

AUTOMATIC EVALUATIONS OF EXERCISING

By

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A thesis submitted in partial fulfillment of the requirements for the degree of

Doktor der Philosophie (Dr. phil.)

December 2015

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Published online at the
Institutional Repository of the University of Potsdam:
URN urn:nbn:de:kobv:517-opus4-92280
<http://nbn-resolving.de/urn:nbn:de:kobv:517-opus4-92280>

Thank you!

My doctorate supervisor, Prof. Dr. Ralf Brand, had one constant advice for me that he mentioned while planning studies, writing manuscripts or discussing new research ideas in the last years: Keep it simple!

As I wish to offer my most heartfelt thanks to more people than can be mentioned in this synopsis, I stick to that advice and simply say:

Thank you!

especially to

Ralf

Markus

Angela

Robert

Hans-Dieter

Jona

Beate

Dietrich

Wanja

Franz

Mascha

Hanna

Jonathan

Elisabeth

Chris

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1 Preface

The present thesis contains the synopsis of my dissertation as required by the Faculty of Humanities at the University of Potsdam. The dissertation, which consists of three publications, is based on research that was conducted at the Division of Sport Psychology, University of Potsdam. The publications are described briefly in this thesis, in order to prevent repetition of content. This thesis should thus provide additional information on theoretical aspects that could not be described in the publications and offer a framework for the relationship between the publications. Finally, the main results of this dissertation are summarized, practical implications discussed and future research perspectives elaborated on.

2 Automatic evaluations of exercising: Outline of the research program

Changing the perspective sometimes offers completely new insights to an already well-known phenomenon. Exercising behavior¹, defined as planned, structured and repeated bodily movements with the intention to maintain or increase the physical fitness (Caspersen, Powell, & Christenson, 1985), can be thought of as such a well-known phenomenon that has been in the scientific focus for many decades (Dishman & O’Connor, 2005). Within these decades a perspective that assumes rational and controlled evaluations as the basis for decision making, was predominantly used to understand why some people engage in physical activity and others do not (Ekkekakis & Zenko, 2015).

Dual-process theories (Ekkekakis & Zenko, 2015; Payne & Gawronski, 2010) provide another perspective, that is not exclusively influenced by rational reasoning. These theories differentiate two different processes that guide behavior “depending on whether they operate automatically or in a controlled fashion“ (Gawronski & Creighton, 2012, p. 282). Following this line of thought, exercise behavior is not solely influenced by thoughtful deliberations (e.g. concluding that exercising is healthy) but also by spontaneous affective reactions (e.g. disliking being sweaty while exercising). The theoretical frameworks of dual-process models are not new in psychology (Chaiken & Trope, 1999; Payne & Gawronski, 2010) and have already been used for the explanation of numerous behaviors (e.g. Hofmann, Friese, & Wiers, 2008; Huijding, de Jong, Wiers, & Verkooijen, 2005; Richetin, Perugini, Prestwich, &

¹ Physical activity and exercise behavior are often interchangeably used even though they are differently defined. Physical activity summarizes all bodily movements that result in energy expenditure and can be thought of as an umbrella term for exercise and sports behavior (for a more detailed description see: (Caspersen et al., 1985)).

O’Gorman, 2007). However, they have only rarely been used for the explanation of exercise behavior (e.g. Bluemke, Brand, Schweizer, & Kahlert, 2010; Conroy, Hyde, Doerksen, & Ribeiro, 2010; Hyde, Doerksen, Ribeiro, & Conroy, 2010). The assumption of two dissimilar behavior influencing processes, differs fundamentally from previous theories and thus from the research that has been conducted in the last decades in exercise psychology. Research mainly concentrated on predictors of the controlled processes and addressed the identified predictors in exercise interventions (Ekkekakis & Zenko, 2015; Hagger, Chatzisarantis, & Biddle, 2002; Young, Plotnikoff, Collins, Callister, & Morgan, 2014).

Predictors arising from the described automatic processes, for example *automatic evaluations for exercising* (AEE), have been neglected in exercise psychology for many years. Until now, only a few researchers investigated the influence of these AEE for exercising behavior (Bluemke et al., 2010; Brand & Schweizer, 2015; Markland, Hall, Duncan, & Simatovic, 2015). Marginally more researchers focused on the impact of AEE² for physical activity behavior (Calitri, Lowe, Eves, & Bennett, 2009; Conroy et al., 2010; Hyde et al., 2010; Hyde, Elavsky, Doerksen, & Conroy, 2012). In sum, there is still a dramatic lack of empirical knowledge, when applying dual-process theories to exercising behavior, even though these theories have proven to be successful in explaining behavior in many other health-relevant domains like eating, drinking or smoking behavior (e.g. Hofmann et al., 2008).

The three publications constituting this synopsis therefore try to fill this research gap. By doing so, the debate on an extension of previous exercise psychological theories should be

² Strictly speaking the term automatic evaluations for exercising is not suitable when describing automatic evaluations that focus on physical activity. For reasons of readability the abbreviation AEE is used in this synopsis when addressing automatic evaluations for exercising and physical activity because the core concept of automatic evaluations is equal, even though the specifically measured content of these automatic evaluations might vary.

encouraged. In this synopsis, I reflect on the general assumptions of dual-process models (chapter 3.1.1) before focusing on the Reflective-Impulsive Model (Strack & Deutsch, 2004) as one prototypical representative of this class of models (chapter 3.1.2).

Publication one (chapter 3.1.4) elaborates on the assumed automaticity of the assessed evaluations. Scrutinizing this core feature of AEE is necessary as it affects the measurement procedures used to assess AEE. Furthermore, a lack of automaticity would change subsequent reflections for exercise interventions targeting AEE. For such interventions knowledge on the alteration of AEE, embedded in dual-process theories, is a prerequisite.

Therefore, theoretical assumptions of the Associative-Propositional Evaluation Model (chapter 3.2.1) provide the basis for a better understanding of the mechanisms that lead to the formation or alteration of AEE. Within this theorizing, several studies (chapter 3.2.2) in health behavior research successfully altered automatic evaluations (Hollands, Prestwich, & Marteau, 2011; Houben, Havermans, & Wiers, 2010; Walsh & Kiviniemi, 2014). Again, no experimental studies that systematically manipulated AEE are available for exercise psychology. Publication two (chapter 3.2.3) aimed to fill this gap of non-existent experimental studies on AEE and exercise behavior. Thereto basic ideas on associative learning from the Associative-Propositional Evaluation Model (APE; Gawronski & Bodenhausen, 2006) were utilized. Collecting empirical data on the systematic manipulability of AEE and the examination of consequences of altered AEE was thus the overall target of the three experiments reported in the second publication.

Leaving considerations on the characteristics (publication one) or the alteration of AEE (publication two) behind, publication three focused on AEE as a predictor of exercise course adherence. Moving from the laboratory to a real-life setting, the influence of AEE for exercise course adherence was investigated (chapter 3.3.3). By doing so, the perspective of AEE as predictor for immediate exercise decisions (Brand & Schweizer, 2015) was

broadened and the role of affective influences for exercise adherence, not only on a controlled (chapter 3.3.1; Backhouse, Ekkekakis, Bidle, Foskett, & Williams, 2007; Williams et al., 2008; Williams, Dunsiger, Jennings, & Marcus, 2012) but on an automatic level, highlighted. The long-term influences of initial AEE at the outset of an exercise program were thus deployed for the prediction of exercise course adherence or dropout in a fourteen-week exercise course.

After having outlined the methodological approach and the core findings of the conducted studies, limitations and future research questions resulting from the findings are presented (chapter 4).

3 Automatic evaluations of exercising

3.1 From controlled deliberations to automaticity: On a necessary paradigm shift in exercise psychology

Current exercise psychological research has recently been criticized for having used the same metatheoretical perspective for decades (Ekkekakis & Zenko, 2015). This perspective considers an information-collecting individual, who decides rationally after conscious deliberation on the basis of the available information (Bargh & Chartrand, 1999). The assumption of rationality (Shafir & LeBoeuf, 2002) is hence ubiquitous in current exercise psychological theories and research. Unsurprisingly, the usage of the same metatheory led to diverse but overlapping constructs in the existing set of theories (Bandura, 2004) that aim to describe exercise behavior. These constructs share the assumption, that rational reasoning and thus controlled evaluations (in contrast to spontaneous intuition) guides behavior. Even though these constructs have admittedly led to substantial progress in the explanation of exercise behavior (Hagger et al., 2002; Milne, Sheeran, & Orbell, 2000; Young et al., 2014), elementary innovation that extended the predictors beyond controlled evaluations has not taken place. The necessity of innovation is underlined when examining the preliminary outcomes of interventions aiming to enhance physical activity. A recent ad hoc meta-meta analysis (Ekkekakis & Zenko, 2015) identified generally small effect sizes in such trials with rational reasoning approaches. Leaving the beaten track and turning to new theoretical approaches seems thus reasonable and essential when considering the individual (Knight, 2012; Lee et al., 2012) and global (Kruk, 2014; WHO, 2010) burdens of physical inactivity.

To avoid misunderstandings: the aim of this dissertation is by no means to disparage the substantial achievements of the established theories and models. Instead, the objective is

to enrich the critical discussion on possible gains from further psychological constructs, namely AEE, embedded in dual-process models. In order to understand the entirely different perspective of dual-process models on (exercising) behavior, theoretical reflections on these models core assumptions are a prerequisite for this synopsis.

3.1.1 Dual-process models as one future approach in exercise psychology?

Taken the assumption of rationality as a basis (Shafir & LeBoeuf, 2002) individuals could be expected to exercise regularly if they receive persuading information concerning the possible health benefits. However, convincing individuals to change from an inactive to an active lifestyle is apparently a difficult task (Sallis, 2001; Webb & Sheeran, 2006). This challenge results in unsatisfying rates of exercise prevalence (CDC, 2010; Eurobarometer, 2014). The route of information-based convincement thus seems to be limited when it comes to the prediction and alteration of exercise behavior, since individuals still behave ‘irrationally’ and decide to watch TV and against exercising (Ekkekakis & Zenko, 2015). So, how can such a striking behavior be explained?

Social cognition literature offers different approaches to divide processes that guide behavior, which might provide a basis for the understanding of exercise and non-exercise behavior. Whether these processes should be divided in four, three, two or one process has been intensively debated (Crano, 2006; Moors & De Houwer, 2006; Moskowitz & Li, 2006; Petty & Briñol, 2006; Sherman, 2006). Dual-process models have been applied to explain several behaviors and can be described as the “most popular large-scale theories in social cognition” (Deutsch & Strack, 2006, p. 166). These models generally distinguish two processes (or systems)³ that guide behavior (Chaiken & Trope, 1999; Gawronski &

³ The correct use of the terminology of ‘systems’ and ‘processes’ is highly debated and thoroughly needs to be differentiated (see Evans & Stanovich, 2013). The distinction of these two

Creighton, 2012; Kahneman & Frederick, 2002; Smith & DeCoster, 2000). Labels of the two processes and their ascribed characteristics differ within this set of dual-process theories.

However, the core assumptions of a distinction between intuition (e.g. system 1, impulsive, associative, type 1) and rational reasoning (e.g. system 2, reflective, propositional, type 2) are the same (Evans & Stanovich, 2013; Gawronski & Bodenhausen, 2006; Kahneman, 2003; Strack & Deutsch, 2004). Kahneman (2003) summarized some of these core assumptions and highlighted the processes attributes:

The operations of System 1 are typically fast, automatic, effortless, associative, implicit (not available to introspection), and often emotionally charged; they are also governed by habit and are therefore difficult to control or modify. The operations of System 2 are slower, serial, effortful, more likely to be consciously monitored and deliberately controlled; they are also relatively flexible and potentially rule governed. (p. 698)

The description of these two systems suggests that there is something more than the rationally influenced forces of system 2 that governs behavior. How exactly these other forces can be described, will be clarified in the following section.

3.1.2 The Reflective Impulsive Model – Focusing on operating conditions

The Reflective-Impulsive Model (RIM; Strack & Deutsch, 2004) was referred to “as a prototype of dual-system models” (Deutsch & Strack, 2006, p. 166) and should therefore provide a basis for the following elucidations. According to RIM, two interacting systems, the impulsive and the reflective system, guide behavior. These parallel working systems have different operating principles and conditions. The reflective system weighs information about potential consequences of behavior and decides upon syllogistic rules. If an individual plans

terms is beyond the scope of this synopsis. To avoid misunderstandings, the term of the described model (process vs. system) is used when describing the core features and characteristics of the individual models.

to lose some weight and reads a journal article on the benefits of regular jogging, the behavioral intention to start jogging might be formed after conscious deliberation. The impulsive system assumes that a network of learned associations, i.e. AEE, underlies behavioral decisions. In this case reading the article might evoke spontaneous positive sensations, which facilitate a favorable motivational orientation towards jogging. When experiences such as ‘jogging’ and ‘a pleasant feeling’ occur frequently together, associative clusters between these two and corresponding features are formed within this network (Strack & Deutsch, 2004). AEE represent the stored spontaneous associations of exercising with either positive or negative affective evaluations. These associations can be more or less strongly connected, depending on the frequency of the events co-occurrence. If someone only goes jogging once and likes it, the connection between these two stored memories should thus be less strong, as when someone jogs regularly and experiences the same sensation.

The operating conditions of the two systems need to be addressed as well, since they provide a better understanding for the methods of measurement associated with them. As the reflective system has executive functions that require cognitive capacity, the processing of information is rather time-consuming. Direct measures⁴ like questionnaires ask the participant to introspect and thus correspond with the operating principles of reflective processes. Outputs of the reflective system have extensively been investigated in exercise research (Hagger et al., 2002; Milne et al., 2000; Young et al., 2014), mostly by the help of questionnaires. Regardless whether self-efficacy (Hagger, Chatzisarantis, & Biddle, 2001), attitudes (Brand, 2006) or intentions (Godin, Valois, & Robin, 1991) were examined, to name only a few available constructs, participants were asked to introspect and report their

⁴ According to suggestions by De Houwer (2006), the terms *direct* and *indirect* measures (unlike implicit or explicit measures) are used in this synopsis because they refer to the characteristics of the measurement procedures.

evaluations in questionnaires. The plurality of the examined constructs mirrors the heretofore dominance of theories assuming rational reasoning as a basis for (exercise) behavior. All these constructs can be assigned to the reflective system of RIM. This underlines the additional value of dual-process theories. They do not exclude present findings of existing exercise research but include them in a broader explanation for exercise behavior. A further supporting argument for the compatibility is the recent attempt to unify the present constructs with elementary ideas of the dual-process models in an integrated, multitheory behavior change model for physical activity (Hagger & Chatzisarantis, 2014). This theory integrated AEE, apart from constructs arising from the reflective system, as one construct that directly influences physical activity behavior.

Apposite to the simple associative network structure, the impulsive system operates fast and rather effortless. Indirect measures like reaction-time based tasks tap into the fast processing mode of associative networks and are usually used when assessing outputs of the impulsive system. Studies that directly address AEE as an output of the impulsive system are rare in exercise research. Other domains in health behavior research have detected that AEE are influential for health behavior (Frieze, Hofmann, & Wiers, 2011; Hofmann et al., 2008). There is for example empirical evidence for AEEs' impact on eating (Mai, Hoffmann, Hoppert, Schwarz, & Rohm, 2015; Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010; Richetin et al., 2007; Walsh & Kiviniemi, 2014) and drinking behavior (Houben et al., 2010; Houben & Wiers, 2008; Lindgren et al., 2015), as well as for smoking behavior (Kahler, Daughters, Leventhal, Gwaltney, & Palfai, 2007; Payne, McClernon, & Dobbins, 2007). This elucidates the potential of such investigations in health domains. The findings from other health domains and especially the applicability of these findings for health interventions emphasize the necessity to attach importance to this construct in exercise research. The findings of the few present exercise studies, which used the fast and effortless operating

conditions of indirect measures, are summarized in the following section.

