

Exercise psychology: A view from Europe

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ABSTRACT

Objective: To provide a review and commentary on developments and key issues in the psychology of health-related physical activity ('exercise psychology').

Design and Method: Narrative review and commentary.

Results: A view from Europe is provided, with an emphasis on European influence and research. Summary commentaries are provided using the behavioural epidemiological framework as an organisational tool. The role of psychology is discussed in the study of physical activity correlates, theory, and interventions.

Conclusions: The European influence in exercise and health psychology has been significant. However, more needs to be known about pre-intentional motivation processes and post-intentional volition, as well as clarifying and extending theories (e.g., translating intentions into behaviour). There is also a need to do more intervention work, and to improve how we conduct, evaluate and report interventions. New issues are emerging, including the study of sedentary behaviour.

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Introduction

'Sport and exercise psychology' began to replace the more narrowly defined term of 'sport psychology' around the end of the 1980s. This reflected a shift to widen the field beyond the competitive sport domain and to include health-related topics, such as exercise and fitness motivation and the mental health benefits of physical activity, the latter topic having a long history. During this time, the field of behavioural health sciences expanded a great deal and this is reflected in the growth of areas such as behavioural medicine and health psychology, with subsequent expansion of 'exercise psychology' too. Moreover, physical activity has become an increasingly important topic in health research. This is likely to be a reflection, in part, of the concerns about the rising prevalence of overweight and obesity, and the social, economic and health burden that this brings (World Health Organisation, 2004). Other health benefits, of course, are also evident from appropriate types and levels of physical activity (Dishman, Washburn, & Heath, 2004; Hardman & Stensel, 2003).

Rejeski and Brawley (1988) were the first to attempt a formal definition of 'exercise psychology'. They adapted Mattarazzo's

(1980) definition of health psychology and defined exercise psychology as "the application of the educational, scientific, and professional contributions of psychology to the promotion, explanation, maintenance, and enhancement of behaviours related to physical work capacity" (p. 239). This could probably be simplified to 'the application of psychology to antecedents and consequences of health-related physical activity'. In this way, issues are covered that deal with:

1. Psychological antecedents of health-related physical activity (hereafter referred to as 'physical activity'), such as self-efficacy, attitudes, social norms, and perceptions of barriers
2. Psychological constructs that might help change physical activity and their use in interventions, usually referred to as psychological mediators
3. Psychological consequences (outcomes) of physical activity, such as changes in depression or cognitive functioning as a result of physical activity (Biddle & Mutrie, 2008)

In this paper, we focus on themes 1 and 2 above. Space does not allow us to do justice to the work on the psychological consequences of physical activity. However, it is worth noting that Europeans have made significant contributions to the literature in this area. This builds on the seminal work of American researchers William P. Morgan (probably the 'founding father' of this field and with work going back to the

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1960s) (Morgan, 1968, 1969a, b, 1985, 1997; Morgan & Goldston, 1987) and Rod K. Dishman (Buckworth & Dishman, 2002; Dishman, 1986). For example, Europeans, over the past three decades, have co-edited important overview books, or contributed to such books, on physical activity and psychological well-being (Biddle, Fox, & Boutcher, 2000; Faulkner & Taylor, 2005; Mutrie, 2000), conducted important intervention research in psychiatric settings (Martinsen, Medhus, & Sandvik, 1985), contributed to extensive debate on the measurement of affective responses to acute exercise (Backhouse, Biddle, Ekkekakis, Foskett, & Williams, 2007; Ekkekakis, 2003; Ekkekakis & Petruzzello, 2000), applied physical activity to new topics in mental health (Daley, Crank, Saxton, Mutrie, Coleman, & Roalfe, 2007; Taylor & Dorn, 2005; Taylor & Ussher, 2005), or made important contributions through experimental research (Steptoe & Bolton, 1988) and large survey data (Rütten & Abu-Omar, 2004). This research compliments the positive current climate in Europe in which 'health-enhancing physical activity' has a gathering policy and advocacy agenda through agencies such as HEPA Europe (see <http://www.euro.who.int/hepa>).

The role of psychology in wider behavioural frameworks

Physical activity is a behaviour affected or influenced by many different factors, and psychology is not the only discipline that helps us to better understand this behaviour. One way to enhance our understanding of the role of psychology in physical activity is to view (exercise) psychology within the social–ecological and behavioural epidemiological frameworks.

The social–ecological framework allows for individual and social psychological influences to be seen alongside other important factors in explaining behaviour (Stokols, 1992). Individual psychology is one part of a set of wider influences on behaviour. Such factors are set within social influences, such as family and group norms, parental influence, and peer pressure. Beyond social factors are influences of the physical environment. In the past 10 years or so, interest in the potential influence of the physical environment on population physical activity levels has grown substantially (Owen, Leslie, Salmon, & Fotheringham, 2000). This field of study is still developing and it is likely that physical activity is best explained by an interaction between the person and environment. Hence the best interventions to change physical activity will be based on individual psychology when people are less active but live in a supportive environment, whereas environmental interventions may be required for people when the environment is clearly inhibiting physical activity.

Finally, the social–ecological framework allows for the influence of policy in shaping behaviour. Individual, social and environmental factors exist in the context of supportive or unsupportive policies (or no policies). There has been a clear move towards great involvement of policy makers in physical activity over recent years at international (van Mechelen, 1997; World Health Organisation, 2004) and national (e.g., Department of Health, 2008) levels.

Psychological influences, therefore, are best seen in the wider context of social, environmental and policy influences. Ultimately, it is individual's who make decisions to engage in planned behaviours, such as recreational walking or attending an exercise class. Individual psychology, therefore, cannot be ignored. However, it is recognised that such decision-making is not made in a vacuum, nor is it automatically influenced by external factors. Despite the importance of the social-ecological approach, one cannot get away from the important role of psychology in physical activity as a complex behaviour.

The behavioural epidemiology framework was first advocated in physical activity by Sallis and Owen (1999). Behavioural epidemiology considers the link between behaviours and health and disease, such as why some people are physically active and others

are not. In relation to physical activity, this framework has five main phases:

1. *To establish the link between physical activity and health.* This is now well documented for many diverse health conditions and well-being in adults (Hardman & Stensel, 2003) and young people (Stensel, Gorely, & Biddle, 2008).
2. *To develop methods for the accurate assessment of physical activity.* This continues to be a challenging area with large-scale surveillance of population trends usually relying on self-report, a method that has significant problems with validity and reliability. Recent 'objective' methods, such as accelerometers, heart rate monitors, or pedometers, are useful but do not necessarily give all of the information required, such as intensity or type of activity or the setting in which the activity takes place, although geographic information systems (GIS) and global positioning systems (GPS) may assist with providing data on location. However, it must be recognised that currently such devices are expensive and unlikely to be a practical option for population-wide assessment. Objective methods may also create behavioural reactivity or be unappealing or obtrusive to some individuals, thus reducing the likelihood of compliance.
3. *To identify factors that are associated with different levels of physical activity.* It is important to identify factors that might be associated with the adoption and maintenance of behaviour. This area is referred to as the study of 'correlates' or 'determinants' of physical activity (Biddle & Mutrie, 2008). The term correlates is usually preferred to denote a variable that is associated with physical activity, whether the association is considered causal or otherwise.
4. *To evaluate interventions designed to promote physical activity.* Once a variable is identified as a correlate of physical activity (e.g., family support), then interventions can manipulate this variable to test if it is, in fact, a determinant (Baranowski, Anderson, & Carmack, 1998).
5. *To translate findings from research into practice.* If interventions work, it is appropriate to translate such findings into ecologically valid 'real-world' settings. 'Translational research' is important and increasing (Davis et al., 2003; Dziewaltowski, Estabrooks, & Glasgow, 2004), yet underrepresented in the literature (Sallis, Owen, & Fotheringham, 2000).

