Effects of exercise and outcome feedback on mood: evidence for misattribution

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Considerable research supports the view that physical activity promotes psychological well-being, with positive effects on mood and self-esteem demonstrated across many forms of chronic and acute exercise (see Biddle, Fox and Boutcher, 2000). Indeed, analyses by Craft and Landers (1998) and Byrne and Byrne (1993) conclude that exercise could be an effective treatment for clinical depression and anxiety.

Many explanations for the positive psychological effects of long-term fitness have been hypothesised, including combinations of improved physical health, enhanced feelings of attractiveness, and increased self-efficacy. The reasons for short-term effects of acute exercise are more difficult to tease out, with theorists differing widely in their focus on such distinct processes as distraction, escapism, mastery and chemical production (Seraganian, 1993).

Many examples of short term improvements in mood following discrete bouts of exercise have been demonstrated (Biddle, Fox and Boutcher, 2000; Yeung, 1996). McGowan, Talton and Thompson (1996) reported positive changes in affect among college students following physical activity, and Kennedy and Newton (1997) found decreases in tension, depression, fatigue and anger after a high-intensity step aerobics session

Although the literature recognises the difficulties in establishing the processes underlying these phenomena (Ojanen, 1994; Tomporowski and Ellis, 1986), the majority of sport psychology textbooks and papers support unquestionably the view that exercise has overwhelmingly beneficial effects on well-being. Not all psychological theory, however, predicts that physical exertion will inevitably promote well-being. Misattribution perspectives (see Schacter, 1999; Zillmann, 1978) imply that under certain circumstances physical exertion might actually be associated with a negative shift in mood. This is likely to occur when residual arousal induced by exercise is misattributed to a subsequent aversive stimulus.

Zillmann's (1978) theory of excitation transfer is based on the notion that people have difficulties interpreting the causes for their own physiological state. He proposes that the sympathetic nervous system produces similar symptoms of arousal, such as increased heart rate, shortness of breath and sweating, not only during exercise but also in a wide range of different situations such as those involving fear, excitement, anticipation, and sexual attraction. Arousal indicators on their own are not sufficient for an individual to assess what has caused them, bringing about the possibility of misinterpretation.

Two classic studies showed some interesting evidence for the misattribution process. Schachter and Singer (1962) found that people who had been given epinephrine but were uninformed that the drug would induce arousal symptoms were highly influenced by the presence of an angry or euphoric bystander compared to those who had been told to expect the symptoms. People in the latter group presumably had a ready-made interpretation for their arousal, whereas the former misinterpreted their arousal in line with the bystander's behaviour. Dutton and Aron (1974) found that men who crossed a rickety suspension bridge responded much more positively to an attractive woman than those crossing a safe, solid bridge. Here the arousal which was initiated by the frightening bridge was seen to have transferred to attraction toward the woman. Thus an overall intensified experience of mood change in a positive or negative direction can be determined by the nature of the accompanying environmental conditions. Misattribution effects have also been implicated in the context of misinterpretations of drunkenness (Epps, Monk, Savage and Marlatt, 1998) and aggression (Taylor, O'Neal, Langley and Butcher, 1991).

These findings suggest that exercise-induced arousal can be similarly misinterpreted. An individual who has just engaged in physical exertion will be physiologically aroused and have little problem identifying the source of this activation. After a period of rest, however, the obvious physiological markers of physical exertion (e.g. racing pulse, panting, perspiring) have largely dissipated, and the individual feels recovered from the exertion. At this point, because arousal is slow to decay, increased levels of arousal still remain (Cantor, Zillman and Bryant 1975; Gollwitzer, Earle and Stephan 1982). Under these circumstances, people will have difficulties identifying the source of their arousal. Indeed, they may only be vaguely if at all cognizant of the fact that they are still aroused. At such times they are susceptible to attributing their residual arousal to whatever salient cues are available in the environment rather than to the exercise. If the environmental conditions are positive (such as a radio broadcast of good news or a compliment from an admired person), then people will associate their arousal with the positive stimulus and thus experience an intensified good mood. However, if these conditions are aversive, the result will be an increased negative mood. In other words, the residual arousal initially induced by exercise is transferred and added to the response to the second stimulus. This effect should be particularly likely to occur among people who are unfamiliar with their physiological responses to exercise, as they will be more susceptible to confusion about the reasons for their arousal.

Cantor, Zillmann and Bryant (1975) exposed male undergraduates to an erotic film immediately after they had exercised, or after five minutes later, or after their arousal had returned to baseline level. Those for whom five minutes had elapsed rated the film as significantly more erotic and exciting than did those in the immediate or delayed conditions. The experimenters suggested that the 'immediate' group correctly attributed their arousal to the exercise, and the 'delayed' group had no arousal to attribute, but the five-minute group misattributed their residual exercise-induced arousal to the film. Similar misattribution effects of exercise have been found by Zillmann, Katcher and Milavsky (1972) with aggressive behaviour, Martin, Harlow and Strack (1992) with affective responses to a story, and Sinclair et al. (1994) with reactions to primed concepts.