3.1.3 Automatic evaluations of exercising

Research on AEE and exercising has mainly focused on the quality of AEE (i.e. rather positive or rather negative AEE) and the associated quantity of exercise (exercise much or little; Bluemke et al., 2010; Calitri et al., 2009; Conroy et al., 2010; Hyde et al., 2012).

Bluemke et al. (2010) used an Evaluative Priming paradigm (EP; Fazio, Sanbonmatsu, Powell, & Kardes, 1986) with supraliminal prime presentation to measure the participants' AEE. The EP task asked participants to work on a two-featured task that needs the participants to classify word stimuli (i.e. target) as either favorable or unfavorable. Prior to each target a word prime (e.g. to jog or to read) was presented for 100 ms. Since the previously displayed word primes were presented supraliminally, participants were instructed to neglect the first stimulus (i.e. prime) and only respond to the second stimulus (i.e. target). The fundamental assumptions of reaction-time based tasks are a faster reaction in the classification task, when two strongly associated stimuli are presented. Dominant associations between 'exercise' and 'enjoyable' (i.e. positive AEE) lead accordingly to faster reactions when the task combines such positive attributes with exercising stimuli compared to when negative attributes follow an exercise stimulus. The authors found a positive relationship between AEE and self-reported amounts of exercise. Exercisers displayed more positive AEE in the EP than non-exercisers. Apart from this group difference, AEE predicted self-reported amounts of exercise per week in an ordinal regression analysis.

Conroy et al. (2010) measured AEE with a Single-Category Implicit Association Test (SC-IAT; Karpinski & Steinman, 2006). The SC-IAT is a sorting task in which individuals have to categorize stimuli (e.g. the word 'jogging') to one of two categories (e.g. exercise and good vs. bad) as fast as possible. It is important to note, that stimuli words remained on the

screen until the participant indicated his or her classification of the stimulus by pushing the respective button on a keyboard. This conforms to the standard proceeding of Implicit Association Tests (IAT; Greenwald, McGhee, & Schwartz, 1998). Conroy et al. (2010) showed that AEE significantly improved model fit in a regression analysis with daily step amounts as outcome variable after having controlled for exercise predictors of the (rational) reflective system like efficacy beliefs or behavioral intention.

The same method of supraliminal AEE assessment was used by Hyde et al. (2012) to examine the stability of AEE within a week. Physical activity behavior as well as AEE at the beginning and the end of the week were documented and connections between changes in AEE and physical activity observed. Results indicated that AEE might have stable components, which resemble previously learned associations and additionally rather instable and time-varying components. Moreover, the dynamics of AEE were intertwined with physical activity behavior. Individual who's' AEE became more positive within one week mirrored increases in physical activity.

Calitri et al. (2009) used another variant of the IAT to assess AEE, the Extrinsic Affective Simon Task (EAST; De Houwer, 2003). The task deviates slightly from the above stated procedures as it asks participants to either designate the color (white, green or blue) or the valence (good vs. bad) of a given stimulus by pressing the respective key on a keyboard. The critical trials of Calitri et al.'s procedure (2009) combined (colored) exercise-related words either with the 'good' or the 'bad' button on the keyboard. Participants again had to sort stimuli as fast and accurate as possible. It is essential to point out that, similar to the (SC-) IATs procedures, the stimuli in the EAST remain on the screen until the participant categorized it by pushing the accordingly button on the keyboard. In line with the stated findings, Calitri and colleagues (2009) showed in their correlational study that positive AEE are linked to high levels of physical activity.

In sum, all the findings above highlight that positive AEE are associated with great amounts of exercising (or physical activity) and can be ascribed to regular exercisers. Whether qualitative differences within these highly active exercisers' AEE exist, has not been investigated yet. When considering the underlying architecture of the associative networks that lead to AEE, more specific associations, that go beyond the general association of exercise as something pleasurable, are plausible for highly active individuals. Furthermore, all the stated studies build on measures that use supraliminal stimuli presentation for assessing AEE. These measures are "often assumed to reflect automatic evaluations" (Gawronski & Bodenhausen, 2007, p. 696). However, it cannot be precluded that the measured evaluations are contaminated through controlled (i.e. reflective) processes. In order to obtain more convincing demonstrations of automaticity, one approach might be to use different (i.e. subliminal) methods of measurement, which circumvent the arguable display of supraliminal stimuli in the stated indirect tests. Thus, the automaticity⁵ of affect triggered by exercise-related stimuli could be more persuasively demonstrated.

⁵ For more information on automaticity and the defining aspects associated with it, see Bargh (1994).

3.1.4 *Publication 1: Automatic evaluations and exercise setting preferences in frequent exercisers*⁶

A deeper understanding of automatic evaluations is essential when targeting automatic aspects of behavior in (exercise) interventions efficiently, as recently demanded (Marteau, Hollands, & Fletcher, 2012). Thus, an inspection of one core assumption of automatic evaluations, the eponymous imputation of automaticity, is necessary. The first publication's aim was consequently to examine whether or not the evaluative responses after exercise stimuli presentation can be referred to as *automatic* evaluations.

Drawing on experimental methodology with subliminal stimulus presentation (Murphy & Zajonc, 1993), two research objectives were empirically tested:

- ◆ First, AEE have successfully been associated with physical activity and exercise behavior (Bluemke et al., 2010; Calitri et al., 2009; Conroy et al., 2010; Hyde et al., 2012). None of these studies used procedures that allow categorizing the measured AEE as products of a purely automatic process. The main aim of publication one was therefore to test whether subliminally presented exercise-related stimuli can in fact elicit genuinely automatic evaluative responses.
- ◆ Second, the abovementioned studies focused on a very general connection between qualitative differences in AEE and quantitative differences in exercising amounts. Taking the presumption of associative networks as a basis (Deutsch & Strack, 2006; Strack & Deutsch, 2004), individuals with recurrent experiences in specific exercise domains can be expected to have much more unique AEE to their respective exercising environment. Assessing these unique AEE could consequently allow for inferences that go beyond the established coherence of AEE and exercise amounts. Hence, the second aim of this publication was to provide evidence for exercise setting specific AEE in highly active individuals.

⁶ Antoniewicz, F. & Brand, R. (2014). Automatic evaluations and exercise setting preferences in frequent exercisers. *Journal of Sport and Exercise Psychology*, 36, 631-636. doi:10.1123/jsep.2014-0033

Seventy-five graduate sport and exercise students (26.00 ± 9.03 years old, 31 female) were recruited for this study. The sample contained highly active individuals (309.91 ± 190.46 min of exercise per week), of whom sharply defined positive automatic evaluations (to exercising in general) could be expected. In order to address the expected qualitative differences in these positive AEE, a very specific form of exercising (i.e. fitness center exercising) was targeted. The sample contained fitness center exercisers ($n = 34$) and otherwise active individuals ($n = 41$) that worked through an adapted Affect Misattribution Procedure (AMP; Payne, Cheng, Govorun, & Stewart, 2005). The AMP⁷ used subliminally (7 ms) presented fitness center primes as critical stimuli and gray rectangles as control stimuli in order to detect setting preferences.

The results provide empirical evidence for the triggering of genuinely AEE after subliminally presented exercise stimuli. Only fitness center exercisers revealed the expected positive automatic affective responses after subliminal presented fitness center cues. AEE were thus indicative for a qualitative aspect of exercising, the exercise setting preference, in highly active individuals. The theoretical understanding of AEE as truly automatically driven responses to exercise-related cues constitutes an essential foundation for the purposeful measurement of AEE and enables the precise conceptualization and implementation of interventions that target automatic precursors of exercise behavior. Study two used the collected knowledge and addressed the plasticity of AEE, which would be indispensable for exercise interventions.

⁷ For a detailed description of the AMP's procedure and for information on reliability and validity see the recent review of Payne and Lundberg (2014).

3.2 From measuring to manipulating: Changing automatic evaluations of exercising

As described before, positive AEE have been associated with higher amounts of exercise or physical activity than neutral or negative AEE (Bluemke et al., 2010; Conroy et al., 2010; Eves, Scott, Hoppé, & French, 2007; Hyde et al., 2012). Moreover, positive AEE represent exercise setting preferences in frequent exercisers (Antoniewicz & Brand, 2014). All the extant findings conducted correlational studies. Concluding a causal relationship, like positive AEE as a cause for increased exercise behavior, is thus not possible. Following a recent call for extension and innovation in the area of automatic evaluation research (Nosek, Hawkins, & Frazier, 2011), time seems right for experimental approaches that systematically try to manipulate individuals' AEE (Marteau et al., 2012; Sheeran, Gollwitzer, & Bargh, 2012).

Having this aim in mind, some findings of the available AEE studies should be illuminated from an interventional perspective. Apart from looking on the AEEs' influence on quantitative aspects of exercise behavior, two main findings need to be elaborated.

First, the stability of AEE and thus the possible accessibility of AEE has already been under investigation (Hyde et al., 2012). Hyde et al. (2012) demonstrated that AEE are at least partly variable and that natural improvements from negative to positive AEE (within a week) are connected to actual increases in physical activity behavior in this time frame. Their findings indicate that AEE might not be as stable as assumed in RIM, where “associative weights between contents change slowly and gradually” (Deutsch & Strack, 2006, p. 167). The study underlines that changes in AEE are at least somehow connected to desirable activity shifts, although the non-experimental approach of the study does not allow inferring a cause-effect chain (Hyde et al., 2012).

Second, Brand and Schweizer (2015) investigated whether AEE affect commonplace

exercise decisions between behavioral alternatives. Individuals had to indicate for eight prototypical situations, whether they would opt for or against an exercising alternative if confronted with the situation. Positive AEE explained such situated decisions for the benefit of exercise choices. These decisions again were linked to exercise behavior. Even though this finding does not shed light on the causal relationship between AEE and exercise behavior, relevant information for the conception of such research endeavors can be derived.

Manipulated, in the sense of enhanced, AEE could be expected to result in favorable exercise decisions. These decisions in turn would be easily workable and verifiable in experimental settings.

For such successful manipulations and the assessment of expected exercise consequences, profound knowledge on the principles leading to changes in automatic evaluations is inevitable. A theoretical framework within the class of dual-process theories that directly discusses the formation and alteration of automatic evaluations provides the Associative-Propositional Evaluation Model (APE; Gawronski & Bodenhausen, 2006).

3.2.1 The Associative-Propositional Evaluation Model – Focusing on operating principles

APE “builds on earlier dual-process theories of cognitive functioning that distinguish between two qualitatively different kinds of mental processes”, here an associative and a propositional process (Gawronski & Bodenhausen, 2006, p. 693). APE can thus be understood as a progression in the field of dual-process theories that more clearly describes what a particular process is doing (i.e. operating principles) in contrast to other theories that focus more on the operating conditions (e.g. automatic evaluation of information) of a process (Gawronski & Bodenhausen, 2014).

In APE, associative processes are characterized by the activation of associations in

memory (Gawronski & Bodenhausen, 2011). When seeing the jogging shoes in the corridor, the pleasant feelings of the last jogging lap in the sun might for example be activated. Such automatically activated associative evaluations are defined as "automatic affective reactions" (Gawronski & Bodenhausen, 2006, p. 693) that underlie pattern activation. Appropriate to the efficient operating principles of the associative process, the activation of associations does not proceed on means of an all-or-none structure but activates only a limited subset of associations. The jogging shoes could for example trigger associations like 'running' and 'exhausting' but not the concept 'weightlifting', even though it corresponds to the overall concept of exercising. Other than processing in the propositional process, the triggered associations in the associative process are independent of truth-values. AEE like 'jogging is exhausting' are thus not necessarily equivalent to rational deliberations on exercising like 'jogging with a moderate intensity is easy for me'. This constitutes the main difference between associative and propositional processing (Gawronski & Bodenhausen, 2006, 2011), since propositional processes validate the available information (including associations). Findings were evaluations of the associative process (i.e. AEE) and the propositional process differ (Antoniewicz & Brand, 2014; Hyde et al., 2010) are thus, apart from measurement issues, explainable with this inconsistency concerning truth-values. The uncorrelated findings (between automatic and controlled affective evaluations) again emphasize the idea of two divergent processes that need different addressing when manipulating these in interventions.

Especially relevant, in the context of experimental manipulations of AEE, is the APE's theoretical framework on associative learning (i.e. the formation of new associations). APE does not only explain how changes in automatic evaluations take place but also names a specific experimental technique - Evaluative Conditioning - (EC; De Houwer, Thomas, & Baeyens, 2001; De Houwer, 2007; Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010) to obtain such changes. Associative learning takes place when two experiences or

mental concepts repeatedly co-occur. Spatiotemporal contiguity is therefore necessary, if two concepts should be linked in memory (Gawronski & Bodenhausen, 2014). Either because they occur on its own in real-life, like going to a fitness center and feeling relaxed afterwards or because they are systematically paired in experimental EC learning settings (e.g. combining pictures of exercising in a fitness center and pictures that evoke relaxed sensations).

When looking on the operating conditions, associative learning is described as independent of conscious awareness, unintentional, efficient and uncontrollable (Gawronski & Bodenhausen, 2014). Associative learning, e.g. induced via EC, therefore matches the required features of automaticity (see Bargh, 1994), which is in line with the findings on AEE from publication one (Antoniewicz & Brand, 2014). Moreover, EC was already effectively used for the alteration of automatic evaluations (Dijksterhuis, 2004; Hermans, Baeyens, Lamote, Spruyt, & Eelen, 2005; Hermans, Vansteenwegen, Crombez, Baeyens, & Eelen, 2002; Olson & Fazio, 2001). When searching for a method that could expand the findings of controlled and rational interventions (Webb & Sheeran, 2006), EC can be considered a suitable approach for interventions that target automatic processes.

3.2.2 Altering automatic evaluations using Evaluative Conditioning

So far, there is no study that used EC as a means to enhance AEE in the exercising domain. However, health research has already taken advantage of the knowledge on the systematic combination of health-related stimuli (conditioned stimulus, CS) with stimuli with either positive or negative valence (unconditioned stimulus, US) in EC paradigms.

Depending on the context, the combination of CS with US of negative sensations (e.g. acquire negative associations to alcohol; Houben et al., 2010) or positive sensations (e.g. acquire positive associations to healthy food; Walsh & Kiviniemi, 2014) is more reasonable.

The stated studies successfully used EC as the described means to facilitate health behavior. The EC task had an effect on the participants' behavior and resulted in (immediate) favorable decisions for healthy food (Walsh & Kiviniemi, 2014) and reduced alcohol intake one week after manipulation through EC (Houben et al., 2010). Transferred to exercise-related research questions, altering AEE could lead to favorable exercise decisions and desirable exercise behavior. Experimental exercise studies with the stated findings would consequently a) fill the research gap on causal connections between AEE and exercise behavior and b) strengthen the argument for developing exercise interventions that directly target AEE (Marteau et al., 2012).