The field of 'exercise psychology' has tended to grow from 'sport science' and 'sport psychology', and to some extent this has brought some weaknesses. Looking at the behavioural epidemiology framework, exercise psychology has been weak in the measurement of physical activity and has conducted too few well designed, theoretically sound, interventions. Moreover, translational research is rare. We are still dominated by cross-sectional studies that seem more intent on testing a social-psychological theory than using diverse approaches and methods in bringing about meaningful behaviour change. One could argue that we have been too focussed on the 'psychology of exercise/physical activity' rather than 'psychology for exercise/physical activity'. The field needs to look more broadly at behavioural medicine and, possibly, health psychology, notwithstanding the latter's propensity to be over-reliant on a narrow range of theoretical approaches. We also need to spend more in phases 4 and 5 of the framework, and to allow for greater assessment and reflection on intervention fidelity.

Physical activity patterns: What can psychology learn from this?

Exercise psychology is concerned with understanding physical activity behaviours. This requires us to have knowledge of the

behaviour itself, including physical activity patterns of individuals and populations. Physical activity surveillance at population level has grown as a field of study in the past decade or more and we now have a number of data sets that allow for cross-sectional analyses of physical activity patterns in different countries, as well as trends over time.

It is not our intention to provide a comprehensive data summary of physical activity patterns in Europe or elsewhere. However, from a behavioural and psychological perspective there are important issues that require noting and that exercise psychologists might wish to address in their work. We know that physical activity is very difficult to assess, ranging from observation, proxy reports, and self-reports to 'objective' measures using variations of movement sensors (e.g., pedometers and accelerometers). We are also interested in assessing lack of movement, i.e., sedentary behaviour, such as TV viewing or motorised transport use. All of these methods produce certain aspects of behavioural data with varying degrees of certainty (Marshall & Welk, 2008). Exercise psychologists need to assist in developing methods to boost more valid methods of self-report and contribute to methods that identify what activities people are doing and why. This may be more important than simply quantifying volume of physical activity or time spent being sedentary, depending, of course, on the research question being asked.

We know that physical activity tends to decline with age, including within narrow age ranges, such as across the teenage years, and that most assessment methods show males to be more active than females (Telama & Yang, 2000; Van Mechelen, Twisk, Post, Snel, & Kemper, 2000). Those with a higher level of education are often more active, although this may depend on the nature of the activity being assessed (McElroy, 2002). However, we know much less about the behaviours of some cultures, ethnic groups or special populations (Martinez, Arredondo, Ayala, & Elder, 2008) or how these might be changing as some parts of Europe, for example, have undertaken significant political and economic change since the 1980s (Soós, Hamar, Molnár, Biddle, & Sándor, 2008). Moreover, we need to know more about population trends over time, such as shifting behavioural patterns in use of sedentary entertainment, access to sports clubs, active commuting to school/work etc. For example, Samdal et al. (2006) studied trends in physical activity in seven European countries from 1985 to 2002 using the 'Health Behaviour in School-aged Children' project survey instrument. Samples of children aged 11, 13, and 15 years were assessed in Austria, Finland, Hungary, Norway, Scotland, Sweden, and Wales. Results showed a small increase in young people reporting vigorous physical activity four or more times a week in Finland, whereas other countries showed a more stable pattern. Moreover, some behaviours will show a negative trend, such as walking to school in the UK (Pooley, Turnbull, & Adams, 2005). Physical activity in university students varies widely across European countries (Steptoe et al., 1997). Psychologists may need to identify why these differences occur, and why some populations are increasing their activity levels and why some are declining, as inevitably will be the case. Finally, we need to explore why some countries and cultures have established certain 'accepted' behavioural patterns, such as cycling in the Netherlands and sports club membership in Sweden. In Europe, activity levels tend to be higher in the northern countries compared to those in the south (de Almeida et al., 1999).

Psychological correlates of physical activity

There has been a great deal of research on correlates of physical activity since the 1980s. This area is often referred to as 'exercise adherence' and addresses psychological and other potential correlates of activity. Studies and reviews provide evidence for both

young people and adults separately as some factors may differ. Correlates other than psychological factors have often been grouped into the categories of demographic, biological, behavioural, social/cultural and environmental correlates.

Psychological correlates of physical activity in children and adolescents

The most comprehensive review of correlates of physical activity in young people was conducted by Sallis et al. (2000). This has now been updated and extended by van der Horst et al. (2007). In addition, we have published a review on psychological and other correlates of physical activity in adolescent girls (Biddle, Whitehead, O'Donovan, & Nevill, 2005).

The study of correlates with young people has often addressed the setting of structured youth sport and physical education. Less research is available on other environments, such as active transport, play, or 'incidental' physical activity, although this is changing (Robertson-Wilson, Leatherdale, & Wong, 2008; Timmons, Naylor, & Pfeiffer, 2007). This is important from the view point of psychology because physical activity in different settings is likely to have varied psychological antecedents and rely to differing degrees on psychological processing. For example, cycling or walking to school for children many years ago, or in some countries still today, may have been more a function of lack of other transport alternatives than behavioural planning or 'motivation' for exercise. Equally, the cycling 'culture' and infrastructure varies hugely across Europe, with Denmark and The Netherlands having far higher rates of participation than, say, Portugal or the UK. The historical acceptance and supportive environmental infrastructure may override, at least in part, individual psychological preferences and motivations. Equally, such supportive socio-environmental contexts may simply facilitate the behaviour among receptive individuals. Importantly, between-country differences cannot be explained simply by geographical or climatic factors.

While Sallis et al. (2000) addressed correlates of physical activity, van der Horst et al., (2007) also included correlates of 'insufficient physical activity' (i.e., low levels of activity) as well as sedentary behaviours. More researchers are now addressing sedentary behaviour separately from physical activity and, as such, new research is required on correlates of such behaviours and interventions to reduce different sedentary behaviours (Smith & Biddle, 2008). We will provide additional comments on this later in the paper.

For children, there is little consistency in the results reported by Sallis et al. (2000) and van der Horst et al., (2007). Part of this may be explained by a simple lack of studies reported on some correlates. Across the two reviews, physical activity is positively associated with intentions and 'preference' for physical activity. Recent studies have also shown self-efficacy to be associated with greater levels of physical activity in children.

For adolescents, reviews show that higher levels of perceived competence and self-efficacy are associated with greater physical activity. Biddle et al. (2005) reported that the strength of the association between physical activity and perceived competence for adolescent girls was small, but small-to-moderate for self-efficacy. 'Goal orientation/motivation' and 'achievement orientation' were identified by van der Horst et al., 2007 and Sallis et al., 2000 as being positively associated with physical activity in adolescents. Limited information is available on these constructs in either review, but it is likely that some form of 'task orientation' is being referred to. This is a style or 'orientation' of motivation where the individual defines competence and success in self-referenced terms. The individual is motivated to learn from mistakes, to exert

effort, and improve, rather than necessarily seek to win against others (Biddle, Wang, Kavussanu, & Spray, 2003).

The psychological literature is clear that the motivation to take part in behaviours of free choice, such as physical activity in leisure-time, is associated with strong intentions (Ajzen, 2001), and this was supported in the review by Sallis et al. (2000). Intention is a key mediating variable in the Theory of Planned Behaviour, a framework that has been studied extensively in the context of physical activity and other health behaviours (see later). Intentions to act are the immediate antecedent of behaviour, and research supports an association between intentions and physical activity. Planning how best to implement intentions may strengthen this relationship further (Gollwitzer & Sheeran, 2006) and help close the 'intention-behaviour gap'. European researchers have readily adopted this approach in the physical activity domain (Hill, Abraham, & Wright, 2007; Kwak, Kremers, van Baak, & Brug, 2007).

Issues of body image and appearance seem to be important for adolescent girls in the context of physical activity decision making. Specifically, the correlates of perceived body attractiveness, importance of appearance, and physical self-worth were positive and small-to-moderate in their strength of association with physical activity in adolescent girls (Biddle et al., 2005). It is important to note that the assessment of physical self-perceptions has received considerable support from European researchers (Fox, 1998; Hagger, Biddle, Chow, Stambulova, & Kavussanu, 2003).