However, none of these studies has examined how misattribution might affect a person's response to a competitive situation. Given that combinations of physical exertion and competition are integral elements of many sport activities, an increased insight into excitation transfer effects might be useful in understanding and predicting sport behaviour. The present study was designed to investigate this among a group of people who were relatively unfamiliar with their physiological response to exercise recovery. It was hypothesised that when such people exercised and were subsequently informed that they had performed better than the others on a cognitive task, they would experience an intensified positive response relative to other winners who had not exercised. However, when such people exercised and were then told that they had performed poorly, they would experience an intensified negative response compared to people who had not exercised.

Method

Design and Measures

A 2 x 3 independent factorial design was employed, varying exercise (exercise or no exercise) and outcome feedback (positive, neutral or negative). The dependent variables were the six Profile of Mood States (Lorr and McNair, 1988) subscales which form the POMS-B1 measure of overall mood. Constructed in response to the proliferation of mood measures which focus on negative affect in clinical settings, the POMS-B1 is designed to measure both positive and negative mood among normal and clinically abnormal populations. As reviewed in Berger and Owen (1988), the bipolar 'right now' version of the POMS is highly sensitive to changes in mood in normal populations, and it has been used successfully in studies of exercise and mood (Kolt and Kirkby, 1994; Stanton and Arroll, 1996).

Participants and Procedure

Potential participants were approached by the experimenter and asked a series of questions, some of which were buffers. The key recruitment item asked how often they took part in activities involving physical exercise. If no regular sport or exercise was indicated, they were asked if they would be willing to participate in a study of the effects of various factors on the performance of a task. All participants were assured that they could leave the study at any time if they wished, and this point was reiterated after the experimental instructions were given. Twenty six female (M age = 22.22) and 28 male (M age = 22.15) eligible undergraduate students volunteered to participate.

All participants were tested in randomly-assigned triads. After all three had arrived at the laboratory, each participant was shown into one of three identical adjacent cubicles and proceeded to complete the 'right now' version of the POMS. On completion, participants took part in a 20-minute cognitive task, either accompanied by exercise or not. Participants in the exercise condition were told to exercise by stepping rhythmically on and off the aerobic step in front of them. Measurements by Oldam (1995) showed that this type of exercise led to significantly elevated heart rate during exercise compared to a baseline measure, followed by a significant drop within a five minute rest period and a further significant drop to the baseline rate after ten minutes.

The cognitive task was administered through audio cassette. Eight sets of number strings, similar to those used in the WAIS-R (Wechsler, 1981) digit span scale, were presented. Each set contained an initial number string followed by two alternatives, A and B. Number strings varied in length from eight numbers in the first trial to eleven in the last trial. In five of the sets either A or B was identical to the initial string. In order to increase the ambiguity of the eventual feedback, the three other sets contained no correct answer. For example, Initial String 6 was 5 2 9 4 6 7 3 1 8 2. Test String 6A was 5 2 9 6 4 7 3 1 8 2, and Test String 6B was 5 2 9 4 6 7 3 1 8 2.

The participants were given a stack of cards numbered from 1 to 8. For Trial 1 the participant put Card 1 into one of two large bins labeled A and B, depending on whether they believed Test String A or B was the correct answer. This procedure continued for all 8 trials and was designed to allow exercise to continue uninterrupted throughout the session.

Following the 20 minute test period, all participants sat down and relaxed for five minutes. This ostensibly gave the experimenter time to calculate individual performance on the cognitive task, but it also allowed residual arousal to dissipate to a level where excitation transfer would be likely to occur.

Having rested, participants remained in their individual cubicles and were assigned feedback sheets informing them they had come first (positive feedback), second (neutral feedback) or third (negative feedback) out of the three people taking part in the task. Participants then completed the second POMS, after which debriefing occurred. All participants within each triad actually received the same outcome feedback so that subsequent debriefing information given regarding the false nature of the feedback would be believable after the full purpose of the experiment was disclosed.

Results

The overall mood score was derived in accordance with the POMS-BI manual (Lorr and McNair, 1988). As there were no significant differences between the initial POMS scores of the participants across the conditions, the changes between initial and final mood were analysed using a 2 x 3 independent measures ANOVA. A score of zero represents no mood change, positive scores represent improved mood changes and negative scores negative changes. The results of the analysis of overall mood are illustrated in Figure 1.