3.2.3 *Publication 2: Learning to like exercising: Evaluative Conditioning changes automatic evaluations to exercising and influences subsequent exercising behavior*⁸

In order to provide a first theory-driven approach that addresses the systematic alteration of automatic evaluations in the exercising domain, a set of three experiments was conducted in publication two (Antoniewicz & Brand, 2015b, *subm.*; see table 1 for an overview). In all three experiments, two experimental groups (APA group; acquiring positive associations and ANA group; acquiring negative associations) and a control group had to work through an EC task. The EC task combined exercise and non-exercise-related CSs with USs that evoked either positive or negative sensations, according to group affiliation. The main aim of publication two was twofold:

- ◆ First, EC is an effective method for altering (health-related) automatic evaluations (Hofmann et al., 2010; Hollands et al., 2011; Houben et al., 2010). The plasticity of AEE has not been investigated yet. Consequently the first experiment was expected to demonstrate the applicability of the described EC paradigm and lead to more positive AEE in the APA group and more negative AEE in the ANA group, when compared to the control group.
- ◆ Second, AEE are known to influence exercise behavior (Antoniewicz & Brand, 2014; Bluemke et al., 2010; Conroy et al., 2010; Hyde et al., 2012) and affect exercise decisions (Brand & Schweizer, 2015). Behavioral consequences of altered automatic evaluations and decisions for or against a certain behavior have been registered for different health behaviors

⁸ Antoniewicz, F. & Brand, R. (2015b, *subm.*). Learning to like exercising: Evaluative Conditioning changes automatic evaluations of exercising and influences subsequent exercising behavior. (Manuscript submitted for publication to Journal of Sport and Exercise Psychology).

This synopsis contains the data and analyses of three studies that were conducted for publication two. Due to word limitations, the manuscript of the second publication includes only two of these three studies (in this synopsis the first and third experiment).

(Hollands et al., 2011; Houben et al., 2010; Walsh & Kiviniemi, 2014). Experiment two and three therefore tested for behavioral consequences of altered AEE while using different group assignment strategies (see table 1).

Table 1.

Overview of the methods and research foci of the three experiments of publication two

	<i>Research focus</i>	<i>n</i>	<i>Mean age in years with SD</i>	<i>Group Assignment strategy (groups)</i>	<i>Dependent Variable</i>
<i>Experiment I</i>	Plasticity of AEE	64 sport and exercise students (27 female)	23.02 ± 2.44	Randomized (APA, ANA, control)	AEE assessed with a ST-IAT
<i>Experiment II</i>	Influences of manipulated AEE on subsequent exercise behavior	71 sport and exercise students (30 female)	23.48 ± 3.67	Randomized (APA, ANA, control)	Decision (i.e. selected wattage on a bike ergometer) in an exercise task
<i>Experiment III</i>	Influences of manipulated AEE on subsequent exercise behavior	41 psychology students (41 female)	23.51 ± 3.90	Placed group assignment according to baseline AEE (APA = negative baseline AEE, ANA = positive baseline AEE, control = randomized)	Decision (i.e. selected wattage bike ergometer) in an exercise task

Note. *n* = number of participants. *SD* = Standard Deviation. APA = acquiring positive associations to exercise. ANA = acquiring negative associations to exercise. ST-IAT = Single Target Implicit Association Test (see Bluemke & Friese, 2008; Dotsch & Wigboldus, 2008)

The first experiment provided empirical evidence for the plasticity of AEE. Contrary to our expectations, shifts in AEE were only present for the APA group and thus towards the (more promising) positive pole of the AEE continuum. When taking a closer look at the specific components of AEE that lead to this overall change in AEE, the newly strengthened associations between the concept of ‘non-exercising’ and ‘bad’ attributes turned out to be more accessible for intervention than the apparently relatively robust associations between ‘exercising’ and ‘positive’ attributes. Considering the very special characteristics of the study’s sample of sport and exercise students in this experiment, the manifest positive component of the overall AEE can be explained by the pre-dominant experiences and thus repeatedly learned associations within this sample (Gawronski & Bodenhausen, 2006). The overall pattern of the experiment (i.e. EC induced changes towards the desirable health direction) consorts with other findings in health research that targeted automatic evaluations with EC (Hollands et al., 2011; Houben et al., 2010). The systematic reinforcement of positive AEE could hence be achieved via experimental set ups like the EC that are based on the theoretical knowledge of associative learning. Taken together, the results of experiment one provide preliminary evidence that EC represents an effective method to alter AEE in health interventions. Whether this alteration leads to meaningful changes in subsequent exercise behavior was investigated in experiment two and three.

No behavioral consequences of altered AEE were found in experiment two with randomized group assignment⁹. As a consequence, a more applied perspective with placed group assignment was utilized for the third experiment. This included for example the placement of individuals with initially negative AEE in the APA group and not an

⁹ Explanations for this non-effect could easily be found in the sample’s characteristics. The gained knowledge of experiment two led to the changes in the study design (placing to groups vs. randomization) and sample (exercise vs. psychology students) of study three.

unsystematic randomization to one group. This strategy was due to deliberations on tailored interventions (Kreuter & Skinner, 2000; Noar, Benac, & Harris, 2007), which recommends approaching individuals according to their individual needs. Participants that acquired positive associations in the EC task selected higher wattages in the subsequent bicycle ergometer task. Again this effect was only present for the APA group that was manipulated towards the desired, health-relevant direction. Due to the study's experimental approach, inferring on AEE as the cause for the observed exercise behavior is legitimate. Individuals that were supposed to acquire negative associations to exercising did not choose less wattage than the control group.

In sum, the presented set of experiments constitutes the first experimental approach that systematically altered AEE with a theory-based EC paradigm. Furthermore, the results of the second publication represent the first in the research area of exercising, that allow concluding on the cause-effect chain of AEE for decisions on exercising behavior. With the second publication the short-term impact of AEE was experimentally demonstrated. Whether AEE could have a more wide-reaching impact on long-term exercise behavior was examined in publication three.

3.3 From laboratory to real-life: Automatic evaluations of exercising and exercise adherence

The findings of publication one and two substantiated the important role of AEE for exercise behavior. More precisely, publication one underlined the AEEs' impact on exercise setting preferences, whereas publication two focused on immediate changes in exercising after AEE manipulation. However, what is still missing for a more complete picture of AEE is an understanding of the long-term impact of AEE for exercise behavior. The possible role of AEE for exercise maintenance has not been studied so far, although the adherence to exercise in general and exercise courses in particular constitutes a tremendous problem in current health programs (Marcus et al., 2000; Matsumoto & Takenaka, 2004). Publication three (Antoniewicz & Brand, 2015a, *subm.*) targeted this research gap and offers a theoretical approach for the long-term impact of AEE on exercise behavior.

3.3.1 The effect of affect

First of all, why should something that is thought to occur quickly and spontaneous like automatic affective evaluations be jointly responsible for a complex and long-dated phenomenon like exercise adherence? To resolve this question, it is important to take a closer look at the individual parts that add up to the behavior of exercise adherence. Simply put, exercise adherence can be understood as a sequence of individual decisions for or against exercising. This perception of an accumulation of individual decisions decomposes the complex structure. Theoretical reflections on the factors that influence each of these individual exercise decisions can easily be found in recent exercise research (e.g. Brand & Schweizer, 2015).

Since exercising is a behavior that evokes massively affective sensations (Backhouse et al., 2007; Ekkekakis, Hargreaves, & Parfitt, 2013), the memorizing of such affective evaluations (Clore, 1992) and utilization as a criterion for future exercise behavior can be

assumed (Peters, Västfjäll, Gärling, & Slovic, 2006; Slovic, Finucane, Peters, & MacGregor, 2007). There are no studies on automatic affective evaluations and exercise adherence. When broadening the view to controlled affective influences on exercise adherence, a number of encouraging findings are available (Ekkekakis et al., 2013; Kwan & Bryan, 2010; Rhodes & Kates, 2015; Williams et al., 2008). Kwan and Bryan (2010) showed that (controlled) affective evaluations during exercising moderated the intention-behavior relationship. Individuals that had more favorable affective evaluations to exercising were more likely to convert their intentions to actual (future) exercise behavior. Furthermore, anticipated positive affective experiences of exercising positively predicted exercise adherence after three months (Dunton & Vaughan, 2008). Williams et al. (2008) found equally far-reaching consequences of controlled affective evaluations. They demonstrated that controlled affective evaluations of exercise with moderate intensity predicted self-reported physical activity in a six and twelve months follow up.

Considering that exercise research shifts gradually and accredits the importance of such controlled affective evaluations for (long-term) exercise behavior, broadening this view to automatic affective evaluations is reasonable. Moreover, favorable (controlled) affective evaluations firstly seem to lead to increased amounts of exercising and secondly facilitate enduring exercise behavior. The similarity of these findings with automatic affective evaluations (i.e. AEE) has been shown for the first aspect, the amount of exercise (Bluemke et al., 2010; Conroy et al., 2010). Assuming likewise consequences for the second aspect, the adherence to exercise programs seems natural and could conclusively be substantiated within dual-system theorizing.

3.3.2 Putting automatic evaluations of exercising under the microscope

Whether one takes RIM (Strack & Deutsch, 2004) or APE (Gawronski &

Bodenhausen, 2006) as a dual-process basis for the explanation of AEE's long-term impact on exercise behavior, both theories agree that AEE represent learned associations in memory that contain affective content. Participating in an exercise session evokes affective sensations that reinforce or alter pre-existing AEE. Hence, there is a continuous alignment between the existing (already experienced) AEE and the newly undergone affective sensations evoked while exercising. The manifestation of present AEE has been shown to influence exercise-related decisions (Brand & Schweizer, 2015). Positive AEE at the outset of an exercise program should thus result in favorable decisions for exercising, when critical situations (e.g. attending the exercise session or spending time differently) occur. As a consequence, positive AEE could be thought of as a promotional factor for long-term exercise adherence that gets reinforced with every attended exercise session.

Moreover, both dual-process theories describe AEE as multifaceted, since they derive from an associative network with different, more or less dominant, associations. Specific behaviors like attending an aerobic class might be associated with positive AEE (e.g. liking to exercise with music) and negative AEE (e.g. disliking the caused muscle ache) both alike. This duality is addressed by indirect measures that assess AEE. EP (Fazio et al., 1986) and IAT (Greenwald et al., 1998) procedures confront the participant with stimuli that cover exactly these two dimensions (positive and negative affect) and calculate a relative score from the reaction times needed to process each stimulus. The following publication claims that the accounting of positive and negative affective associations (PAA and NAA; Sriram & Greenwald, 2009) to one united AEE score involves the danger of overlooking nuances in the individual associations' importance. Publication two (Antoniewicz & Brand, 2015b, *subm.*) already pointed towards differently accessible (and alterable) PAA and NAA for frequent exercisers. Examining these nuances of AEE in more detail might facilitate further interpretations on the impact of automatic affective influences for exercising amounts.

Especially since all the extant findings would not suggest assuming differences in the overall AEE score within such a sample with high exercising volumes (Antoniewicz & Brand, 2014; Bluemke et al., 2010; Calitri et al., 2009; Conroy et al., 2010; Hyde et al., 2010, 2012).

3.3.3 *Publication 3: Dropping out or keeping up? Baseline automatic evaluations of exercise predict adherence to a fourteen-week exercise course*¹⁰

Positive AEE¹¹ have repeatedly been associated with high amounts of exercising (Bluemke et al., 2010; Conroy et al., 2010). Publication two demonstrated the short-term accessibility of these AEE for systematic manipulation and thereby offered a perspective to attain such positive AEE (Antoniewicz & Brand, 2015b, *subm.*). Publication one (Antoniewicz & Brand, 2014) underlined that AEE cannot only differentiate between different amounts of exercising but also be indicative for exercise setting preferences in highly active individuals. Within this set of regularly exercising individuals, an estimation of particular exercise course adherence would not be possible from the extant findings. All participants could be expected to have generally positive AEE (Bluemke et al., 2010; Conroy et al., 2010).

A more detailed consideration of the components of AEE (i.e. PAA and NAA) might provide an opportunity to elucidate exercise adherence to specific exercise courses in this sample. The impact of especially manifest PAA or very dominant NAA could thus be diverse even though an overall favorable AEE is existent. The third publication's aim was

¹⁰ Antoniewicz, F. & Brand, R. (2015a, *subm.*). Dropping out or keeping up? Baseline automatic evaluations of exercise predict adherence to a fourteen-week exercise course. (Manuscript submitted for publication to *Frontiers in Psychology*).

¹¹ In the following, the term AEE refers to the totaled up score of positive and negative affective associations. For an easier determination the abbreviation PAA (positive affective associations) and NAA (negative affective associations) are introduced as the components that assemble to AEE.

consequently to answer the following research questions between the poles of AEE and long-term exercise adherence.

- ◆ First, it is hypothesized that within exercise courses, distinct adherence groups can be observed (e.g. maintainer vs. dropouts). These adherence groups are expected to exhibit differences in PAA and NAA before the start of the exercise course, even though the overall AEE do not reflect group differences.
- ◆ Second, it is examined whether PAA and NAA contribute equally to exercise course adherence. It could for example be anticipated that PAA are especially robust in frequent exercisers (Antoniewicz & Brand, 2015b, subm.) and their influence therefore especially important for exercise course adhering.

Eighty-eight regular exercisers (24.98 years \pm 6.88; 45 female) that stated high intentions to adhere to the exercise course, completed a Brief IAT (BIAT; Sriram & Greenwald, 2009) at the beginning of a fourteen-week exercise program. The BIAT assessed PAA, NAA and thereby also AEE. The documentation of exercise course adherence in the fourteen weeks led to three different adherence patterns (maintainer, early-dropouts, late-dropouts) that were detected by means of a cluster analysis. As hypothesized, the adherence groups did not differ with regard to AEE. All exercisers¹² exhibited rather positive AEE at the outset of the exercise course, what corresponds to the findings of previous studies (Bluemke et al., 2010; Conroy et al., 2010). The assumption of differently pronounced associations (i.e. PAA and NAA) at the beginning of the course was corroborated. Since adherence groups

¹² The inspection of habitual exercise volumes showed no ex ante differences between the three adherence groups, $F(2,83) = 1.13, p > .05$.

served as grouping variable in the investigation of differently pronounced PAA and NAA, an influence of these two associations for long-term exercise behavior can be concluded. Moreover, the PAA were even more indicative for group affiliation than NAA. This emphasizes the idea of additional predictive information that can be gained through the observation of decomposed AEE. PAA seem to serve as factor that facilitates individual decisions in favor of exercising, what in the end adds up to persistent course adherence. Finally, it has to be emphasized that all course participants, whether in the maintainer or dropout groups, stated high intentions to finalize the course. Such intentions can be explained by controlled evaluations like self-efficacy or subjective norms within theories that assume rational reasoning of the individual (Ajzen, 1985, 1991; Bandura, 1986). The finding of PAA and NAA as variables from automatic processes, which can differentiate between the mentioned adherence groups, highlights the unique predictive power of variables that go beyond the established assumption of deliberation and rationality.

4 Conclusion

4.1 Summary

The main goal of the present dissertation was to collect empirical evidence for the influence of AEE on exercise behavior. By doing so, the ongoing debate on a paradigm shift from controlled and deliberative influences of exercise behavior towards approaches that consider automatic and affective influences (Ekkekakis & Zenko, 2015) was encouraged. All three publications are embedded in dual-process theorizing (Gawronski & Bodenhausen, 2006, 2014; Strack & Deutsch, 2004). These offer a theoretical framework that could integrate the established controlled variables of exercise behavior explanation and additionally consider automatic factors for exercise behavior like AEE.