Psychological correlates of physical activity in adults

There have been many reviews of the correlates of physical activity in adults over the past three decades (Dishman & Sallis, 1994; Trost, Owen, Bauman, Sallis, & Brown, 2002). The update by Trost et al. (2002) of the review by Sallis and Owen (1999) located 38 new studies published between 1998 and 2000. Of those addressing psychological correlates of physical activity, there was evidence for a consistent positive association with physical activity, across both reviews, for the variables of enjoyment, expected benefits, intention, perceived health, self-motivation, self-efficacy, stage of behaviour change, and self-schemata for exercise, and negative associations for barriers and mood disturbance.

The strongest evidence, based on 12 studies in the updated review by Trost et al. (2002), is for self-efficacy. Self-efficacy is the belief that one can undertake the desired behaviour. This is likely to be more important for behaviours that require effort, such as structured fitness programmes. The correlate of enjoyment is associated with intrinsic motivational states (Deci & Ryan, 2002). However, enjoyment might be seen as both an antecedent of behaviour ('I exercise to seek enjoyment'), or an outcome ('I enjoyed that session of exercise'). There is also a need in the exercise psychology literature to go beyond simply notions of 'fun' and enjoyment and explain what this psychological state represents, what its antecedents are, and how best to measure it.

Although psychological correlates have been studied quite extensively, and we have a reasonably clear picture of what seem to be most consistently identified, this does not tell us whether we are able, or how easily we are able, to change these correlates. It is typical for research to say whether a correlate is 'modifiable' or 'non-modifiable', but for all the most obvious cases of non-modifiable correlates, we cannot be sure how much some variables will actually change, if at all. This is an important issue for intervention researchers.

Psychological theories in physical activity research

Correlates of physical activity help to identify potentially important constructs that may underpin behaviour, but for better understanding we need to see their place within wider theoretical

frameworks. This may assist in the planning of successful interventions. Three of the most popular psychological theories in contemporary health and exercise psychology over many years have been Social Cognitive Theory (Bandura, 1997), the Theory of Planned Behaviour (Ajzen, 2001), and the Transtheoretical Model (Prochaska & Marcus, 1994). More recently, integrated models, such as the Health Action Process Approach (HAPA) have been developed and feature prominently in some European research (Schwarzer, 2008).

Social Cognitive Theory

Social Cognitive Theory (SCT), and the most prominent and key element of the theory, self-efficacy, can be attributed to the work of Albert Bandura (see Bandura, 1997). He developed this approach as a clinical psychologist concerned with patient treatment. SCT suggests that we learn and modify our behaviours through an interaction between personal, behavioural, and environmental influences. This is the so-called model of 'reciprocal determinism', with all three constructs affecting each other.

Key cognitive elements of SCT comprise the ability of humans to think about the likely consequences of their actions ('symbolising capability'), or our ability to think about and anticipate future courses of action. Similarly, SCT comprises a self-regulation component in which we regulate our behaviour based on our own goals, cognitions, and feelings.

We also reflect on our actions, particularly in respect of thinking about the consequences of our behaviours ('outcome expectancies') and our own capabilities ('efficacy expectancies'). Thinking about consequences in physical activity, for example, might involve consideration of the benefits and costs of being more active. An individual might believe these consequences to be positive (e.g., better health) or negative (e.g., cause fatigue).

Self-efficacy is situation-specific confidence to undertake a certain behaviour. This has already been shown to be an important correlate of physical activity, in adolescents (Biddle et al., 2005) as well as adults (Scholz, Sniehotta, & Schwarzer, 2005). Self-efficacy refers to efficacy beliefs and expectations (the 'can I?' question). This will be very influential in many behaviours, especially those that are challenging, such as being more physically active when obese or significantly unfit. It is important not to lose sight of this in exercise psychology and therefore not to expect self-efficacy to predict all behaviours.

There are four main sources of information that we might use to develop our levels of self-efficacy. These are prior behaviour (success and performance attainment), watching others (imitation and modelling), encouragement (verbal and social persuasion), and creating feelings of relaxation and upbeat mood (judgements of physiological states). These could be targeted as mediators of behaviour change in interventions.

Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is based on the assumption that intention is an immediate determinant of behaviour. In turn, intention is predicted from attitude, subjective norms, and perceptions of behavioural control (see Fig. 1). The attitude component of the model is a function of the beliefs held about the behaviour and the evaluation, or value, of the likely outcomes of adopting the behaviour (Ajzen, 2001). Types of attitude are now being studied, such as affective or instrumental attitudes (Lawton, Conner, & Parker, 2007).

The subjective norm component is comprised of the beliefs of significant others and the extent that one wishes to comply with

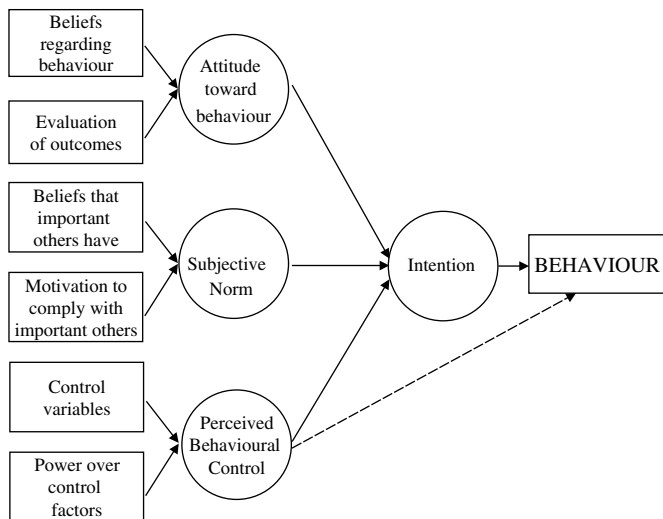


Fig. 1. Theory of Planned Behaviour.

such beliefs. The relative importance of the attitudinal and normative components may depend on the situation under investigation.

Perceived behavioural control (PBC) is defined by Ajzen (1988) as “the perceived ease or difficulty of performing the behaviour” (p. 132) and is assumed “to reflect past experience as well as anticipated impediments and obstacles” (p. 132). Fig. 1 shows that perceived control links with both intentions and behaviour. PBC, therefore, is thought to have a motivational effect on intentions, such that individuals wishing to be physically active, but with little or no chance of doing so (maybe because of largely insurmountable barriers), are unlikely to do so regardless of their attitudes towards activity or the normative factors operating.

The construct of PBC is underpinned by a set of control beliefs and the perceived power of these beliefs. Control beliefs refer to the perceived presence of factors that may help or impede the behaviour, and perceived power refers to the perceived impact that helping or inhibiting factors may have on the behaviour. PBC is thought to accurately predict behaviour under circumstances only when perceived control closely approximates actual control (hence the use of broken line in Fig. 1). It is possible that PBC could mediate the relationship between intention and behaviour.

Two meta-analyses have been conducted using the TPB, or elements of the model. Hausenblas, Carron, and Mack (1997) analysed 31 exercise studies and found that intention had a large effect on exercise behaviour, and attitude had a large effect on intention. The effect of attitude was twice that of subjective norm. Similar findings were reported by Hagger, Chatzisarantis, and Biddle (2002) in their meta-analysis of 72 studies. Correlations were reported of 0.35 between attitude and behaviour, 0.60 between attitude and intention, and 0.51 between intention and behaviour.

A key issue in the TPB is that there is far from a perfect correlation between intentions and behaviour. One approach that has been put forward to resolve the inadequacies of the intention-behaviour relationship in the TPB is ‘implementation intentions’ (Gollwitzer & Sheeran, 2006). These are goals and plans that involve specifying when, how, and where performance of behaviour will take place. According to Gollwitzer (1999), implementation intentions help people move from a motivational phase to a volitional phase, thus ensuring that intentions are converted into behaviour. The motivational phase is concerned about the elements on the left side of Fig. 1 (up to intentions), whereas the volitional phase is concerned with translating motivational beliefs into behaviour (right side of Fig. 1).