A significant main effect for exercise, $F(l, 48)=4.18$, $p <.05$, revealed that participants who exercised during the task had significantly higher mood scores overall ($M =.99$, $sd=7.40$) than non-exercisers ($M=-.62$, $sd=2.96$). A main effect, $F(2, 48)=61.46$, $p<.001$, was also found for outcome feedback, with positive ($M = 4.94$, $sd=4.24$) and neutral feedback ($M = 1.26$, $sd=2.87$) associated with higher mood scores than negative feedback ($M=-5.64$, $sd=3.48$).

The exercise by feedback interaction was significant, $F(2,48)=12.48$, $p<.001$. Analysis of the interaction using planned comparisons showed that exercisers' mood improved significantly compared to non-exercisers' mood following positive feedback, $F(1, 48) = 13.828$, $p < 0.001$ and neutral feedback, $F(1, 48) = 7.168$, $p <0.01$, while exercisers were found to be in a significantly worse mood than non-exercisers following negative feedback, $F(1, 48)=8.14$, $p <0.006$.

Analyses of the six constituent POMS scales revealed significant interactions for Composed-Anxious, Agreeable-Hostile, Elated-Depressed, Confident-Unsure, and Confused-Clearheaded. On all of these, people who had exercised reacted more intensely to the feedback they received than those who had not exercised. The pattern for Energetic-Tired was similar but not significant. The individual means are shown in Table 1.

Discussion

The results provide evidence for misattribution effects. As predicted, exercisers receiving positive feedback were significantly higher in mood improvement than non-exercisers receiving the same feedback, while exercisers receiving negative feedback were significantly lower in mood improvement than non-exercisers. It appears that the residual arousal which remained following a rest from the exercise may have been transferred to the participants' subsequent experience, leading to an intensified response to that stimulus.

Exercisers receiving neutral feedback also experienced a greater mood improvement than non-exercisers, though not as extremely as those who received positive feedback. This could be interpreted in several ways. The neutral feedback took the form of a 'middle' result, wherein the participants were informed that they had come in second place out of three. Perhaps the recipients of this message felt a degree of comfort that they had not actually lost. If so, their relief combined with the residual arousal could indeed have produced elevated positive affect. Alternatively, if the feedback was actually perceived as neutral, the improved mood state might simply have been a direct response to the exercise (Kennedy and Newton, 1997; McGowan, Talton and Thompson, 1996).

These results suggest that when physical exertion is combined with a positive or neutral outcome, mood shifts are likely to be elevated in a positive direction. This is in keeping with the main thrust of the literature which illustrates a wide range of positive effects associated with exercise. However, contrary to the more optimistic view highlighted in many research reports, improved mood is not necessarily an inevitable result of exercise. When combined with a negative outcome, exercise might very well yield a reverse effect, leaving people feeling frustrated, depressed or angry.

The current findings cast some doubt on both social and chemical production explanations often proposed to account for feelings of euphoria associated with exercise (see Biddle, 1995; Longand Vanstavel, 1995; and Rostadand Long, 1996). Any distractions or opiate-like effects should theoretically offer some inoculation against negative emotions following physical activity. The results are more consistent with Everly's (1989) suggestion that aerobic exercise can only be expected to serve as a stress management tool if it is unevaluative and egoless: a competitive element which allows people to experience losing, disappointment and the desire for revenge can interfere with the otherwise healthful characteristics of exercise. Although Everly did not elaborate on this view from an attributional perspective, his observations are wholly compatible with the predictions of excitation transfer theory.

The current sample consisted of sedentary people for whom excitation transfer was particularly likely to occur, given their relative unfamiliarity with their physiological response to exercise. Theoretically, the less acquainted one is with one's response to exercise, the more susceptible that person should be to excitation transfer effects. Therefore, it is conceivable that the present findings might not generalise to people with more active lifestyles, and further research is needed to investigate such groups.

On the other hand, no matter how highly trained athletes might be, it would no doubt prove difficult for them to assess just how much of their physiological arousal comes from one source as opposed to another. Even the most experienced exerciser is unlikely to have developed a foolproof method for apportioning how much accumulated arousal emanates from exercise and how much from a subsequent experience. This could have important implications for aggressive behaviour in sport. For example, a football player who is aroused as a result of physical exertion could be highly susceptible to provocative behaviours from an opponent or aversive decisions from a referee. Unable to separate out the physically induced from the socially induced arousal, the player might very well overreact in a negative fashion to a physical transgression or unwelcome comment. This could explain why players who have been fouled will often respond aggressively, even when they are intellectually aware that their assailant is likely to be pun ished and that their own retaliative act can only lead to their being reprimanded or removed from the game.