My first publication targeted one core assumption of AEE, the feature of automaticity of the assessed affective evaluations (Antoniewicz & Brand, 2014). The study's methodological approach with a subliminal AMP procedure (Murphy & Zajonc, 1993; Payne et al., 2005) enabled the conclusion, that genuinely automatic affective evaluations were elicited after exercise stimulus exposure. Furthermore, the existing (limited) knowledge on AEE was extended. The available studies predominantly focused on the AEEs' influence on exercising amounts (Bluemke et al., 2010; Conroy et al., 2010). The impact of AEE for a qualitative exercise characteristic, the preference for specific settings, was allocated.

My second publication (Antoniewicz & Brand, 2015b, *subm.*) aimed to provide essential information for the implementation of exercise interventions that target the automatic basis of exercise behavior (Marteau et al., 2012; Sheeran et al., 2012). In a set of three studies, the experimental accessibility of AEE, the purposeful manipulation in the direction of health-relevant AEE and the therewith-connected behavioral consequences of altered AEE were investigated. The induction of positive AEE was achieved with an EC task (Hofmann et al., 2010) and resulted in the selection of increased exercise intensities in a

subsequent exercise task. Moreover, analysis indicated that associative learning of positive AEE is not equally driven by the acquisition of positive associations to exercising and negative associations to non-exercising. The reinforcement of positive associations was not possible in a sample of frequent exercisers and thus with pre-existing positive associations to exercising. Instead, strengthening the associative connection between non-exercising and unpleasant affective evaluations was the main force for overall changes in AEE.

The third publication (Antoniewicz & Brand, 2015a, *subm.*) was based on these findings and addressed the different components of AEE (i.e. PAA and NAA) with regard to long-term exercise behavior, specifically exercise course adherence in a fourteen-week exercise program. Applying the extant knowledge on PAA and NAA to a long-term perspective led to two main findings. First, the practical relevance of baseline PAA and NAA for exercise course adherence was demonstrated. Initial differences in PAA and NAA were indicative for adherence to the exercise program or (sooner or later) dropout of this program. Second, theoretical implications on the composition of AEE, consisting of PAA and NAA, were possible. Both components were not equally important for exercise adherence, at least in this specific sample. PAA, representing salient connections between concepts of exercising and favorable evaluations, have been demonstrated to have a greater impact on the distinction between maintainers and dropouts than NAA. Again, the special characteristics of the sample offer a conclusive explanation for this finding. As people tend to do what makes them feel better (Ekkekakis & Backhouse, 2014), habitual exercisers might have acquired primarily positive affective sensations when exercising. Pre-existing strong PAA might act as a buffer against the effects of future exercise classes and consequently facilitate exercise maintenance.

Taken together, the empirical findings collected in this dissertation suggest that AEE play an important and diverse role for exercise behavior. They represent exercise setting preferences, are a cause for near-term exercise decisions and are decisive for long-term

exercise adherence. These multifaceted results strongly encourage the opening of extant theories for the explanation of exercise behavior towards automatic components like AEE.

4.2 Implications and limitations

This dissertation commenced with the initial claim that exercise psychology might profit from a paradigm shift. This claim is seized on and critically discussed in the following section. Thereby a number of theoretical and practical implications can be derived from the studies of this dissertation. Whereas I answered some research questions were answered with the presented studies, some new ones were posed. The newly evolved research questions are elaborated subsequently.

4.2.1 Dual-process models as a chance for exercise psychology?

„The application of psychology to antecedents and consequences of health-related physical activity“ has been defined as one core task of exercise psychology (Biddle & Fuchs, 2009, p. 410). This includes both the search for predictors of exercise behavior and the examination of constructs that can be addressed in interventions (Biddle & Fuchs, 2009). Consequently, constructs (whether they are a result of automatic or controlled processes) can be evaluated according to the extent with which they fulfill the described functions.

Constructs arising from controlled processes of information processing have been shown to explain an appreciable amount of variance in exercise behavior (e.g. Hagger et al., 2002). The same was found for interventions that target the identified predictors of exercise behavior (e.g. Ashford, Edmunds, & French, 2010). The available meta-analyses on the effectiveness of these interventions consider the impact on diverse target groups like healthy adults or obese individuals (Conn, Hafdahl, & Mehr, 2011; Gourlan, Trouilloud, & Sarrazin, 2011), diverse settings like workplaces or primary care facilities (Conn, Hafdahl, Cooper, Brown, & Lusk, 2009; Orrow, Kinmonth, Sanderson, & Sutton, 2012) as well as different

communication channels like face-to face or computer-based interventions (Krebs, Prochaska, & Rossi, 2010; Richards, Thorogood, Hillsdon, & Foster, 2013). However, the effect-sizes, depending on the considered meta-analysis, differ between small ($d = 0.14$; French, Olander, Chisholm, & Mc Sharry, 2014) and medium effect sizes ($d = 0.52$; Kassavou, Turner, & French, 2013). Whereas a pragmatic interpretation of these findings could lead to a conclusion of satisfaction with the achieved, a less optimistic mind could ask why a tremendous amount of people is still (despite all efforts) inactive (Ekkekakis & Zenko, 2015). One explanation for the unsatisfying results might be the mentioned usage of the same metatheoretical background for decades. To avoid applying double standards, constructs that arise from automatic processes (like AEE) should be evaluated by means of the same definitional tasks of exercise psychology (i.e. role as a predictor for exercise behavior and consequences when addressed in interventions) as the controlled constructs.

(i) AEE as a predictor of exercise behavior

Naturally, the amount of available studies on AEE and exercise behavior is limited, due to the construct's neglect in the last years. The impact of AEE for exercise behavior in short (Antoniewicz & Brand, 2015b, *subm.*; Conroy et al., 2010; Hyde et al., 2012) and long time frames (Antoniewicz & Brand, 2015a, *subm.*) was highlighted. Furthermore, the predictive power of AEE for habitual exercising (Bluemke et al., 2010) and for setting preferences (Antoniewicz & Brand, 2014) has been shown. Decisions for or against exercising in critical situations are also influenced by AEE (Brand & Schweizer, 2015). Hyde et al. (2010) demonstrated that controlled and automatic evaluations of exercising independently explain exercise behavior. This uncorrelated pattern was also found in publication one (Antoniewicz & Brand, 2014). In sum, a relative large amount of exercise nuances can be explained by AEE at the moment (Antoniewicz & Brand, 2014, 2015a, *subm.*;

Bluemke et al., 2010; Brand & Schweizer, 2015; Conroy et al., 2010; Hyde et al., 2010). As described above, the publications of this dissertation contributed to the understanding of AEE and exercise behavior.

Publication one applied a measurement technique to AEE, the AMP (Payne et al., 2005), that has not been used before for the assessment of AEE. As the psychometric qualities of indirect measures diverge (e.g. Cunningham, Preacher, & Banaji, 2001; Reinecke, Becker, & Rinck, 2010) and are debatable (Payne & Lundberg, 2014), adding another alternative to the assessment methods is helpful. The AMP is currently one of the most widely used indirect measures (Nosek et al., 2011). The task is very simple and requires only a limited amount of time for the treatment. Most strikingly, it is a task that measures (automatic) evaluations using an evaluative judgment (Payne & Lundberg, 2014) and does not need to infer on AEE from reaction-times. Since one of the main aims of the first study was to work out the automaticity feature of these affective evaluations, the use of a task that directly states to test affective misattributions by the help of evaluative judgments was only reasonable. The decision for subliminal stimulus presentation as described by Murphy and Zajonc (1993) was mainly driven by the study's aim to more convincingly demonstrate the automaticity of the measured process. Fiske and Shelley (2013) stated that "automatic processes come in all varieties" (p. 32). They furthermore describe a continuum between purely automatic and purely controlled processes and match measurement techniques or features to each increment along this continuum. The subliminal fitness center prime presentation of publication one resembles the closest increment to automaticity on this continuum (Fiske & Taylor, 2013). Even though the assessed AEE might not qualify for a purely automatic process in terms of Bargh (1994), it is nonetheless legitimate to assume that the assessed evaluations include more automaticity features than all extant findings, which used supraliminal stimulus presentation (e.g. Bluemke et al., 2010; Hyde et al., 2010). Besides the implications on the automaticity of AEE, the

generalizability of the study's results needs to be addressed. The chosen activity of exercising in a fitness center represents a very specific one that presumably results in sharply defined AEE. Less structured forms of physical activity (e.g. riding the bike) might not necessarily lead to measurable preferences (via AEE) for this activity. Additionally, no conclusions on the causality of exercise setting preferences can be drawn. It is likewise reasonable that frequent exercising in such a setting results in positive AEE or that positive AEE to fitness center exercising facilitate the attending of such facilities. However, having the results of the second publication in mind (Antoniewicz & Brand, 2015b, *subm.*), there is empirical evidence for AEE as cause for later exercise behavior.

The third publication (Antoniewicz & Brand, 2015a, *subm.*) of this dissertation tried to shed light on AEE as a predictor for long-term exercise adherence. One theoretical implication resulting from the stated study is the unequal impact of PAA and NAA for exercise adherence. The demonstrated 'buffer effect' of PAA for exercise adherence might be especially important in situations when individuals are depleted (Baumeister, Bratslavsky, Muraven, & Tice, 1998) and less willing to deliberate. Dual-process theories (e.g. Deutsch & Strack, 2006; Gawronski & Bodenhausen, 2011) are in line with this assumption and describe automatic processes as most influential when time or motivation to deliberate is rare. From an applied perspective, the strengthening of positive AEE (and thus PAA) should be considered. This thought leads to publication two and the possibilities to target AEE in interventions.

(ii) AEE as a target for exercise interventions

When positive AEE are decisive for exercise behavior, a systematic examination of interventions that aim to alter AEE is crucial. Reviewing the literature exhibited EC (De Houwer, 2007) as a method to alter AEE that can directly be derived from fundamental assumptions of dual-process theories (e.g. Gawronski & Bodenhausen, 2014). Albeit the

plasticity of AEE was already observed by Hyde et al. (2012), no intervention directly targeted AEE by the help of EC. One recent study that addressed the plasticity of AEE (Markland et al., 2015) focused on imagery interventions and demonstrated that the envisioning of pleasant exercise experiences makes (positive) AEE more salient. The study did not focus on subsequent exercise behavior and could thus not be used to shed light on the causal connections between AEE and exercising. The findings of publication two (Antoniewicz & Brand, 2015b, *subm.*) illustrate that positive AEE can be induced via EC and that this manipulation leads to changes in subsequent exercise behavior. More generally, one can conclude that positive reinforcement has an impact on automatic processes and that this impact influences exercise behavior. From an applied perspective, exercise instructors working with the target group of inactive individuals should purposely use positive reinforcement. Even though study two employed only generally active individuals, a transfer of the mechanisms (i.e. associative learning) that lead to changes in AEE to less active samples is reasonable (Gawronski & Bodenhausen, 2011, 2014). Moreover, study two showed that the alteration of AEE was only possible for individuals with initially negative AEE. This finding highlights the importance of tailored interventions (e.g. Noar et al., 2007). Exactly these negative AEE could be expected in the inactive target group of exercise interventions (Antoniewicz & Brand, 2015b, *subm.*; Bluemke et al., 2010). A positive reinforcement through exercise instructors or the generation of pleasurable sensations while exercising could represent methods for interventions that facilitate shifts in AEE. Techniques like the mentioned ones can easily be implemented and should in the future be controlled in randomized-controlled trials with AEE as dependent variable.

There are a number of publications addressing the issue of experienced joy while exercising (e.g. Ekkekakis, Hall, & Petruzzello, 2008; Ekkekakis, Lind, & Vazou, 2010; Lind, Ekkekakis, & Vazou, 2008). These might help preparing interventions that target altered AEE

in real-life settings. Lind, Ekkekakis and Vazou (2008) demonstrated for example that exceeding the preferred intensity of exercising for only ten percent significantly decreased the experienced joy of exercising. Similar findings are present for overweight individuals (Ekkekakis & Lind, 2006). As (controlled and automatic) aspects of affect have been associated with exercise adherence (Antoniewicz & Brand, 2015a, *subm.*; Williams et al., 2008), the creation of pleasurable exercise situations is crucial.

The research that I presented in this synopsis aimed to provide empirical evidence for the impact of AEE on exercise behavior. Adding to the few already present studies in this field, the influence of (positive) AEE for exercise behavior was confirmed in all three presented publications. Even though the available set of studies needs to be extended in prospectively studies, first steps towards a more complete picture have been taken. Closing with the beginning of this synopsis: I think that time is right for a change of perspectives! This means a careful extension of the present theories with controlled evaluations explaining exercise behavior. Dual-process theories including controlled and automatic evaluations could provide such a basis for future research endeavors in exercise psychology.

5 References

- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. *Action Control: From Cognition to Behavior*, 11–39. http://doi.org/10.1007/978-3-642-69746-3_2
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [http://doi.org/10.1016/0749-5978\(91\)90020-T](http://doi.org/10.1016/0749-5978(91)90020-T)
- Antoniewicz, F., & Brand, R. (2014). Automatic Evaluations and Exercise Setting Preference in Frequent Exercisers. *Journal of Sport & Exercise Psychology*, 36, 631–636. <http://doi.org/10.1123/jsep.2014-0033>
- Antoniewicz, F., & Brand, R. (2015a, subm.). Dropping out or keeping up? Baseline automatic evaluations predict exercise course adherence in a fourteen-week exercise course. (Manuscript submitted for publication to *Journal of Sport and Exercise Psychology*)
- Antoniewicz, F., & Brand, R. (2015b, subm.). Learning to like exercising: Evaluative Conditioning changes automatic evaluations of exercising and influences subsequent exercising behavior. (Manuscript submitted for publication to *Frontiers in Psychology*)
- Ashford, S., Edmunds, J., & French, D. P. (2010). What is the best way to change self-efficacy to promote lifestyle and recreational physical activity? A systematic review with meta-analysis. *British Journal of Health Psychology*, 15(2), 265–288. <http://doi.org/10.1348/135910709X461752>
- Backhouse, S., Ekkekakis, P., Bidle, S., Foskett, A., & Williams, C. (2007). Exercise makes people feel better but people are inactive: paradox or artifact? *Journal of Sport & Exercise Psychology*, 29(4), 498–517.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall: Inc.
- Bandura, A. (2004). Health Promotion by Social Cognitive Means. *Health Education & Behavior*, 31(2), 143–164. <http://doi.org/10.1177/1090198104263660>
- Bargh, J. A. (1994). The Four Horsemen of Automaticity: Awareness, Efficiency, Intention, and Control in Social Cognition. *Handbook of Social Cognition*. <http://doi.org/10.1007/s00572-005-0022-9>
- Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *American Psychologist*, 54(7), 462–479. <http://doi.org/10.1037/0003-066X.54.7.462>
- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: is the active self a limited resource? *Journal of Personality and Social Psychology*, 74(5), 1252–1265. <http://doi.org/10.1037/0022-3514.74.5.1252>
- Biddle, S. J. H., & Fuchs, R. (2009). Exercise psychology: A view from Europe. *Psychology of Sport and Exercise*, 10(4), 410–419. <http://doi.org/10.1016/j.psychsport.2009.02.011>
- Bluemke, M., Brand, R., Schweizer, G., & Kahlert, D. (2010). Exercise might be good for me, but I don't feel good about it: do automatic associations predict exercise behavior? *Journal of Sport & Exercise Psychology*, 32(2), 137–153.