Recent research has evaluated the effectiveness of interventions that combine motivational techniques with volitional techniques, such as implementation intentions, in influencing the performance of social and exercise behaviour (Prestwich, Lawton, & Conner, 2003). The rationale for this is that motivational strategies centre on increasing intention levels while volitional strategies, such as implementation intentions, increase the probability that these strong intentions will be converted into behaviour.

Transtheoretical Model

Research concerning the Transtheoretical Model (TTM) in physical activity is now quite extensive (Marshall & Biddle, 2001). The model proposes that behaviour change involves moving through a series of stages and proposes various ways that behaviour change may be enhanced. It therefore tackles both the ‘when’ (stages) and the ‘how’ of behaviour change. The latter include the processes (strategies) of change and moderators of change such as decisional balance (pros and cons of change) and self-efficacy.

Studies on physical activity assess the stages of precontemplation, contemplation, preparation, action, and maintenance. Precontemplation includes people who are not currently physically active (at whatever criterion level is specified) and have no intention of doing so in the near future. Those in the contemplation stage include those not currently physically active but who do have an intention to start in the near future. Those in preparation are somewhat physically active, but not on a regular basis. The action stage represents people who are currently active, but have only recently started. Finally, the maintenance stage includes those who are currently physically active and have been doing so for some time, usually at least 6 months.

The stages of change are concerned with the temporal patterning of behaviour change. By also identifying processes of change we are able to better understand why and how this temporal shift might take place. Processes of change, therefore, are important for interventions by helping move people between stages. Processes of change are strategies and techniques that people use to help them progress through the different stages. Typically, 10 processes of change have been identified, with five of these described as cognitive or ‘thinking’ strategies and the other five as behavioural or ‘doing’ strategies. The results of a meta-analysis (Marshall & Biddle, 2001) showed that individuals use all 10 processes of change when trying to modify their physical activity behaviour, although this is based on a limited number of studies. Cognitive processes (e.g., increasing knowledge, being aware of health risks) peak during the action stage while behavioural processes (e.g., enlisting social support, reminding yourself) peak later, in the maintenance stage. The meta-analysis also showed that precontemplation to contemplation and preparation to action are characterised by sharper increases in behavioural process use compared to other stage transitions. Moreover, nine of the 10 processes followed similar patterns of change across the stages. This argues against the presence of a stage-by-process interaction whereby some processes are thought to be more important or likely at certain stages.

One strategy that can assist people to make successful behaviour change is to weigh up the advantages of change (‘pros’) against the disadvantages or costs of change (‘cons’). This ‘decisional balance’ exercise is one that has been at the core of the TTM. Research suggests that in the early stages of behaviour change the cons outweigh the pros of change. Those in preparation see more equality between the pros and cons, whereas those who are in maintenance will perceive more pros than cons. Changing perceptions of pros and cons, therefore, may assist in behaviour change.

Results from Marshall and Biddle's meta-analysis also showed that self-efficacy increased with each stage of change, as proposed by the TTM. The pattern of increase was not linear, with effects being moderate between precontemplation and contemplation, small-to-moderate from contemplation to preparation, moderate from preparation to action, and moderate-to-large from action to maintenance.

The majority of studies investigating the TTM in physical activity are cross-sectional (Marshall & Biddle, 2001). This presents difficulties in establishing causal relationships between constructs and stages. In addition, there have been some critical views of the model and a questioning of its utility. For example, Riemsma et al. (2002) conducted a systematic review to assess the effectiveness of stage-based approaches in behaviour change interventions, including seven studies targeting physical activity. Results showed that only one of the seven studies demonstrated a positive effect for behaviour change, with two showing mixed effects. Similarly, Adams and White (2005) have questioned the long term effectiveness of such interventions. However, several commentators suggest that short-term effectiveness has been demonstrated (Titze, Martin, Seiler, Stronegger, & Marti, 2001), and that further work is required before dismissing the model or replacing it with something else (Brug, Conner Harre, Kremers, McKeller, & Whitelaw, 2005). Interestingly, in the context of the current paper, much of this debate has been undertaken by European researchers.

Health Action Process Approach

The Health Action Process Approach (HAPA) (see Schwarzer, 2008) extends previous theories (SCT, TPB) into a process model that distinguishes between (a) pre-intentional motivation processes that culminate in the formation of a specific behavioural intention, and (b) post-intentional volitional processes that translate this intention into actual health behaviour (see Fig. 2). The motivational processes are dominated by three factors: risk perceptions (e.g., "I am at risk for cardiovascular disease"), positive and negative outcome expectancies (e.g., "If I exercise regularly ... I can reduce my high blood pressure; ... my knee starts hurting again"), and self-efficacy beliefs (e.g., "I am able to stick to my exercise schedule although there is still much office work to do"). After a person has developed an intention to perform a specific health behaviour (e.g., "I intend to begin with regular fitness training"), he or she enters the realm of volition processes. HAPA

focuses in particular on three volitional constructs: action planning, coping planning and phase-specific self-efficacy.

Action planning is a cognitive procedure necessary to transform the (relatively vague) intention into a concrete behaviour by specifying the when, where and how of this action. While the concept of action planning is not necessarily new, it has received recent attention through implementation intentions, as discussed earlier. Several studies have demonstrated the strong effects of implementation effects on health behaviour in general (Gollwitzer & Sheeran, 2006) and on physical exercise in particular (Lippke, Ziegelmann, & Schwarzer, 2004).

Coping planning refers to the anticipation of problems and barriers that might impede the implementation of one's behavioural intentions. Coping planning encompasses not only identification of difficulties that could lead to the cessation of the behaviour, but also detailed planning on how to overcome such difficulties (Ziegelmann, Lippke, & Schwarzer, 2006). A typical coping plan would be, for example, "If it rains heavily, I will go to the gym instead of going running". Coping plans have been found to be effective in changing health behaviours, such as physical activity (Scholz, Schüz, Ziegelmann, Lippke, & Schwarzer, 2008; Ziegelmann, Lippke, & Schwarzer, 2006).

According to HAPA the volitional processes are influenced by self-efficacy beliefs which determine the effort and perseverance. People with strong self-doubts are more likely to anticipate failure scenarios, they are more inclined to worry about possible performance deficiencies, and abort their attempts prematurely. In the post-intentional phase, HAPA distinguishes between three types of self-efficacy beliefs (Scholz, Sniehotta, & Schwarzer, 2005; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008): task self-efficacy (which also affects pre-intentional motivation processes), coping self-efficacy, and recovery self-efficacy. Task self-efficacy reflects the confidence in one's ability to be physically active in general ("I am confident that I can be physically active at least 3 times a week for 30 min"). Coping self-efficacy addresses the belief in one's abilities to overcome internal and external barriers that might impede one's action plans ("I am confident to engage in physical activity regularly on a long-term basis even if I am together with friends who are not physically active"). Finally, recovery self-efficacy refers to the experience of failure and recovery from setbacks. In the case of a lapse, the person is certain of being able to resume the intended physical activity ("I am confident that I can return to a physically active lifestyle even if I have relapsed for several weeks") (all example items were taken from Scholz et al., 2005).

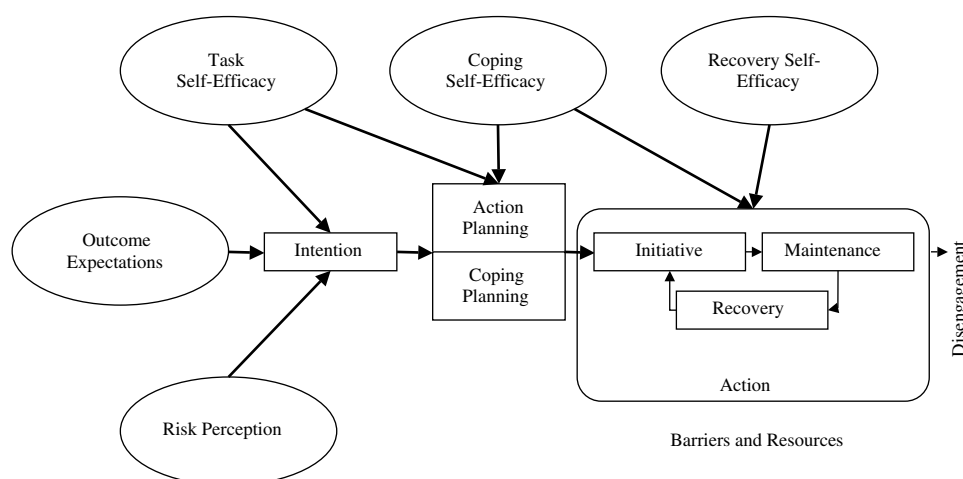


Fig. 2. Health Action Process Approach.