Heyman (1993) notes that behavioural control amongst competitors sometimes requires time to reset. Excitation transfer theory proposes a theoretical base to determining this resetting time. An aggressive reaction should be particularly likely to occur after the performer has had a short period of time to 'recover' from the physical activity. At this point the residual arousal, if consciously sensed at all, is likely to seem far removed from the original exertion but is nonetheless operative. An ice hockey player who commits a foul and is taken out of the game to 'cool off' for a few minutes might thus actually return to the game primed to take offense to any hostile act. Quite apart from having a calming effect, the 'sin bin' (penalty box) might actually serve to increase the likelihood of further aggressive behaviour. Perhaps performers and coaches need to be familiarised with excitation transfer effects so that they are fully aware of the exerciser's susceptibility to negative responses following unpleasant results or provocation.

The attributional approach on which the current study is based conceptualises arousal as an activated physiological state, not an emotional condition. The cognitive label attached to the aroused state establishes how this arousal is defined, and the ensuing interpretation plays an integral role in determining the affective and behavioural response. This stance represents a departure from much of the sport psychology literature, where arousal and anxiety are often seen as interchangeable, or where arousal is seen as a type of anxiety. The widely used CSAI-2, or Competitive State Anxiety Scale (Martens, Vealey and Burton, 1990), for example, contains items such as "My heart is racing" and "My hands are clammy" which contribute to a somatic anxiety score. According to Zillmann's approach, these somatic symptoms could well be interpreted in such diverse ways as excitement, exhilaration or sexual interest, and so might only be considered indicative of anxiety if interpreted accordingly. It is thus conceivable that elite performers who interpret their 'anxiety' symptoms as facilitative (see Jones and Swain, 1995) might not, in attributional terms, be experiencing a state of anxiety in the first place.

The present study did not measure arousal directly, but based its assumptions on past research which shows clear increases in arousal indicators following similar forms of physical exertion. Different levels of exercise intensity would no doubt mediate the strength of misattribution effects and the time at which they would occur. Level of intensity might in turn interact with fitness-related individual differences. Such differences need to be explored in future research so that misattribution phenomena can be better applied to a variety of sports situations. In this context, of particular importance is the identification of the intermediate point at which arousal is no longer salient to the exerciser but has not yet returned to baseline level, as this is when the individual should be most susceptible to excitation transfer effects.

Finally, a replication of these results using other mood measures might be attempted. Similar interaction patterns within each of the mood states measured in the POMS-BI were found in the present study. Nonetheless, Wormington, Cockerill and Nevill (1992) found inconsistencies between the original monopolar POMS (McNair, Lorr and Droppleman, 1971) and the bipolar version, although Lorr and McNair (1988) report validating evidence supporting the bipolar nature of moods. It is conceivable that shorter measures might more accurately measure mood in a sports environment (Grove and Prapavessis, 1992), as they should be more sensitive to temporary mood changes. Given that the patterns of results in the present study for the six mood subscales were so similar, the value of measuring different kinds of mood may be questioned, especially in light of the intercorrelations reported by Lorr and MeNair (1988).

[FIGURE 1 OMITTED]

Table 1

Individual POMS Mean Differences/Standard Deviations as a Function of Exercise and Outcome Feedback

	EXERCISE			NO EXERCISE			ANOVA Results		
	1st Place	2nd Place	3rd Place	1st Place	2nd Place	3rd Place	Main Effect Place F p<	Main Effect Exercise F p<	Interaction F p<
Composed-	7.67	4.11	-6.78	2.00	-0.22	-3.67	34.46	5.09	7.19
Anxious	4.58	2.80	6.08	3.39	2.22	1.32	.001	.05	.001
Agreeable-	6.22	4.26	-8.89	4.33	0.11	-4.11	46.94	ns	5.63
Hostile	5.31	1.81	4.26	4.06	3.33	2.52	.001		.05
Elated-	12.11	1.56	-11.00	7.11	1.67	-5.00	44.43	ns	4.33
Depressed	5.37	5.36	9.01	5.37	2.96	3.32	.001		.02
Confident-	8.00	4.11	-7.67	3.22	-2.44	-4.11	26.35	ns	5.75
Unsure	6.48	5.42	5.22	3.63	3.88	3.18	.001		.05
Energetic-	3.56	2.67	-3.22	-1.67	-0.33	-1.00	ns	ns	ns
Tired	9.32	6.24	4.58	5.89	6.30	4.87			
Confused-	7.33	3.11	-8.00	-0.67	-2.22	-4.22	13.51	4.39	5.50
Clearheaded	9.72	2.52	5.72	4.33	4.44	4.00	.001	.05	.05
TOTAL	7.48	3.09	-7.59	2.39	-0.57				

TOTAL	-3.69	61.46 .001	4.18 .05	12.48 .001

Note: Positive scores indicate positive mood change

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