- Bluemke, M., & Friese, M. (2008). Reliability and validity of the Single-Target IAT (ST-IAT): assessing automatic affect towards multiple attitude objects. *European Journal of Social Psychology*, *38*(6), 977–997. <http://doi.org/10.1002/ejsp.487>
- Brand, R. (2006). Die affektive Einstellungskomponente und ihr Beitrag zur Erklärung von Sportpartizipation. *Zeitschrift Für Sportpsychologie*, *13*(4), 147–155. <http://doi.org/10.1026/1612-5010.13.4.147>
- Brand, R., & Schweizer, G. (2015). Going to the Gym or to the Movies?: Situated Decisions as a Functional Link Connecting Automatic and Reflective Evaluations of Exercise With Exercising Behavior. *Journal of Sport and Exercise Psychology*, *37*(1), 63–73. <http://doi.org/10.1123/jsep.2014-0018>
- Calitri, R., Lowe, R., Eves, F. F., & Bennett, P. (2009). Associations between visual attention, implicit and explicit attitude and behaviour for physical activity. *Psychology & Health*, *24*(9), 1105–1123. <http://doi.org/10.1080/08870440802245306>
- Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports*, *100*(2), 126–131. <http://doi.org/10.2307/20056429>
- CDC. (2010). *State Indicator Report on Physical Activity*. Centers For Disease Control And Prevention (CDC). Retrieved from www.cdc.gov/physicalactivity
- Chaiken, S., & Trope, Y. (Eds.). (1999). *Dual-process theories in social psychology*. *Social Psychology*. New York: Guilford Press.
- Clore, G. L. (1992). Cognitive phenomenology: Feelings and the construction of judgment. In L. Martin & A. Tesser (Eds.), *The Construction of Social Judgments*. Lawrence Erlbaum.
- Conn, V. S., Hafdahl, A. R., Cooper, P. S., Brown, L. M., & Lusk, S. L. (2009). Meta-analysis of workplace physical activity interventions. *American Journal of Preventive Medicine*, *37*(4), 330–9. <http://doi.org/10.1016/j.amepre.2009.06.008>
- Conn, V. S., Hafdahl, A. R., & Mehr, D. R. (2011). Interventions to increase physical activity among healthy adults: meta-analysis of outcomes. *American Journal of Public Health*, *101*(4), 751–8. <http://doi.org/10.2105/AJPH.2010.194381>
- Conroy, D. E., Hyde, A. L., Doerksen, S. E., & Ribeiro, N. F. (2010). Implicit attitudes and explicit motivation prospectively predict physical activity. *Annals of Behavioral Medicine*, *39*(2), 112–118. <http://doi.org/10.1007/s12160-010-9161-0>
- Crano, W. D. (2006). Reading the Tea Leaves in Models That Seek to Integrate Implicit and Explicit Measures and Cognitions : Is This the Future of Social Psychology ? *Psychological Inquiry*, *17*(3), 205–210.
- Cunningham, W. a, Preacher, K. J., & Banaji, M. R. (2001). Research Article Consistency, Stability and Convergent Validity. *Psychological Science*, *12*(2), 163–170. <http://doi.org/10.1111/1467-9280.00328>
- De Houwer, J. (2003). The extrinsic affective simon task. *Experimental Psychology*, *50*(2), 77–85.
- De Houwer, J. (2006). What are implicit measures and why are we using them? In. In R. W. Wiers & A. Stacy (Eds.), *Handbook of implicit cognition and addiction* (p. Handbook of implicit cognition and addiction). New York: Sage.

- De Houwer, J. (2007). A conceptual and theoretical analysis of evaluative conditioning. *The Spanish Journal of Psychology*, *10*(2), 230–241. <http://doi.org/psi/11387416/articulos/SJOP0707220230A.PDF>
- De Houwer, J., Thomas, S., & Baeyens, F. (2001). Associative learning of likes and dislikes: a review of 25 years of research on human evaluative conditioning. *Psychological Bulletin*, *127*(6), 853–869. <http://doi.org/10.1037//D033-2909.127.6.853>
- Deutsch, R., & Strack, F. (2006). Duality models in social psychology: From dual processes to interacting systems. *Psychological Inquiry*, *17*(3), 166–172. http://doi.org/10.1207/s15327965pli1703_2
- Dijksterhuis, A. (2004). I Like Myself but I Don't Know Why: Enhancing Implicit Self-Esteem by Subliminal Evaluative Conditioning. *Journal of Personality and Social Psychology*, *86*(2), 345–355. <http://doi.org/10.1037/0022-3514.86.2.345>
- Dishman, R. K., & O'Connor, P. J. (2005). Five decades of sport and exercise psychology: A festschrift for William P. Morgan. *International Journal of Sport and Exercise Psychology*, *3*(4), 399–409. <http://doi.org/10.1080/1612197X.2005.10807314>
- Dotsch, R., & Wigboldus, D. H. J. (2008). Virtual prejudice. *Journal of Experimental Social Psychology*, *44*(4), 1194–1198. <http://doi.org/10.1016/j.jesp.2008.03.003>
- Dunton, G. F., & Vaughan, E. (2008). Anticipated affective consequences of physical activity adoption and maintenance. *Health Psychology*, *27*(6), 703–710. <http://doi.org/10.1037/0278-6133.27.6.703>
- Ekkekakis, P., & Backhouse, S. H. (2014). Physical activity and feeling good. In A. G. Papaioannou & H. D. (Eds.), *Routledge companion to sport and exercise psychology: Global perspectives and fundamental concepts* (pp. 687–704). New York: Routledge.
- Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2008). The Relationship Between Exercise Intensity and Affective Responses Demystified: To Crack the 40-Year-Old Nut, Replace the 40-Year-Old Nutcracker! *Annals of Behavioral Medicine*, *35*(2), 136–149. <http://doi.org/10.1007/s12160-008-9025-z>
- Ekkekakis, P., Hargreaves, E. A., & Parfitt, G. (2013). Invited Guest Editorial: Envisioning the next fifty years of research on the exercise–affect relationship. *Psychology of Sport and Exercise*, *14*(5), 751–758. <http://doi.org/10.1016/j.psychsport.2013.04.007>
- Ekkekakis, P., & Lind, E. (2006). Exercise does not feel the same when you are overweight: the impact of self-selected and imposed intensity on affect and exertion. *International Journal of Obesity (2005)*, *30*(4), 652–660. <http://doi.org/10.1038/sj.ijo.0803052>
- Ekkekakis, P., Lind, E., & Vazou, S. (2010). Affective responses to increasing levels of exercise intensity in normal-weight, overweight, and obese middle-aged women. *Obesity (Silver Spring, Md.)*, *18*(1), 79–85. <http://doi.org/10.1038/oby.2009.204>
- Ekkekakis, P., & Zenko, Z. (2015). Escape from cognitivism: Exercise as hedonic experience. To appear in M. Raab, P. Wylleman, R. Seiler, A.-M. Elbe, & A. Hatzigeorgiadis (Eds.), *Sport and Exercise Psychology Research from Theory to Practice*.
- Eurobarometer, S. (2014). *Sport and Physical Activity*. Belgium: TNS Opinion & Social. <http://doi.org/10.2766/7294>

- Evans, J., & Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science*, 8(3), 223–241. <http://doi.org/10.1177/1745691612460685>
- Eves, F. F., Scott, E. J., Hoppé, R., & French, D. P. (2007). Using the affective priming paradigm to explore the attitudes underlying walking behaviour. *British Journal of Health Psychology*, 12(Pt 4), 571–85. <http://doi.org/10.1348/135910706X153775>
- Fazio, R. H., Sanbonmatsu, D. ., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology*, 50, 229–238.
- Fiske, S. T., & Taylor, S. E. (2013). *Social cognition: from brains to culture* (2nd ed.). Sage Publications Ltd.
- French, D. P., Olander, E. K., Chisholm, A., & Mc Sharry, J. (2014). Which Behaviour Change Techniques Are Most Effective at Increasing Older Adults' Self-Efficacy and Physical Activity Behaviour? A Systematic Review. *Annals of Behavioral Medicine*, 48(2), 225–234. <http://doi.org/10.1007/s12160-014-9593-z>
- Friese, M., Hofmann, W., & Wiers, R. W. (2011). On taming horses and strengthening riders: Recent developments in research on interventions to improve self-control in health behaviors. *Self and Identity*, 10(3), 336–351. <http://doi.org/10.1080/15298868.2010.536417>
- Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: an integrative review of implicit and explicit attitude change. *Psychological Bulletin*, 132(5), 692–731. <http://doi.org/10.1037/0033-2909.132.5.692>
- Gawronski, B., & Bodenhausen, G. V. (2007). Unraveling the Processes Underlying Evaluation: Attitudes from the Perspective of the APE Model. *Social Cognition*, 25(5), 687–717. <http://doi.org/10.1521/soco.2007.25.5.687>
- Gawronski, B., & Bodenhausen, G. V. (2011). The Associative–Propositional Evaluation Model: Theory, evidence and open questions. In J. M. Olson & M. P. Zanna (Eds.), *Advances in Experimental Social Psychology* (Vol. 44, pp. 59–127). <http://doi.org/10.1016/B978-0-12-385522-0.00002-0>
- Gawronski, B., & Bodenhausen, G. V. (2014). The associative-propositional evaluation model: Operating principles and operating conditions of evaluation. In J. W. Sherman, B. Gawronski, & Y. Trope (Eds.), *Dual-process theories of the social mind* (pp. 188–203). New York: Guilford Press.
- Gawronski, B., & Creighton, L. A. (2012). Dual-Process Theories. *The Oxford Handbook of Social Cognition*, 1–35. <http://doi.org/10.1017/S0140525X03340130>
- Godin, G., Valois, P., & Robin, J. (1991). Prediction of intention to exercise of individuals who suffered from coronary heart disease. *Journal of Clinical Psychology*, 47(6), 762–772.
- Gourlan, M. J., Trouilloud, D. O., & Sarrazin, P. G. (2011). Interventions promoting physical activity among obese populations: a meta-analysis considering global effect, long-term maintenance, physical activity indicators and dose characteristics. *Obesity Reviews*, 12(7), e633–e645. <http://doi.org/10.1111/j.1467-789X.2011.00874.x>

- Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: the implicit association test. *Journal of Personality and Social Psychology*, *74*(6), 1464–80. <http://doi.org/10.1037/0022-3514.74.6.1464>
- Hagger, M. S., Chatzisarantis, N., & Biddle, S. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport & Exercise Psychology*.
- Hagger, M. S., Chatzisarantis, N., & Biddle, S. J. (2001). The influence of self-efficacy and past behaviour on the physical activity intentions of young people. *Journal of Sports Sciences*, *19*(9), 711–725. <http://doi.org/10.1080/02640410152475847>
- Hagger, M. S., & Chatzisarantis, N. L. D. (2014). An integrated behavior change model for physical activity. *Exercise and Sport Sciences Reviews*, *42*(2), 62–69. <http://doi.org/10.1249/JES.0000000000000008>
- Hermans, D., Baeyens, F., Lamote, S., Spruyt, A., & Eelen, P. (2005). Affective priming as an indirect measure of food preferences acquired through odor conditioning. *Experimental Psychology*, *52*(3), 180–186. <http://doi.org/10.1027/1618-3169.52.3.180>
- Hermans, D., Vansteenwegen, D., Crombez, G., Baeyens, F., & Eelen, P. (2002). Expectancy-learning and evaluative learning in human classical conditioning: affective priming as an indirect and unobtrusive measure of conditioned stimulus valence. *Behaviour Research and Therapy*, *40*(3), 217–234. [http://doi.org/10.1016/S0005-7967\(01\)00006-7](http://doi.org/10.1016/S0005-7967(01)00006-7)
- Hofmann, W., De Houwer, J., Perugini, M., Baeyens, F., & Crombez, G. (2010). Evaluative conditioning in humans: a meta-analysis. *Psychological Bulletin*, *136*(3), 390–421. <http://doi.org/10.1037/a0018916>
- Hofmann, W., Friese, M., & Wiers, R. W. (2008). Impulsive versus reflective influences on health behavior: a theoretical framework and empirical review. *Health Psychology Review*, *2*(2), 111–137. <http://doi.org/10.1080/17437190802617668>
- Hollands, G. J., Prestwich, A., & Marteau, T. M. (2011). Using aversive images to enhance healthy food choices and implicit attitudes: An experimental test of evaluative conditioning. *Health Psychology : Official Journal of the Division of Health Psychology, American Psychological Association*, *30*(2), 195–203. <http://doi.org/10.1037/a0022261>
- Houben, K., Havermans, R. C., & Wiers, R. W. (2010). Learning to dislike alcohol: Conditioning negative implicit attitudes toward alcohol and its effect on drinking behavior. *Psychopharmacology*, *211*(1), 79–86. <http://doi.org/10.1007/s00213-010-1872-1>
- Houben, K., & Wiers, R. W. (2008). Implicitly positive about alcohol? Implicit positive associations predict drinking behavior. *Addictive Behaviors*, *33*(8), 979–986. <http://doi.org/10.1016/j.addbeh.2008.03.002>
- Huijding, J., de Jong, P. J., Wiers, R. W., & Verkooijen, K. (2005). Implicit and explicit attitudes toward smoking in a smoking and a nonsmoking setting. *Addict Behav*, *30*(5), 949–961. <http://doi.org/10.1016/j.addbeh.2004.09.014>
- Hyde, A. L., Doerksen, S. E., Ribeiro, N. F., & Conroy, D. E. (2010). The independence of implicit and explicit attitudes toward physical activity: Introspective access and attitudinal concordance. *Psychology of Sport and Exercise*, *11*(5), 387–393. <http://doi.org/10.1016/j.psychsport.2010.04.008>