Interventions to change physical activity: The role of psychology

Currently there are two major reviews summarising the status of research regarding individual or group-focused interventions towards promoting physical activity (Hillsdon, Foster, & Thorogood, 2005; Kahn et al., 2002). Kahn et al. reviewed individually-adapted health behaviour change programmes based on 18 reports. All taught specific self-management skills (e.g., goal setting, self-monitoring) that enable participants to increase their physical activity. Such interventions are usually offered to participants in group settings, by mail, or by telephone. Studies that measured changes in the time spent on physical activity found a median net increase of 35%, while studies that measured change in fitness (VO₂ max) observed a median increase of 64%. Kahn et al. (2002) concluded that “there is strong evidence that individually-adapted health behavior change programs are effective in increasing levels of physical activity” (p. 87).

The review by Hillsdon et al. (2005) considered 18 randomised controlled trials with at least a 6-month follow-up. The effect of interventions on self-reported physical activity was positive and moderate (pooled standardised mean difference 0.31). Of the four studies reporting the outcome more than six months after initial intervention, two studies found significant differences in cardio-respiratory fitness levels, but no study found significant differences in physical activity levels between the intervention and control group at the 12 or 24 month follow-up. The authors summarise their review by stating that “physical activity interventions have a positive moderate sized effect on increasing self-reported physical activity... at least in the short to mid-term” (p. 7f.). However, it is still unclear to what extent the specific components of the intervention could have contributed to behaviour change.

In order to improve effectiveness of interventions in physical activity a stronger theoretical foundation has been demanded (Hillsdon, Foster, & Thorogood, 2005; Schlicht, Kanning, & Bös, 2006), and this might involve two different types of theories (Fuchs, 2003): explanation theories and intervention theories. While explanation theories deal with the causes and effects of events, such as physical activity, intervention theories focus on the methods and techniques that need to be applied to influence these events. According to this distinction three of the four theories presented earlier in the paper (SCT, TPB, and HAPA) are primarily explanation theories. They explain onset and maintenance of regular physical activity by specifying the underlying psychological factors and mechanisms. They also identify the critical variables (psychological mediators) that should be changed in order to change the behaviour. However, they do not tell us how we can accomplish this change. For this reason, intervention theories are needed that provide evidence-based information on the therapeutic, educational, political and structural measures to be taken in order to influence the mediators. Intervention theories that are relevant to the field of physical activity are, for example: (a) operant and cognitive behaviour modification (Kanfer & Goldstein, 1991); (b) goal setting (Locke & Latham, 1990); (c) persuasive communication (Witte, 1995); social marketing (Andreasen, 1995); and (e) diffusion of innovation (Rogers, 1995). In this context, the Transtheoretical Model (TTM) is regarded as a ‘hybrid theory’ because it is, in part, an explanation theory (stages of change; determinants of change) and, in part, an intervention theory (processes of change).

The recently developed MoVo concept (Mo: motivation, Vo: volition) is an attempt to bring together explanation theories and intervention theories in order to develop a theory-guided intervention for physical activity. The MoVo concept consists of two components, the MoVo process model and the MoVo intervention

programme. The MoVo process model (Fuchs, Göhner, & Seelig, submitted for publication) summarises the current knowledge from the relevant explanation theories, including SCT, TPB, HAPA, and PSI-theory by Kuhl (2000), and determines the critical motivational and volitional parameters of behaviour change (psychological mediators). The MoVo intervention programme, on the other hand, aims at the modification of these parameters by using techniques and methods proposed by the relevant intervention theories (e.g., decision making, action planning, barrier management, and self-monitoring). There are different versions of the MoVo intervention programme for specific settings and target groups (e.g., overweight groups, members of health insurance). The MoVo-LISA programme was developed for the setup of a physically active lifestyle among in-patients of an orthopaedic rehabilitation clinic (LISA: “Lifestyle-Integrated Sport Activity”). The contents, procedures and effects of MoVo-LISA are documented in Göhner, Seelig, and Fuchs (in press).

Conclusions and future directions

In this overview paper we have outlined some basic concepts regarding exercise psychology, and in particular current thinking and evidence on psychological correlates of physical activity, psychological theories used in the field, and issues of intervention research. Emphasis has been placed on European research, where appropriate, and views have been offered by the authors from their vantage point in two European countries.

Psychology has much to offer in the fight against the contemporary ‘slothogenic’ environment and culture, yet continued efforts are required to (a) conceptualise theory in the context of interventions and how much behaviour change can be made, (b) better understand who does and does not benefit from interventions, and (c) understand psychology’s role in the study of sedentary behaviour. We conclude with some thoughts on these issues.

Explanation theories in physical activity research

The predictive power of explanation theories in physical activity research is still modest. The amount of explained inter-individual variance in the target behaviour (regular physical activity) rarely reaches 30% (Baranowski, Anderson, & Carmack, 1998). Two major reasons may be responsible for what many may regard as an unsatisfactory outcome:

- Volitional factors and processes which control the transformation of goal intentions into actions are yet not well understood and need better theoretical representations (Hall, Fong, Epp, & Elias, 2007).
- The criterion variable “physical activity participation” may not be appropriately conceptualised. Often it is seen as a simple continuous variable (expressed in “hours per week”). A closer look at the phenomenon shows that there may be distinct patterns of participation that cannot be adequately projected on one dimension. Cluster analyses of participation behaviour in physical exercise courses, for example, revealed four different types of participants: maintainers, fluctuators, early dropouts and late dropouts (Fuchs, Seelig, & Kilian, 2005). Maybe the explanatory power of our psychological theories can be improved if we use such multi-dimensional concepts of physical activity participation.

Differential intervention

There is no intervention equally suited to everyone. With any specific programme we can only ever reach a certain segment of the

population. This can be illustrated by using the MoVo-LISA intervention as an example (Fuchs et al., submitted for publication). With MoVo-LISA it is possible to reach another 15–20% of all sedentary patients who are ready for change but who would not receive sufficient guidance from the usual rehabilitation programmes to actually transform their readiness into concrete actions. With MoVo-LISA, the rate of those who exercise at least 60 min/week increased up to 50% after 12 months (control group: 33%), indicating that 50% of the target group remained unaffected by this intervention. For those persons other programmes need to be developed that better match their social and personal predispositions and environmental contexts. Further research will reveal the psychological characteristics of those participants that profited most from a given intervention programme. Based on these characteristics screening procedures should be developed to help identify those persons for which the programme would be the optimal answer to their physical inactivity. It is expected that in such selected groups, the rate of effectiveness of the programme can be markedly enhanced (differential intervention).

Maintaining intervention effects

A lasting change of lifestyle cannot be accomplished by short, temporary, interventions. It is an illusion to assume that by the provision of just two or three intervention sessions a physical activity behaviour can be set up that is fully maintained over the next months and years, even if they might effect change in attitudes or intentions. Results from intervention studies such as MoVo-LISA (Fuchs et al., submitted for publication) or CHANGE (Moore et al., 2006) demonstrate that it is possible to achieve a substantial behaviour change at the end of the intervention phase. However, in the weeks and months thereafter this change diminishes, even if a significant intervention effect remains observable after one year (e.g., MoVo-LISA). From this we can conclude that our psychological interventions are able to initiate a new physical activity behaviour, but that this change also needs to be supported by additional booster sessions in the following months. We need to know about what processes facilitate this and whether they are different from those that are responsible for behavioural adoption (Rothman, 2000). We could use the metaphor of a launch pad: At the beginning people need to get a strong force or impulse to take off, and when in the air they require, at least for a while, some additional help to stay flying. Simple “launch pad interventions” without boosters will not lead to long-lasting changes in physical activity behaviour.

