and decision making cannot rely exclusively on analytic process. By definition, as soon as we start to think ahead to future experiences and how people might respond, we begin to draw upon our intuitive and interpretive abilities. We begin to imagine and empathize.' It is this difficult evolution of the narrative story that draws specifically on the imagination of the animator. Since many of the situations described cannot be seen: the end product, its style and visuals, are at the sole discretion of the designer/animator, providing further creative value.

Scale and level of reality become a major part of decisions on *artistic license*. If it is decided to err on the side of accuracy certain elements may actually appear completely out of scale to the preconceptions of lay viewers in relation to other elements involved, possibly making the animation visually awkward and difficult to follow. Deciding to emphasize scale differently, use simplistic form, texture, and colour, may allow the interpretations of animations to flow more freely, looking less cumbersome, and so be read more clearly without needing to hold to scientific accuracy.

Conclusion

The lessons that come out of using digital animation as a creative tool for facilitating moments of insight, both in the process of animating, and in the viewing of the animations, build confidence in designer/animators making explicit the implicit knowledge of the mechanics and processes of new technologies.

It is important to involve the cross-disciplinary experiences within the project community in the creative processes of brief development, and storyboarding, through to review of wireframe previews, and critical review of the messages conveyed by each component of the animation before final production. In this way, it is found, that not only does the production become more effective, it can also develop new levels of understanding and creative thinking between team members, through the stimulation of critique and negotiation between members of the team

Although this paper has focused upon cases of medical science communication, the principles of: discussion, storyboarding, visualization, and rendering, including concepts of *'Truth to Position'*

and *'Representational Familiarity'*, are considered applicable to all sectors that design engages with.

The designer/animator needs to ensure that *front end* investment of time, and expectation management, reduces potential down line costs of mis-communication. The designer/animator's approach to open learning through questioning, as a layperson, should be appreciated as crucial to developing an effective *story of benefit*, to facilitate the desired *a-ha* moment, aiding the design process.

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Ian Hewitt is an Industrial Designer and a senior lecturer, teaching on the BA(Hons) Design for Industry programme at Northumbria University. With over 18 years practical industrial design experience, his knowledge spans both the public and private sector in both the UK and US. Ian is about to embark on a PhD to explore playfulness as an approach to learning and developing better design practices, influenced by and incorporating visual design communication for future teaching activities.

Dr. David A. Parkinson

David's experience within the design industry pre-dominantly consists of the management of service and product development projects within the health sector (NHS) and FMCG industry (Unilever). His research focuses on understanding the relationship between design and storytelling. In particular, he relates storytelling approaches designers take during a design pitch to their impact on a client's ability to: understand, value, and think more critically and holistically about a concept.

Dr. Kevin H. Hilton

Dr. Kev Hilton is now a consultant in Design for Transformational Experiences, having spent much of his career investigating how individuals can develop their innovative thinking in order to improve the way in which they see, think, and do things. This area of study has covered a wide range of subjects from Design Against Crime, and Gender Diversity Communication, to the importance of play in developing new approaches to Computer Aided Design.