- Hyde, A. L., Elavsky, S., Doerksen, S. E., & Conroy, D. E. (2012). The stability of automatic evaluations of physical activity and their relations with physical activity. *Journal of Sport & Exercise Psychology, 34*(6), 715–36. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/23204356>
- Kahler, C. W., Daughters, S. B., Leventhal, A. M., Gwaltney, C. J., & Palfai, T. P. (2007). Implicit associations between smoking and social consequences among smokers in cessation treatment. *Behaviour Research and Therapy, 45*(9), 2066–2077. <http://doi.org/10.1016/j.brat.2007.03.004>
- Kahneman, D. (2003). A perspective on judgment and choice: mapping bounded rationality. *The American Psychologist, 58*(9), 697–720. <http://doi.org/10.1037/0003-066X.58.9.697>
- Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In *Heuristics and biases: The psychology of intuitive judgment* (pp. 49–81). New York: Cambridge University Press.
- Karpinski, A., & Steinman, R. B. (2006). The single category implicit association test as a measure of implicit social cognition. *Journal of Personality and Social Psychology, 91*(1), 16–32. <http://doi.org/10.1037/0022-3514.91.1.16>
- Kassavou, A., Turner, A., & French, D. P. (2013). Do interventions to promote walking in groups increase physical activity? A meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity, 10*, 18. <http://doi.org/10.1186/1479-5868-10-18>
- Knight, J. A. (2012). Physical Inactivity: Associated Diseases and Disorders. *Annals of Clinical & Laboratory Science, 42*(3), 320–337.
- Krebs, P., Prochaska, J. O., & Rossi, J. S. (2010). A meta-analysis of computer-tailored interventions for health behavior change. *Preventive Medicine, 51*(3-4), 214–221. <http://doi.org/10.1016/j.ypmed.2010.06.004>
- Kreuter, M. W., & Skinner, C. S. (2000). Tailoring: what's in a name? *Health Education Research, 15*(1), 1–4. <http://doi.org/10.1093/her/15.1.1>
- Kruk, J. (2014). Health and Economic Costs of Physical Inactivity. *Asian Pacific Journal of Cancer Prevention, 15*(18), 7499–7503. <http://doi.org/10.7314/APJCP.2014.15.18.7499>
- Kwan, B. M., & Bryan, A. (2010). In-task and post-task affective response to exercise: translating exercise intentions into behaviour. *British Journal of Health Psychology, 15*(Pt 1), 115–131. <http://doi.org/10.1348/135910709X433267>
- Lee, I.-M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The Lancet, 380*(9838), 219–229. [http://doi.org/10.1016/S0140-6736\(12\)61031-9](http://doi.org/10.1016/S0140-6736(12)61031-9)
- Lind, E., Ekkekakis, P., & Vazou, S. (2008). The affective impact of exercise intensity that slightly exceeds the preferred level: “pain” for no additional “gain”. *Journal of Health Psychology, 13*(4), 464–468. <http://doi.org/10.1177/1359105308088517>

- Lindgren, K. P., Neighbors, C., Teachman, B. A., Gasser, M. L., Kaysen, D., Norris, J., & Wiers, R. W. (2015). Habit doesn't make the predictions stronger: Implicit alcohol associations and habitualness predict drinking uniquely. *Addictive Behaviors*, *45*, 139–145. <http://doi.org/10.1016/j.addbeh.2015.01.003>
- Mai, R., Hoffmann, S., Hoppert, K., Schwarz, P., & Rohm, H. (2015). The spirit is willing, but the flesh is weak: The moderating effect of implicit associations on healthy eating behaviors. *Food Quality and Preference*, *39*, 62–72. <http://doi.org/10.1016/j.foodqual.2014.06.014>
- Marcus, B. H., Dubbert, P. M., Forsyth, L. H., McKenzie, T. L., Stone, E. J., Dunn, A. L., & Blair, S. N. (2000). Physical activity behavior change: issues in adoption and maintenance. *Health Psychology*, *19*(1 Suppl), 32–41. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/10709946>
- Markland, D., Hall, C. R., Duncan, L. R., & Simatovic, J. (2015). The effects of an imagery intervention on implicit and explicit exercise attitudes. *Psychology of Sport and Exercise*, *17*, 24–31. <http://doi.org/10.1016/j.psychsport.2014.11.007>
- Marteau, T. M., Hollands, G. J., & Fletcher, P. C. (2012). Changing Human Behavior to Prevent Disease: The Importance of Targeting Automatic Processes. *Science*, *337*(6101), 1492–1495. <http://doi.org/10.1126/science.1226918>
- Matsumoto, H., & Takenaka, K. (2004). Motivational Profiles and Stages of Exercise Behavior Change. *International Journal of Sport and Health Science*, *2*, 89–96. <http://doi.org/10.5432/ijshs.2.89>
- Milne, S., Sheeran, P., & Orbell, S. (2000). Prediction and Intervention in Health Related Behaviour: A meta-analytic review of Protection Motivation Theory. *Journal of Applied Social Psychology*, *30*(1), 106–143.
- Moors, A., & De Houwer, J. (2006). Problems with dividing the realm of processes. *Psychological Inquiry*, *17*(3), 199–204.
- Moskowitz, G., & Li, P. (2006). One, two, three, what are we fighting, four? *Psychological Inquiry*, *17*(3), 223–231.
- Murphy, S. T., & Zajonc, R. B. (1993). Affect, cognition, and awareness: Affective priming with optimal and suboptimal stimulus exposures. *Journal of Personality and Social Psychology*, *64*(5), 723–739. <http://doi.org/10.1037/0022-3514.64.5.723>
- Nederkoorn, C., Houben, K., Hofmann, W., Roefs, A., & Jansen, A. (2010). Control yourself or just eat what you like? Weight gain over a year is predicted by an interactive effect of response inhibition and implicit preference for snack foods. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, *29*(4), 389–393. <http://doi.org/10.1037/a0019921>
- Noar, S. M., Benac, C. N., & Harris, M. S. (2007). Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychological Bulletin*, *133*(4), 673–693. <http://doi.org/10.1037/0033-2909.133.4.673>
- Nosek, B. a., Hawkins, C. B., & Frazier, R. S. (2011). Implicit social cognition: From measures to mechanisms. *Trends in Cognitive Sciences*, *15*(4), 152–159. <http://doi.org/10.1016/j.tics.2011.01.005>

- Olson, M. A., & Fazio, R. H. (2001). Implicit attitude formation through classical conditioning. *Psychological Science*, *12*(5), 413–417.
- Orrow, G., Kinmonth, A.-L., Sanderson, S., & Sutton, S. (2012). Effectiveness of physical activity promotion based in primary care: systematic review and meta-analysis of randomised controlled trials. *British Medical Journal*, *344*(1). <http://doi.org/10.1136/bmj.e1389>
- Payne, K. B., Cheng, C. M., Govorun, O., & Stewart, B. D. (2005). An inkblot for attitudes: affect misattribution as implicit measurement. *Journal of Personality and Social Psychology*, *89*(3), 277–293. <http://doi.org/10.1037/0022-3514.89.3.277>
- Payne, K. B., & Gawronski, B. (2010). A history of implicit social cognition: Where is it coming from? Where is it know? Where is it going? In K. B. Payne & B. Gawronski (Eds.), *Handbook of implicit social cognition: Measurement, theory, and applications* (pp. 1–15). New York: Guilford Press.
- Payne, K. B., & Lundberg, K. (2014). The Affect Misattribution Procedure: Ten Years of Evidence on Reliability, Validity, and Mechanisms. *Social and Personality Psychology Compass*, *8*(12), 672–686. <http://doi.org/10.1111/spc3.12148>
- Payne, K. B., McClernon, F. J., & Dobbins, I. G. (2007). Automatic affective responses to smoking cues. *Experimental and Clinical Psychopharmacology*, *15*(4), 400–409. <http://doi.org/10.1037/1064-1297.15.4.400>
- Peters, E., Västfjäll, D., Gärling, T., & Slovic, P. (2006). Affect and decision making: a “hot” topic. *Journal of Behavioral Decision Making*, *19*(2), 79–85. <http://doi.org/10.1002/bdm.528>
- Petty, R. E., & Briñol, P. (2006). Understanding social judgement: Multiple systems and processes. *Psychological Inquiry*, *17*(3), 217–223.
- Reinecke, A., Becker, E. S., & Rinck, M. (2010). Three Indirect Tasks Assessing Implicit Threat Associations and Behavioral Response Tendencies. *Zeitschrift Für Psychologie / Journal of Psychology*, *218*(1), 4–11. <http://doi.org/10.1027/0044-3409/a000002>
- Rhodes, R. E., & Kates, A. (2015). Can the Affective Response to Exercise Predict Future Motives and Physical Activity Behavior? A Systematic Review of Published Evidence. *Annals of Behavioral Medicine*, *49*(5), 715–731. <http://doi.org/10.1007/s12160-015-9704-5>
- Richards, J., Thorogood, M., Hillsdon, M., & Foster, C. (2013). Face-to-face versus remote and web 2.0 interventions for promoting physical activity. *The Cochrane Database of Systematic Reviews*, *9*, CD010393. <http://doi.org/10.1002/14651858.CD010393.pub2>
- Richetin, J., Perugini, M., Prestwich, A., & O’Gorman, R. (2007). The IAT as a predictor of spontaneous food choice: The case of fruits versus snacks. *International Journal of Psychology*, *42*(3), 166 – 173. <http://doi.org/10.1258/itt.2010.100803>
- Sallis, J. (2001). Progress in Behavioral Research on Physical Activity. *Annals of Behavioral Medicine*, *15*(4), 77–78. Retrieved from <http://www.springerlink.com/index/086773t77xxk884v.pdf>
- Shafir, E., & LeBoeuf, R. A. (2002). Rationality. *Annual Review of Psychology*, *53*, 491–517. <http://doi.org/10.1146/annurev.psych.53.100901.135213>

- Sheeran, P., Gollwitzer, P. M., & Bargh, J. a. (2012). Nonconscious Processes and Health. *Health Psychology, 32*(5), 460–473. <http://doi.org/10.1037/a0029203>
- Sherman, J. W. (2006). On building a better process model: It's not only how many, but which ones and by which means? *Psychological Inquiry, 17*(3), 173–184.
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research, 177*(3), 1333–1352.
- Smith, E. R., & DeCoster, J. (2000). Dual-Process Models in Social and Cognitive Psychology: Conceptual Integration and Links to Underlying Memory Systems. *Personality and Social Psychology Review, 4*(2), 108–131. http://doi.org/10.1207/S15327957PSPR0402_01
- Sriram, N., & Greenwald, A. G. (2009). The brief implicit association test. *Experimental Psychology, 56*(4), 283–294. <http://doi.org/10.1027/1618-3169.56.4.283>
- Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*(3), 220–247. http://doi.org/10.1207/s15327957pspr0803_1
- Walsh, E. M., & Kiviniemi, M. T. (2014). Changing how I feel about the food: Experimentally manipulated affective associations with fruits change fruit choice behaviors. *Journal of Behavioral Medicine, 37*(2), 322–331. <http://doi.org/10.1007/s10865-012-9490-5>
- Webb, T. L., & Sheeran, P. (2006). Does Changing Behavioral Intentions Engender Behavior Change? A Meta-Analysis of the Experimental Evidence. *Psychological Bulletin, 132*(2), 249–268. <http://doi.org/10.1037/0033-2909.132.2.249>
- WHO, W. H. O. (2010). Global recommendations on physical activity for health. *Geneva: World Health Organization, 60*. <http://doi.org/10.1080/11026480410034349>
- Williams, D. M., Dunsiger, S., Ciccolo, J. T., Lewis, B. a., Albrecht, A. E., & Marcus, B. H. (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychology of Sport and Exercise, 9*(3), 231–245. <http://doi.org/10.1016/j.psychsport.2007.04.002>
- Williams, D. M., Dunsiger, S., Jennings, E. G., & Marcus, B. H. (2012). Does affective valence during and immediately following a 10-min walk predict concurrent and future physical activity? *Annals of Behavioral Medicine, 44*(1), 43–51. <http://doi.org/10.1007/s12160-012-9362-9>
- Young, M. D., Plotnikoff, R. C., Collins, C. E., Callister, R., & Morgan, P. J. (2014). Social cognitive theory and physical activity: A systematic review and meta-analysis. *Obesity Reviews : An Official Journal of the International Association for the Study of Obesity, 15*(12), 983–95. <http://doi.org/10.1111/obr.12225>

6 Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources, and that I have explicitly marked all material which has been quoted.

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7 The Publications as they were Published/Submitted

The three publications are listed below and attached. They are in serial order and exactly as they were published or submitted.

1. Antoniewicz, F. & Brand, R. (2014). **Automatic Evaluations and Exercise Setting Preference in Frequent Exercisers.** *Journal of Sport & Exercise Psychology*, 36, 631-636. doi: 10.1123/jsep.2014-0033
2. Antoniewicz, F. & Brand, R. (2015b, subm.). **Learning to like exercising - Evaluative conditioning changes automatic evaluations to exercising and influences subsequent exercising behavior.** (Manuscript submitted for publication to *Journal of Sport and Exercise Psychology*).
3. Antoniewicz, F. & Brand, R. (2015a, subm.). **Dropping out or keeping up? Baseline automatic evaluations of exercise predict exercise adherence to a fourteen-week exercise course.** (Manuscript submitted for publication to *Frontiers in Psychology*).

Automatic Evaluations and Exercise Setting Preference in Frequent Exercisers

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University of Potsdam

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Antoniewicz, A. & Brand, R. (2014). Automatic evaluations and exercise setting preference in frequent exercisers. *Journal of Sport & Exercise Psychology*, 36, 631-636. doi: 10.1123/jsep.2014-0033

as it was accepted for publication.

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AUTOMATIC EVALUATIONS

Abstract

The goals of this study were to test whether exercise-related stimuli can elicit automatic evaluative responses and whether automatic evaluations reflect exercise setting preference in highly active exercisers. An adapted version of the Affect Misattribution Procedure was employed. Seventy-two highly active exercisers (26 years \pm 9.03; 43% female) were subliminally primed (7ms) with pictures depicting typical fitness center scenarios or grey rectangles (control primes). After each prime, participants consciously evaluated the ‘pleasantness’ of a Chinese symbol. Controlled evaluations were measured with a questionnaire and were more positive in participants who regularly visited fitness centers than in those who reported avoiding this exercise setting. Only center exercisers gave automatic positive evaluations of the fitness center setting ($\eta^2_{\text{part.}} = .08$). It is proposed that a subliminal AMP paradigm can detect automatic evaluations to exercising and that, in highly active exercisers, these evaluations play a role in decisions about the exercise setting rather than the amounts of physical exercise. Findings are interpreted in terms of a dual systems theory of social information processing and behavior.

Keywords: exercise, health, Affect Misattribution Procedure (AMP)

Automatic Evaluations and Exercise Setting Preference in Frequent Exercisers

Exercising in a fitness center is not inherently enjoyable for everyone. Some people spontaneously attach themselves to a sociable aerobic class. Others instantly feel uncomfortable because they automatically associate indoor exercising with stuffy rooms. Spontaneous associations may be an important factor in choice of exercise settings and help explain why some people prefer certain settings.

According to many researchers, exercisers have more positive automatic associations with exercise than non-exercisers (e.g. Bluemke, Brand, Schweizer, & Kahlert, 2010; Conroy, Hyde, Doerksen, & Ribeiro, 2010; Hyde, Elavsky, Doerksen, & Conroy, 2012). There were no data on the role that automatic associations play in behavior regulation in highly active exercisers. A profound knowledge of automatic associations in different settings and populations is necessary for the conception of future interventions targeting automatic associations. To target the automatic basis of behaviors has been suggested to be one of the next public health challenges (Marteau, Hollands, & Fletcher, 2012). Aiming to fill this research gap, we used a subliminal priming paradigm to collect data on automatic associations in order to elucidate their role in exercise setting preferences.

Dual System Models as a Theoretical Framework

Dual system models (Chaiken & Trope, 1999) offer a theoretical framework for understanding the role of automatic evaluations in behavior regulation. These models have two interactive but distinct systems of information processing which are able to influence behavior. According to one dual system model, the Reflective Impulsive Model (RIM; Strack & Deutsch, 2004), controlled evaluations are processed by a *reflective system* and automatic evaluations by the *impulsive system*. The reflective system needs to invest self-regulatory resources to activate behavioral schemata (Vohs, 2006) and mainly influences behavior in situations where such resources, for example time and motivation to reflect, are available. Using the reflective system an exerciser might consciously weigh the pros and cons of taking

out membership of a fitness center in a controlled evaluation process, perhaps deciding in favor of fitness center membership, on the grounds that the social commitment involved would encourage him or her to exercise more regularly. The impulsive system is responsible for automatic evaluations arising from associative clusters present in memory. Automatic evaluations do not require self-regulatory resources yet can still influence behavior, for example an exerciser might suddenly feel (Bluemke et al., 2010; Greifeneder, Bless, & Pham, 2011) that he or she dislikes exercising in a fitness center. The RIM posits that information from the impulsive system will dominate when time is scarce or when we are not motivated to deliberate, and will tend to govern our behavior in these circumstances.