Psychology and sedentary behaviour

There has been a significant growth in interest in the study of sedentary behaviour since the millennium (Hamilton, Healy, Dunstan, Zderic, & Owen, 2008; Marshall, Biddle, Gorely, Cameron, & Murdey, 2004; Owen, Leslie, Salmon, & Fotheringham, 2000; Simon et al., 2004; Smith & Biddle, 2008). This is predicated on the belief that sedentary behaviours (usually operationalised as time spent sitting) may have behavioural antecedents and important negative health outcomes independent of physical activity. While we have a better understanding of sedentary behavioural patterns in young people (Gorely, Marshall, & Biddle, 2004; Gorely, Marshall, Biddle, & Cameron, 2007; Olds, Ridley, & Dollman, 2006) and adults (Salmon, Owen, Crawford, Bauman, & Sallis, 2003), as well as emerging data on the health outcomes of sedentary behaviours (Hamilton, Healy, Dunstan, Zderic, & Owen, 2008; Marshall, Biddle, Gorely, Cameron, & Murdey, 2004; Sugiyama, Healy, Dunstan, Salmon, & Owen, 2008; Williams, Raynor, & Ciccolo, 2008), we know very little about psychological correlates of sedentary behaviour (Murdey, Cameron,

Biddle, Marshall, & Gorely, 2005; Rhodes & Blanchard, 2008). More research is needed to better understand the relative influences of psychological constructs that may, or may not, be prominent in explaining physical activity. For example, how deliberate, conscious or planned is decision making to sit down and watch TV? Do we need self-efficacy to switch from TV to something less sedentary? What is the role of the environment (e.g., technology density in the home; family norms) alongside individual psychology? We also need to understand what effect, if any, new technologies have had in adding to sedentary time or replacing other sedentary pursuits. We must not assume that time children spend playing computer games is a direct replacement for physical activity from previous generations of children. Moreover, what would we expect from ‘exer-games’—computer games requiring greater levels of physical movement? Will these be sufficiently appealing over time to add a meaningful amount to the recommended 60 min per day of at least moderate physical activity? There is much to do for ‘exercise psychologists’ in the world of sedentary behaviour.

References

- Adams, J., & White, M. (2005). Why don't stage-based activity promotion interventions work? *Health Education Research*, 20(2), 237–243.
- Ajzen, I. (1988). *Attitudes, personality and behaviour*. Milton Keynes: Open University Press.
- Ajzen, I. (2001). Nature and operation of attitudes. *Annual Review of Psychology*, 52, 27–58.
- Andreasen, A. R. (1995). *Marketing social change: Changing behavior to promote health, social development, and the environment*. San Francisco, CA: Jossey-Bass.
- Backhouse, S. H., Biddle, S. J. H., Ekkekakis, P., Foskett, A., & Williams, C. (2007). Exercise makes people feel better but people are inactive: Paradox or artefact? *Journal of Sport and Exercise Psychology*, 29, 498–517.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.
- Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions: How are we doing? How might we do better? *American Journal of Preventive Medicine*, 15(4), 266–297.
- Biddle, S. J. H., Fox, K. R., & Boutcher, S. H. (Eds.). (2000). *Physical activity and psychological well-being*. London: Routledge.
- Biddle, S. J. H., & Mutrie, N. (2008). *Psychology of physical activity: Determinants, well-being and interventions* (2nd Edition). London: Routledge.
- Biddle, S.J.H., Wang, C.K.J., Kavussanu, M., & Spray, C.M. (2003). Correlates of achievement goal orientations in physical activity: A systematic review of research. *European Journal of Sport Science*, 3(5), <http://www.humankinetics.com/ejss>.
- Biddle, S. J. H., Whitehead, S. H., O'Donovan, T. M., & Nevill, M. E. (2005). Correlates of participation in physical activity for adolescent girls: A systematic review of recent literature. *Journal of Physical Activity and Health*, 2, 423–434.
- Brug, J., Conner, M., Harre, N., Kremers, S., McKeller, S., & Whitelaw, S. (2005). The transtheoretical model and stages of change: A critique. Observations by five commentators on the paper by Adams, J. and White, M. (2004) Why don't stage-based activity promotion interventions work? *Health Education Research*, 20(2), 244–258.
- Buckworth, J., & Dishman, R. K. (2002). *Exercise psychology*. Champaign, IL: Human Kinetics.
- Daley, A. J., Crank, H., Saxton, J. M., Mutrie, N., Coleman, R., & Roalfe, A. (2007). Randomized trial of exercise therapy in women treated for breast cancer. *Journal of Clinical Oncology*, 25(13), 1713–1721.
- Davis, D., Evans, M., Jadad, A., Perrier, L., Rath, D., Ryan, D., et al. (2003). The case for knowledge translation: Shortening the journey from evidence to effect. *British Medical Journal*, 327(7405), 33–35.
- de Almeida, M. D. V., Graca, P., Afonso, C., D'Amicis, A., Laplainen, R., & Damkjaer, S. (1999). Physical activity levels and body weight in a nationally representative sample in the European Union. *Public Health Nutrition*, 2(1a), 105–113.
- Deci, E. L., & Ryan, R. M. (Eds.). (2002). *Handbook of self-determination research*. Rochester: The University of Rochester Press.
- Department of Health. (2008). *Healthy weight, healthy lives: A cross-government strategy for England*. London: Department of Health.
- Dishman, R. K. (1986). Mental health. In V. Seefeldt (Ed.), *Physical activity and well-being*. Reston, VA: American Alliance for Health, Physical Education, Recreation and Dance.
- Dishman, R. K., & Sallis, J. F. (1994). Determinants and interventions for physical activity and exercise. In C. Bouchard, R. J. Shephard, & T. Stephens (Eds.), *Physical activity, fitness, and health* (pp. 203–213). Champaign, IL: Human Kinetics.
- Dishman, R. K., Washburn, R. A., & Heath, G. W. (2004). *Physical activity epidemiology*. Champaign, IL: Human Kinetics.
- Dzewaltowski, D. A., Estabrooks, P. A., & Glasgow, R. E. (2004). The future of physical activity behavior change research: What is needed to improve translation of research into health promotion practice? *Exercise and Sport Sciences Reviews*, 32, 57–63.