The two systems can trigger either convergent or antagonistic behavioral schemata. Friese, Hofmann, and Wiers (2011) used the analogy of a rider on a horse to illustrate this. In the context of a decision the horse (impulsive, automatic processes) may go in the direction planned by the rider (reflective, controlled processes) or bolt in a completely different direction. In the context of a decision about fitness center membership, the exerciser may decide not to pay for membership because an automatic evaluation produces an unpleasant feeling that exercising there is not what he or she is actually after.

Automatic Evaluations and Health Behavior

Automatic evaluations are part of our everyday impulsive thoughts, and there is strong evidence that they influence everyday behavior. Reviewers have summarized evidence for the influence of automatic evaluations on various aspects of health behavior, e.g. eating, drinking, drug abuse and sexual behavior (Hofman, Friese, & Wiers, 2009). For example, Houben and Wiers (2008) used a positive unipolar Implicit Association Test (IAT) to capture automatic evaluations of alcohol drinking. They showed that predictions of drinking behavior are improved by taking into account the interaction between positive automatic evaluations and controlled alcohol-related cognition as well as reflective system processes. In another study a standard IAT was used to demonstrate a significant correlation between chocolate

consumption and automatic evaluation of chocolate, which was moderated by emotional eating status (Ayres, Prestwich, Conner, & Smith 2011). These authors concluded that automatic evaluations of foods and controlled evaluations have an additive influence on eating behavior.

Fewer studies have investigated the role of automatic evaluations in exercise behavior or physical activity. Bluemke et al. (2010) used an affective priming paradigm with a supraliminal 100ms prime stimulus presentation time to demonstrate that evaluations of exercise are related to self-reported amounts of exercise. Calitri, Lowe, Eves, and Bennett (2009) used an Extrinsic Affective Simon Task (EAST) to show that high levels of physical activity were linked with positive automatic evaluations of physical activity, manifested in an attentional bias towards physical activity cues. In this study stimuli remained visible on the screen until the participant responded correctly. Conroy et al. (2010) measured implicit attitudes to physical activity with a Single-Category Implicit Association Test (SC-IAT). When they controlled for predictors of intentional physical activity, for example behavioral intention and efficacy beliefs, implicit attitudes significantly improved model fit in a regression analysis with daily step amounts as dependent variable. Hyde et al. (2012) also used a SC-IAT to examine the stability of automatic evaluations and their relationship to physical activity. They concluded that automatic and controlled evaluations were dynamically interrelated; shifts towards a more positive automatic evaluation of physical activity mirrored increases in physical activity.

The extant findings and their limitations can be summarized as follows. First, so far studies of physical activity (or exercise) and automatic evaluations have focused on demonstrating that positive automatic evaluations of the behavior are associated with greater amounts of physical activity (or exercise); there has been no investigation of the variability of automatic evaluations in highly active individuals. Second, all the abovementioned studies used supraliminal presentation of stimuli to assess automatic evaluations so the possibility

that these evaluations were contaminated by controlled processes from the reflective system cannot be ruled out.

The Present Study

We drew on experimental methodology introduced by Murphy and Zajonc (1993) to provide a more convincing demonstration of the automaticity of affect triggered by exercise-related stimuli. These authors asked participants to rate their ‘liking’ of a Chinese ideograph immediately after subliminal presentation (4ms duration) of affective and non-affective primes (smiling or angry faces vs. random polygons). Participants were not told about the priming. The subliminal primes produced systematic alterations in participants’ evaluations of ideographs; those preceded by angry faces tended to be disliked and those preceded by smiling faces tended to be liked.

Some years later Payne, Cheng, Govorun, and Stewart (2005) introduced a modification of this test, the *Affect Misattribution Procedure* (AMP) using supraliminal presentation (75ms) of stimuli e.g. a baby (positive), a gun (negative), and a binary pleasant vs. unpleasant response format rather than a five-point rating scale. Participants were instructed to ignore the prime stimuli and only rate the ideographs. Payne, Hall, Cameron, and Bishara (2010) reported evidence for a three-stage process of affect misattribution in which an affective response to the true source is followed by an affective response to the apparent source, before the apparent source is confused with the real source.

At least two studies have used the AMP to draw conclusions about impulsive affective reactions to health behaviors. Payne, Govorun, and Arbuckle (2008) showed that AMP scores predicted participants’ drink choice (beer vs. water), high scorers i.e. participants with favorable alcohol associations reported drinking more alcohol and more often than participants with low AMP scores. Hofmann, van Koningsbruggen, Strobe, Ramanathan, and Aarts (2010) found that priming to tempting food amplified dieters’ positive affective responses in the AMP and concluded that this made it harder for them to resist tempting food.

The first goal of the present study was to provide evidence for the existence of automatic exercise-related evaluations. The second goal was to provide evidence for frequent fitness center visitors' positive automatic evaluations of this exercise setting. This hypothesis was derived from basic social cognition research, which has shown that relatively stable automatic evaluations are rooted in recurrent experiences in specific behavioral domains (Strack & Deutsch, 2004). Frequent positive experiences in fitness centers should result in positive automatic evaluations of that setting, which in turn might influence behavioral choices and setting preferences.

We used an AMP with subliminal prime presentation to demonstrate the existence of genuinely automatic exercise-related evaluative responses. We predicted that highly active exercisers with a preference for exercising in fitness centers would show a more positive automatic response to fitness center primes than exercisers who reported avoiding that exercise setting. The same is expected for the participants' controlled evaluations when they are measured with a questionnaire.

Method

Participants

Seventy-five graduate sport and exercise students were recruited as participants in exchange for course credit. Three of them did not finish the test or were later excluded because they were able to read and understand Chinese ideographs. Data from 72 participants (31 female, 41 male; mean age 26.00 years \pm 9.03) were analyzed. On average participants spent 304.91 minutes per week ($SD = 190.46$; range = 60 - 900 mins) exercising. Based on this level of reported exercise, the sample included highly active participants as intended. Thirty-four participants reported visiting the university's indoor fitness center regularly (*center exercisers*). The remainder reported avoiding this type of exercise setting (*comparison subjects*). Reported weekly exercise time was similar ($t[68] = 0.66, p < .05$) for center exercisers ($M = 320.31$ mins, $SD = 180.80$) and comparison subjects ($M = 290.37$ mins, $SD =$

200.60). There were also no group differences in age ($t[70] = 0.34, p > .05$) or gender ($\chi^2[1] = 0.09, p > .05$).

Design, Procedure, and Materials

All participants were tested using an adapted version of the AMP (Payne et al., 2005). Inquisit™ 2.0 software was used for stimulus presentation and response logging. Primes were presented in the middle of the screen. A 7ms stimulus presentation time was used so that stimuli were perceived without subjects becoming aware of them and ensure that the affective reaction was automatic (Winkielman, Berridge, & Wilbarger, 2005). Primes were followed by 1000ms presentations of Chinese ideographs (targets). There was a 125ms interval between presentation of primes and stimuli. Each target was followed by a mask which remained on the screen until the participant had evaluated the target as either pleasant or unpleasant by pressing the ‘E’ or ‘I’ key respectively on a standard QWERTZ-keyboard. Participants completed 10 practice trials followed by 48 test trials.

The primes were 20 photographs depicting typical fitness center scenarios e.g. using a stepper in an aerobic class; they did not contain any specific affective content such as smiling faces. An example prime is given in Figure 1. The primes were pretested on an unrelated sample of subjects (19 female and 14 male graduate sport and exercise university students, 29.39 years \pm 10.25) who used a nine-point Likert scale (1 = ‘not pleasant at all’ to 9 = ‘very pleasant’) to rate them. The pictures were presented in randomized orders and displayed without time restriction. The range of the mean scores was narrow, from 5.12 to 7.21, but they differed with regard to valence, $F(19) = 5.87, p < .01, \eta^2_{\text{part.}} = .16$. The pictures evoke (different) responses with regard to valence and are not evaluated as extremely pleasant or unpleasant. Therefore they are appropriate for use in the AMP paradigm. Twenty grey rectangles were used as control primes. Targets were drawn from a pool of 200 Chinese ideographs (Payne et al., 2005). Sequences of prime-target combinations were randomized within and between subjects. All participants were exposed to equal numbers of fitness center

and control primes. Primes were presented with replacement, allowing only one prime repetition in order to minimize learning effects.

The AMP score is the difference between the proportion of ideographs evaluated positively after each type of prime (Payne et al., 2005). AMP scores greater than 1 indicated that ideographs were more likely to be evaluated positively following a fitness center prime, scores lower than 1 indicated that a positive ideograph rating was more likely after a control prime.

All participants started by working through the adapted AMP, then completed an online questionnaire to assess their controlled evaluation of exercising in fitness centers. The assessments were ordered in this way to ensure that the procedure for assessing controlled evaluations could not bias automatic evaluations. Controlled evaluations were assessed with the question ‘How pleasant is exercising in a fitness center for you?’, with responses given on a nine-point Likert scale ranging from 1 = ‘not pleasant at all’ to 9 = ‘very pleasant’. Habitual exercise volume was assessed with the single item question ‘I usually exercise ___ times per week for ___ minutes/session’. Basic socio-demographic information (age and gender) was requested at the end of the procedure.

The data were analyzed using a one-way multivariate analysis of variance (MANOVA) with *z*-standardized automatic and controlled evaluations as dependent variables, and exercise setting preference as a factor. The deviation of AMP scores from 1 in the two groups (center exercisers and comparison subjects) was assessed using separate one-sample *t*-tests to demonstrate that the observed relative preference scores could not be attributed to random variation in the proportion of targets attracting a positive rating. Pearson’s correlation coefficient was used to assess the association between automatic and controlled evaluations.

Results

Both automatic and controlled evaluations of the fitness center setting were more positive in fitness center exercisers (automatic $M = 1.15$, $SD = 0.39$; controlled $M = 6.85$ $SD =$

1.65) than in comparison subjects (automatic $M = 0.96$, $SD = 0.24$; controlled $M = 4.58$, $SD = 2.05$). Z-standardized differences are depicted in Figure 2.

The AMP score differed significantly from 1 in fitness center exercisers ($t[33] = 2.26$, $p < .05$, $d = 0.79$) but not in the comparison group ($t[33] = -1.00$, $p > .05$). Correlations between automatic and controlled evaluations were low and not significant either in center exercisers ($r = -.20$, $p > .05$) or in the comparison group ($r = -.08$, $p > .05$).

A significant group effect was found by calculating a MANOVA, indicating that fitness center exercisers differed from the comparison group on at least one type of evaluation, $F(2, 69) = 18.21$, $p < .001$, $\eta^2_{\text{part.}} = .35$. Using a test of between-subjects effects, a medium-sized significant group effect on automatic evaluations ($F[1, 70] = 6.35$, $p < .05$, $\eta^2_{\text{part.}} = .08$) and a large and significant group effect on controlled evaluations ($F[1, 70] = 26.46$, $p < .001$, $\eta^2_{\text{part.}} = .27$) was revealed.

Discussion

The first aim of the present study was to provide evidence for the existence of genuinely automatic evaluations related to exercise. The statistical analyses revealed significant affect misattributions after subliminal exposure to fitness center primes. Affective reactions in the AMP represent evaluative judgments (Payne et al., 2005), and the very short prime presentation time (7ms) means that they qualify as automatic evaluations produced by the impulsive system (Strack & Deutsch, 2004). The present study is the first exercise-related study using subliminal stimulus presentation. In the context of the ongoing debate about how to measure automatic evaluative processes (De Houwer, Teige-Mocigemba Spruyt, & Moors, 2009) this is a major strength. The second aim was to test the hypothesis that automatic evaluations are indicative of exercise setting preferences in highly active exercisers. We found that significant affect misattributions occurred only in fitness center users. Together with the finding that explicit rating (controlled evaluation) of exercising in a fitness center was more negative in the comparison group (those avoiding fitness centers), this indicates that

a positive automatic evaluation of an exercise setting reflects a liking for that setting.

Positive automatic evaluations of exercise can be used to discriminate exercisers from non-exercisers (e.g. Bluemke et al., 2010), and people with physical active lifestyles from rather inactive people (e.g. Calitri et al., 2009; Conroy et al., 2010). Our findings extend this body of evidence as they show that automatic evaluations can be used to discriminate between types of highly active exercisers.

We anticipated that more sharply defined mental representations would be associated with very specific types of exercising than with less structured forms of physical activity. We thus chose to investigate one specific type of exercising, which is fitness center exercising. We used a sample of frequent exercisers – who would therefore have experienced positive evaluative reactions to their preferred exercise settings repeatedly – because we expected to find clearly pronounced automatic evaluations in these people. By investigating a very specific form of exercise in a group with high exposure to that form of exercise we hoped to maximize the magnitude and discriminability of automatic evaluations. Future research is necessary to determine whether the findings obtained from this sample generalize to less clearly defined settings and other populations.

Hyde et al. (2012) proposed that automatic evaluations of physical activity consist of stable and instable components. They posited that recurrent evaluative reactions to experiences initially affect the instable component, which may subsequently affect the stable component. It might be possible to manipulate the instable component of automatic evaluation of a particular form of physical activity using evaluative conditioning techniques (Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010) to motivate people to start doing that particular activity. Future research should investigate whether recurrent initiation of a behavior and positive immediate automatic evaluations of it lead to a more positive stable automatic evaluation of the behavior. Maybe automatic evaluations represent an adherence factor for exercise regimes that could be fostered by means of intervention in the future

(Marteau et al., 2012).

Basic social cognition research suggests that outputs from the impulsive and the reflective systems contribute additively to behavioral choices (Perugini, Richetin, & Zogmaister, 2010). In this study exercisers' controlled and automatic evaluations of exercise settings were not significantly correlated. Previous studies have already demonstrated that implicit and explicit attitudes (i.e. automatic and controlled evaluations) to physical activity can be unrelated (Hyde, Doerksen, Ribeiro, & Conroy, 2010). In our view, these findings provide additional evidence to support the contention that future health and exercise interventions should target both controlled and automatic evaluations (Marteau et al., 2012).

There are limitations pertaining to this work that need to be addressed. It is possible that the lack of correlation between automatic and controlled evaluations was due to methodological variance as we used different methods to assess automatic evaluations (reaction time-based testing on a computer) and controlled evaluations (self-report questionnaires). The relatively low power of the study (72 participants) may also have been a factor. Future studies should investigate the behavioral consequences of both correlation and lack of correlation between automatic and controlled evaluations. Finally, one of the most limitations to our data is that it is impossible to conclude from them whether a liking for exercising in fitness centers was a result of repeated previous positive automatic evaluations whilst regularly exercising in this setting, or whether individuals chose to exercise in fitness centers on the basis of a prior positive automatic evaluation of the setting. Little is known about causal relationships between automatic evaluations and exercise behavior, and future research should use experimental designs suited to investigating what are probably complex interactions between the two variables.