- Ekkkekakis, P. (2003). Pleasure and displeasure from the body: Perspectives from exercise. *Cognition and Emotion*, 17, 213–239.
- Ekkkekakis, P., & Petruzzello, S. J. (2000). Analysis of the affect measurement conundrum in exercise psychology: I. Fundamental issues. *Psychology of Sport & Exercise*, 1, 71–88.
- Faulkner, G. E. J., & Taylor, A. H. (Eds.). (2005). *Exercise, health and mental health. Emerging relationships*. London: Routledge.
- Fox, K. R. (1998). Advances in the measurement of the physical self. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp. 295–310). Morgantown, WV: Fitness Information Technology.
- Fuchs, R. (2003). Sport, Gesundheit und Public Health [Sport, health and public health]. Göttingen: Hogrefe.
- Fuchs, R., Göhner, W., & Seelig, H. (submitted for publication). Long-term effects of a standardized group intervention on physical exercise and health: The MoVo concept.
- Fuchs, R., Seelig, H., & Kilian, D. (2005). Selbstkonkordanz und Sportteilnahme [Self-concordance and sport participation]. *Zeitschrift für Gesundheitspsychologie*, 13, 126–138.
- Göhner, W., Seelig, H., & Fuchs, R. (in press). Intervention effects on cognitive antecedents of physical exercise: A one-year follow-up study. *Applied Psychology: Health and Well-Being*.
- Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist*, July, 493–503.
- Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, 38, 69–119.
- Gorely, T., Marshall, S. J., & Biddle, S. J. H. (2004). Couch kids: Correlates of television viewing among youth. *International Journal of Behavioural Medicine*, 11, 152–163.
- Gorely, T., Marshall, S. J., Biddle, S. J. H., & Cameron, N. (2007). The prevalence of leisure time sedentary behaviour and physical activity in adolescent girls: An ecological momentary assessment approach. *International Journal of Pediatric Obesity*, 2(4), 227–234.
- Hagger, M. S., Biddle, S. J. H., Chow, E. W., Stambulova, N., & Kavussanu, M. (2003). Physical self-perceptions in adolescence: Generalizability of a hierarchical multidimensional model across three cultures. *Journal of Cross-Cultural Psychology*, 34, 611–628.
- Hagger, M. S., Chatzisarantis, N. L. D., & Biddle, S. J. H. (2002). A meta-analytic review of the Theories of Reasoned Action and Planned Behaviour in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport & Exercise Psychology*, 24, 3–32.
- Hall, P. A., Fong, G. T., Epp, L. J., & Elias, L. J. (2007). Executive function moderates the intention-behavior gap for physical activity and dietary behaviour. *Psychology & Health*, 22, 1–18.
- Hamilton, M. T., Healy, G. N., Dunstan, D. W., Zderic, T. W., & Owen, N. (2008). Too little exercise and too much sitting: Inactivity physiology and the need for new recommendations on sedentary behavior. *Current Cardiovascular Risk Reports*, 2, 292–298.
- Hardman, A. E., & Stensel, D. J. (2003). *Physical activity and health: The evidence explained*. London: Routledge.
- Hausenblas, H., Carron, A. V., & Mack, D. E. (1997). Application of the Theories of Reasoned Action and Planned Behavior to exercise behavior: A meta-analysis. *Journal of Sport and Exercise Psychology*, 19, 36–51.
- Hill, C., Abraham, C., & Wright, D. B. (2007). Can theory-based messages in combination with cognitive prompts promote exercise in classroom settings? *Social Science & Medicine*, 65(5), 1049–1058.
- Hillsdon, M., Foster, C., & Thorogood, M. (2005). Interventions for promoting physical activity. The Cochrane Database of Systematic Reviews, Issue 1, Art. No.: CD003180.pub2. doi: 10.1002/14651858.CD003180.pub2.
- Kahn, E. B., Ramsey, L. T., Brownson, R. C., Heath, G. W., Howze, E. H., Powell, K. E., et al. (2002). The effectiveness of interventions to increase physical activity: A systematic review. *American Journal of Preventive Medicine*, 22(4S), 73–107.
- Kanfer, F. H., & Goldstein, A. P. (1991). *Helping people change. A textbook of methods* (4th edition). New York: Pergamon Press.
- Kuhl, J. (2000). A functional-design approach to motivation and self-regulation: The dynamics of personality systems and interactions. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 111–169). San Diego, CA: Academic Press.
- Kwak, L., Kremers, S. P. J., van Baak, M. A., & Brug, J. (2007). Formation of implementation intentions promotes stair use. *American Journal of Preventive Medicine*, 32(3), 254–255.
- Lawton, R. J., Conner, M. T., & Parker, D. (2007). Beyond cognition: Predicting health risk behaviors from instrumental and affective beliefs. *Health Psychology*, 26, 259–267.
- Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2004). Behavioural intentions and action plans promote physical exercise: A longitudinal study with orthopaedic rehabilitation patients. *Journal of Sport and Exercise Psychology*, 26, 470–483.
- Locke, E., & Latham, G. P. (1990). *A theory of goal setting and task performance* (2nd edition). Englewood Cliffs, NJ: Prentice Hall.
- Marshall, S. J., & Biddle, S. J. H. (2001). The Transtheoretical Model of behavior change: A meta-analysis of applications to physical activity and exercise. *Annals of Behavioral Medicine*, 23, 229–246.
- Marshall, S. J., Biddle, S. J. H., Gorely, T., Cameron, N., & Murdey, I. (2004). Relationships between media use, body fatness and physical activity in children and youth: A meta-analysis. *International Journal of Obesity*, 28, 1238–1246.
- Marshall, S. J., & Welk, G. J. (2008). Definitions and measurement. In A. L. Smith, & S. J. H. Biddle (Eds.), *Youth physical activity and sedentary behavior: Challenges and solutions* (pp. 3–29). Champaign, IL: Human Kinetics.
- Martinez, S. M., Arredondo, E. M., Ayala, G. X., & Elder, J. P. (2008). Culturally appropriate research and interventions. In A. L. Smith, & S. J. H. Biddle (Eds.), *Youth physical activity and sedentary behavior: Challenges and solutions* (pp. 453–477). Champaign, IL: Human Kinetics.
- Martinsen, E. W., Medhus, A., & Sandvik, L. (1985). Effects of aerobic exercise on depression: A controlled trial. *British Medical Journal*, 291, 100.
- McElroy, M. (2002). *Resistance to exercise: A social analysis of inactivity*. Champaign, IL: Human Kinetics.
- Moore, S., Charvat, J., Gordon, N., Pashkow, F., Ribisl, P., Roberts, B., et al. (2006). Effects of a CHANGE Intervention to increase exercise maintenance following cardiac events. *Annals of Behavioral Medicine*, 31, 53–62.
- Morgan, W. P. (1968). Selected physiological and psychomotor correlates of depression in psychiatric patients. *Research Quarterly*, 39, 1037–1043.
- Morgan, W. P. (1969a). Physical fitness and emotional health: A review. *American Corrective Therapy Journal*, 23, 124–127.
- Morgan, W. P. (1969b). A pilot investigation of physical working capacity in depressed and non-depressed psychiatric males. *Research Quarterly*, 40, 859–861.
- Morgan, W. P. (1985). Affective beneficence of vigorous physical activity. *Medicine and Science in Sports and Exercise*, 17, 94–100.
- Morgan, W. P. (Ed.). (1997). *Physical activity and mental health*. Washington, DC: Taylor & Francis.
- Morgan, W. P., & Goldston, S. E. (Eds.). (1987). *Exercise and mental health*. Washington: Hemisphere.
- Murdey, I. D., Cameron, N., Biddle, S. J. H., Marshall, S. J., & Gorely, T. (2005). Short-term changes in sedentary behaviour during adolescence: Project STILL (Sedentary Teenagers and Inactive Lifestyles). *Annals of Human Biology*, 32, 283–296.
- Mutrie, N. (2000). The relationship between physical activity and clinically defined depression. In S. J. H. Biddle, K. R. Fox, & S. H. Boutcher (Eds.), *Physical activity and psychological well-being* (pp. 46–62). London: Routledge.
- Olds, T., Ridley, K., & Dollman, J. (2006). Screenieoppers and extreme screenies: the place of screen time in the time budgets of 10–13 year-old Australian children. *Australian and New Zealand Journal of Public Health*, 30(2), 137–142.
- Owen, N., Leslie, E., Salmon, J., & Fotheringham, M. J. (2000). Environmental determinants of physical activity and sedentary behavior. *Exercise and Sport Sciences Reviews*, 28, 153–158.
- Pooley, C. G., Turnbull, J., & Adams, M. (2005). The journey to school in Britain since the 1940s: Continuity and change. *Area*, 37(1), 43–53.
- Prestwich, A., Lawton, R., & Conner, M. (2003). The use of implementation intentions and the decision balance sheet in promoting exercise behaviour. *Psychology and Health*, 18, 707–721.
- Prochaska, J. O., & Marcus, B. H. (1994). The transtheoretical model: Application to exercise. In R. K. Dishman (Ed.), *Advances in exercise adherence* (pp. 161–180). Champaign, IL: Human Kinetics.
- Rejeski, W. J., & Brawley, L. R. (1988). Defining the boundaries of sport psychology. *The Sport Psychologist*, 2, 231–242.
- Rhodes, R. E., & Blanchard, C. M. (2008). Do sedentary motives adversely affect physical activity? Adding cross-behavioural cognitions to the theory of planned behaviour. *Psychology & Health*, 23(7), 789–805.
- Riemsma, R., Pattenden, J., Bridle, C., Sowden, A., Mather, L., Watt, I., et al. (2002). A systematic review of the effectiveness of interventions based on a stages-of-change approach to promote individual behaviour change. *Health Technology Assessment*, 6(24).
- Robertson-Wilson, J. E., Leatherdale, S. T., & Wong, S. L. (2008). Social-ecological correlates of active commuting to school among high school students. *Journal of Adolescent Health*, 42(5), 486–495.
- Rogers, E. M. (1995). *Diffusion of innovation* (4th Edition). New York: Free Press.
- Rothman, A. J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology*, 19, 64–69.
- Rütten, A., & Abu-Omar, K. (2004). Prevalence of physical activity in the European Union. *Social & Preventive Medicine*, 49, 281–289.
- Sallis, J. F., & Owen, N. (1999). *Physical activity and behavioral medicine*. Thousand Oaks, CA: Sage.
- Sallis, J. F., Owen, N., & Fotheringham, M. J. (2000). Behavioral epidemiology: A systematic framework to classify phases of research on health promotion and disease prevention. *Annals of Behavioral Medicine*, 22, 294–298.
- Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise*, 32, 963–975.
- Salmon, J., Owen, N., Crawford, D., Bauman, A., & Sallis, J. F. (2003). Physical activity and sedentary behavior: A population-based study of barriers, enjoyment, and preference. *Health Psychology*, 22, 178–188.
- Samdal, O., Tynjala, J., Roberts, C., Sallis, J. F., Villberg, J., & Wold, B. (2006). Trends in vigorous physical activity and TV watching of adolescents from 1986 to 2002 in seven European Countries. *European Journal of Public Health* kcl245.
- Schlicht, W., Kanning, M., & Bös, K. (2006). Psychosocial interventions to influence physical inactivity as a risk factor: Theoretical models and practical evidence. In J. Jordan, B. Bardé, & A. M. Zeiger (Eds.), *Contributions toward evidence-based psychocardiology: A systematic review of the literature* (pp. 107–123). Washington, D.C.: American Psychological Association.
- Scholz, U., Schüz, B., Ziegelmann, J. P., Lippke, S., & Schwarzer, R. (2008). Beyond behavioural intentions: Planning mediates between intentions and physical activity. *British Journal of Health Psychology*, 13, 479–494.

- Scholz, U., Sniehotta, F. F., & Schwarzer, R. (2005). Predicting physical exercise in cardiac rehabilitation: The role of phase-specific self-efficacy beliefs. *Journal of Sport and Exercise Psychology*, 27, 135–151.
- Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: An International Review*, 57, 1–29.
- Schwarzer, R., Luszczynska, A., Ziegelmann, J. P., Scholz, U., & Lippke, S. (2008). Social-cognitive predictors of physical exercise adherence: Three longitudinal studies in rehabilitation. *Health Psychology*, 27, S54–S63.
- Simon, C., Wagner, A., DiVita, C., Rauscher, E., Klein-Plat, C., Arveiler, D., et al. (2004). Intervention centred on adolescent's physical activity and sedentary behaviour (ICAPS): Concept and 6-month results. *International Journal of Obesity*, 28, S96–S103.
- Smith, A. L., & Biddle, S. J. H. (Eds.). (2008). *Youth physical activity and sedentary behavior: Challenges and solutions*. Champaign, IL: Human Kinetics.
- Soós, I., Hamar, P., Molnár, G., Biddle, S. J. H., & Sándor, I. (2008). Erdélyi tanulók fizikai aktivitásának és inaktivitásának vizsgálata EMA (Ecological Momentary Assessment) módszerrel (An investigation into physical activity and sedentary behaviours in Transylvanian students: Ecological momentary assessment). *Magyar Sporttudományi Szemle (Hungarian Review of Sport Science)*, 4, 20–24.
- Stensel, D. J., Gorely, T., & Biddle, S. J. H. (2008). Youth health outcomes. In A. L. Smith, & S. J. H. Biddle (Eds.), *Youth physical activity and sedentary behavior: Challenges and solutions* (pp. 31–57). Champaign, IL: Human Kinetics.
- Steptoe, A., & Bolton, J. (1988). The short-term influence of high and low intensity physical exercise on mood. *Psychology and Health*, 2, 91–106.
- Steptoe, A., Wardle, J., Fuller, R., Holte, A., Justo, J., Sanderman, R., et al. (1997). Leisure-time physical exercise: Prevalence, attitudinal correlates, and behavioural correlates among young Europeans from 21 countries. *Preventive Medicine*, 26, 845–854.
- Stokols, D. (1992). Establishing and maintaining healthy environments: Toward a social ecology of health promotion. *American Psychologist*, 47, 6–22.
- Sugiyama, T., Healy, G.N., Dunstan, D.W., Salmon, J., & Owen, N. (2008). Joint associations of multiple leisure-time sedentary behaviours and physical activity with obesity in Australian adults. *International Journal of Behavioral Nutrition and Physical Activity*, 5, <http://www.ijbnpa.org/content/5/1/35>.
- Taylor, A. H., & Dorn, L. (2005). Stress, fatigue, health, and risk of road traffic accidents among professional drivers: The contribution of physical inactivity. *Annual Review of Public Health*, 27, 1–21.
- Taylor, A. H., & Ussher, M. H. (2005). Effects of exercise on smoking cessation and coping with withdrawal symptoms and nicotine cravings. In G. E. J. Faulkner, & A. H. Taylor (Eds.), *Exercise, health and mental health. Emerging relationships* (pp. 135–158). London: Routledge.
- Telama, R., & Yang, X. (2000). Decline of physical activity from youth to young adulthood in Finland. *Medicine and Science in Sport and Exercise*, 32(9), 1617–1622.
- Timmons, B. W., Naylor, P. J., & Pfeiffer, K. A. (2007). Physical activity for preschool children: How much and how? *Applied Physiology, Nutrition, and Metabolism*, 32(Supplement 2E), S122–S134.
- Titze, S., Martin, B. W., Seiler, R., Stronegger, W., & Marti, B. (2001). Effects of a life-style physical activity intervention on stages of change and energy expenditure in sedentary employees. *Psychology of Sport and Exercise*, 2, 103–116.
- Trost, S. G., Owen, N., Bauman, A. E., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: Review and update. *Medicine and Science in Sports and Exercise*, 34, 1996–2001.
- Van der Horst, K., Chin A Paw, M. J., Twisk, J. W. R., & Van Mechelen, W. (2007). A brief review on correlates of physical activity and sedentariness in youth. *Medicine and Science in Sports and Exercise*, 39(8), 1241–1250.
- van Mechelen, W. (1997). National policies for promoting physical activity, physical fitness and better nutrition in Europe. In A. P. Simopoulos (Ed.), *Nutrition and fitness: Evolutionary aspects, children's health, programs and policies* (pp. 136–147). Basel: Karger.
- Van Mechelen, W., Twisk, J. W. R., Post, G. B., Snel, J., & Kemper, H. C. G. (2000). Physical activity of young people: The Amsterdam Longitudinal Growth and Health Study. *Medicine and Science in Sports and Exercise*, 32, 1610–1616.
- Williams, D. M., Raynor, H. A., & Ciccolo, J. T. (2008). A review of TV viewing and its association with health outcomes in adults. *American Journal of Lifestyle Medicine*, May/June 250–259.
- Witte, K. (1995). Fishing for success. Using the persuasive health message framework to generate effective campaign messages. In E. Maibach, & R. L. Parrott (Eds.), *Designing health messages* (pp. 145–166). Thousand Oaks, CA: Sage.
- World Health Organisation. (2004). *Global strategy on diet, physical activity and health*. Geneva: World Health Organisation.
- Ziegelmann, J. P., Lippke, S., & Schwarzer, R. (2006). Adoption and maintenance of physical activity: Planning interventions in young, middle-aged, and older adults. *Psychology and Health*, 21, 145–163.