In spite of these limitations, we show that positive automatic evaluations related to exercise can be detected in exercisers and that they provide information about highly active exercisers' preferences. Repeated positive automatic reactions could result in improvements

in the relatively stable automatic attitude to specific forms of exercise and thus serve as an adherence factor. In frequent exercisers automatic evaluations might thus play a role in qualitative behavioral regulation, i.e. choice of exercise setting or forms of exercise, rather than in quantitative behavioral regulation e.g. total exercise time per week.

References

- Ayres, K., Prestwich, A., Conner, M., & Smith, P. (2011). Emotional eating moderates the relationship between implicit measures of attitudes and chocolate consumption. *European Journal of Personality, 25*, 317-325. doi: 10.1002/per.793
- Bluemke, M., Brand, R., Schweizer, G., & Kahlert, D. (2010). Exercise might be good for me, but I don't feel good about it: Do automatic associations predict exercise behavior? *Journal of Sport & Exercise Psychology, 32*, 137-153.
- Calitri, R., Lowe, R., Eves, F. F., & Bennett, P. (2009). Associations between visual attention, implicit and explicit attitude and behavior for physical activity. *Psychology & Health, 24*, 1105-1123. doi: 10.1080/08870440802245306.
- Chaiken, S. & Trope, Y. (Eds.) (1999). *Dual-process theories in social psychology*. New York: Guilford.
- Conroy, D. E., Hyde, A. L., Doerksen, S. E. & Ribeiro, N. F. (2010). Implicit attitudes and explicit motivation prospectively predict physical activity. *Annals of behavioral medicine, 39*, 112-118. doi: 10.1007/s12160-010-9161-0
- De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin, 135*, 347-368.
- Friese, M., Hofmann, W., & Wiers, R. W. (2011). On taming horses and strengthening riders: Recent developments in research on interventions to improve self-control in health behaviors. *Self and Identity, 10*, 336-351. doi: 10.1080/15298868.2010.536417
- Greifeneder, R., Bless, H., & Pham, M.T. (2011). When do people rely on affective and cognitive feelings in judgment? A Review. *Personality and Social Psychology Review, 15*, 107-141. doi: 10.1177/1088868310367640
- Hofmann, W., De Houwer, J., Perugini, M., Baeyens, F., & Crombez, G. (2010). Evaluative conditioning in humans: A meta- analysis. *Psychological Bulletin, 136*, 390-421. doi:

10.1037/a0018916

- Hofmann, W., Friese, M., & Wiers, R. W. (2009). Impulsive versus reflective influences on health behavior: A theoretical framework and empirical review. *Health Psychology Review, 1*, 1-27. doi: 10.1080/17437190802617668
- Hofmann, W., van Koningsbruggen, G. M., Stroebe, W., Ramanathan, S., & Aarts, H. (2010). As pleasure unfolds: hedonic responses to tempting food. *Psychological Science, 21*, 1863-1870. doi: 10.1177/0956797610389186
- Houben, K. & Wiers, R. (2008). Implicitly positive about alcohol? Implicit positive associations predict drinking behavior. *Addictive Behaviors, 33*, 979-986. doi: 10.1016/j.addbeh.2008.03.002
- Hyde, A. L., Doerksen, S. E., Ribeiro, N. F., & Conroy, D. E. (2010). The independence of implicit and explicit attitudes toward physical activity: Introspective access and attitudinal concordance. *Psychology of Sport and Exercise, 11*, 387-393. doi: 10.1016/j.psychsport.2010.04.008
- Hyde, A. L., Elavsky, S., Doerksen, S. E., & Conroy, D. E. (2012). The stability of automatic evaluations of physical activity and their relations with physical activity. *Journal of Sport & Exercise Psychology, 34*, 715-736.
- Krosnick, J. A., Judd, C. M., & Wittenbrink, B. (2005). The measurement of attitudes. In D. Albarracín, T. B. Johnson, & M. P. Zanna (Eds.), *Handbook of Attitudes* (pp. 21-76). New York, NY: Lawrence Erlbaum Associates Publishers.
- Marteau, T. M., Hollands, G. J., & Fletcher, P. C. (2012). Changing human behavior to prevent diseases. *Science, 337*, 1492-1495. doi:10.1126/science.1226918
- Murphy, S. T. & Zajonc, R. B. (1993). Affect, cognition and awareness: affective priming with optimal and suboptimal stimulus exposures. *Journal of Personality and Social Psychology, 64*, 723-739. doi: 10.1037/0022-3514.64.5.723
- Payne, B. K., Cheng, C. M., Govourun, O., & Stewart, B. D. (2005). An inkblot for attitudes:

affect misattribution as implicit measurement. *Journal of Personality and Social*

Psychology, 89, 277-293. doi: 10.1037/0022-3514.89.3.277

Payne, B. K., Hall, D., Cameron, C. D., & Bishara, A. J. (2010). A process model of affect

misattribution. *Personality and Social Psychological Bulletin*, 36, 1397-1408.

doi:10.1177/0146167210383440

Payne, B. K., Govorun, O., & Arbuckle, N. L. (2008). Automatic attitudes and alcohol: Does

implicit liking predict drinking? *Cognition and Emotion*, 22, 238-271. doi:

10.1080/02699930701357394

Perugini, M., Richetin, J., & Zogmaister, C. (2010). Prediction of Behavior. In B. Gawronski,

& B. K. Payne (Eds.), *Handbook of Implicit Social Cognition* (pp. 255-277). New

York, NY: The Guilford Press.

Strack, F. & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior.

Personality and Social Psychology Review, 8, 220-247. doi:

10.1207/s15327957pspr0803_1

Vohs, K. D. (2006). Self-regulatory resources power the reflective system: evidence from five

domains. *Journal of Consumer Psychology*, 16, 215-221. doi:

10.1207/s15327663jcp1603_3

Winkielman, P., Berridge, K. C., & Wilbarger, J. L. (2005). Unconscious affective reactions

to masked happy versus angry faces influence consumption behavior and judgments of value. *Personality and Social Psychology Bulletin*, 31, 121-135. doi:

10.1177/0146167204271309

AUTOMATIC EVALUATIONS

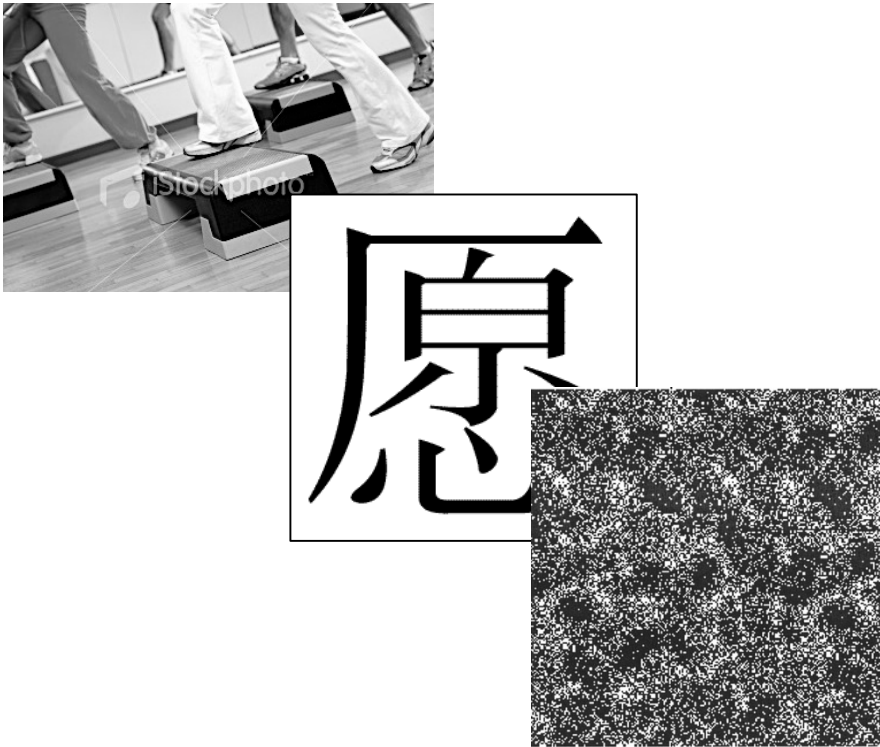


Figure 1. Experimental set-up in the affect misattribution procedure.

CHANGING AUTOMATIC EVALUATIONS

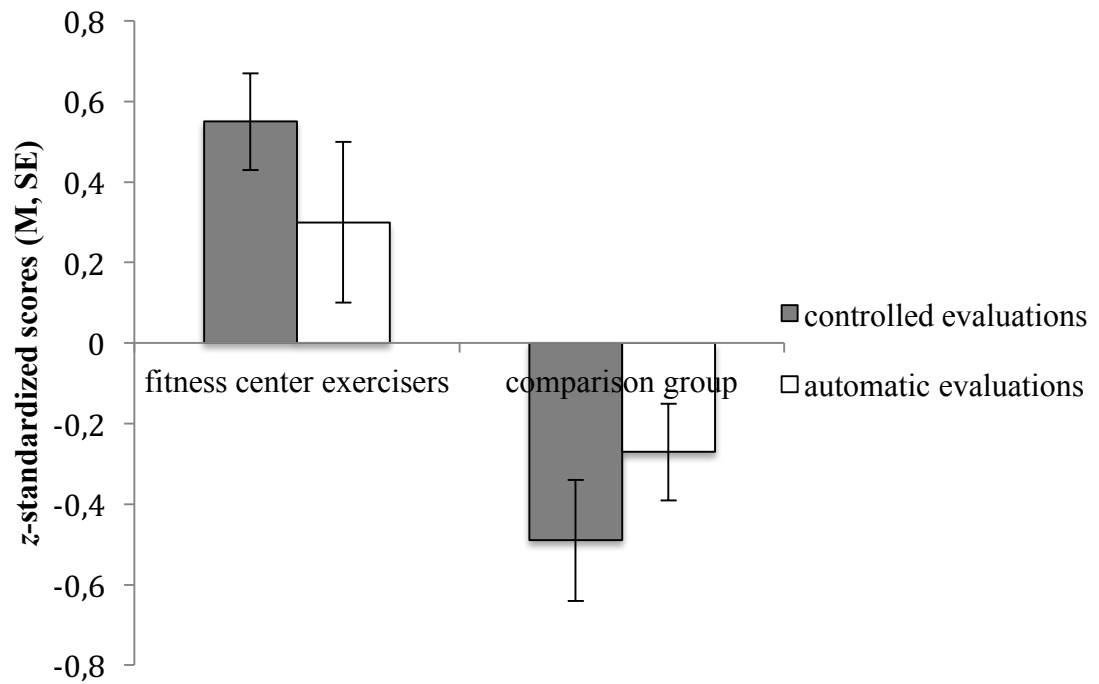


Figure 2. Group differences in controlled and automatic evaluations of exercising in fitness centers. Controlled evaluations were measured by questionnaire; automatic evaluations were assessed with an Affect Misattribution Procedure (Payne et al., 2005).

Learning to Like Exercising: Evaluative Conditioning Changes Automatic Evaluations of
Exercising and Influences Subsequent Exercising Behavior.

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Antoniewicz, F. & Brand, R. (2016). Learning to Like Exercising: Evaluative Conditioning
Changes Automatic Evaluations of Exercising and Influences Subsequent Exercising Behavior.
Journal of Sport & Exercise Psychology, doi: 10.1123/jsep.2015-0125

as it was accepted for publication.

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Abstract

This multi-study report used an experimental approach to alter automatic evaluations of exercise (AEE). First, we investigated the plasticity of AEE (study 1). A computerized evaluative conditioning task was developed that altered the AEE of participants in two experimental groups (acquisition of positive/negative associations involving exercising) and a control group ($\eta^2_{\text{part.}} = .11$). Second, we examined connections between changes in AEE and subsequent exercise behavior (chosen intensity on a bike ergometer; study 2) in individuals that were placed in groups according to their baseline AEE. Group differences in exercise behavior were detected ($\eta^2_{\text{part.}} = .29$). The effect was driven by the performance of the group with pre-existing negative AEE that acquired more positive associations. This illustrates the effect of altered AEE on subsequent exercise behavior and the potential of AEE as a target for exercise interventions.

Keywords: exercise, manipulation, evaluative conditioning, automatic evaluations

Learning to Like Exercising: Evaluative Conditioning Changes Automatic Evaluations of Exercising and Influences Subsequent Exercising Behavior.

Imagine going for a bike ride every week. Some readers will immediately associate this activity with pleasure, fun and health – and start planning this weekend’s ride! Others won’t. This example illustrates how different automatic evaluations of exercise, which we make frequently in everyday life, can be and that positive automatic evaluations are connected with behavior. It also raises a question: Are positive automatic evaluations of exercise (AEE) a cause or consequence of regular exercise? Although there is growing interest in the relationship between AEE and physical activity behavior (e.g. Brand & Schweizer, 2015; Hyde, Doerksen, Ribeiro, & Conroy, 2010), little is known about the causality of the postulated link.

Recent research has demonstrated an association between positive AEE and exercise volumes (Bluemke, Brand, Schweizer, & Kahlert, 2010), illustrated the influence of AEE on choice of exercise setting (Antoniewicz & Brand, 2014), revealed the impact of automatic self-schema evaluation (Banting, Dimmock, & Lay, 2009) and demonstrated that situated decisions mediate the relationship between AEE and exercise behavior (Brand & Schweizer, 2015). All these studies converge on at least one important conclusion: positive AEE are positively correlated with exercise behavior and should therefore be promoted. Other recent studies have drawn similarly positive conclusions about the potential of changing in automatic attitudes to exercise to influence exercise behavior (Hyde, Elavsky, Doerksen, & Conroy, 2012; Marteau, Hollands, & Fletcher, 2012; Sheeran, Gollwitzer, & Bargh, 2013).

The aim of this study was to provide experimental evidence that changing AEE can change subsequent exercise behavior. We conducted two experiments investigating (1) a systematic method to induce or encourage positive AEE and (2) the immediate effects of

manipulations of AEE on exercise behavior.

Dual-process Models as a Theoretical Framework

Dual process theories of social cognition provide a theoretical framework for understanding automatic evaluations and their relationship to behavior (Chaiken & Trope, 1999). These theories distinguish between two types of cognitive processing, automatic processing (also referred to as type 1, impulsive or associative processing) and controlled processing (also referred to as type 2, reflective or propositional processing; Evans & Stanovich, 2013; Gawronski & Bodenhausen, 2007; Strack & Deutsch, 2004). Type 2 processes operate comparatively slowly and more resources – e.g. time or motivation – are needed if they are to be reflected in behavior. Turning to our introductory example, conscious deliberation about the potential health consequences of regular bike rides would be an example of type 2 processing. Type 1 – automatic – processes are fast and less effortful and do not require self-regulatory resources. Returning again to our example, Type 1 processes might lead an individual to set out on a bike ride as a spontaneous, immediate consequence of the positive associations cycling has for him or her, especially in situations when he or she is unwilling or unable to deliberate.

Automatic Evaluations of Physical Activity and Exercise

AEE has been shown to be related to self-reports of exercise volume (Bluemke et al., 2010), assessments of AEE using an evaluative priming paradigm indicated that exercisers had more positive AEE than non-exercisers. The relationship between physical activity and AEE was analyzed by Calitri, Lowe, Eves and Bennett (2009); they reported a positive association between self-reported physical activity history and AEE assessed with an extrinsic affective Simon task. Eves, Scott, Hoppé and French (2007) used an evaluative priming task to assess AEE and asked participants to recall their physical activity over the

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previous week. They found that participants who had been very active during the previous week had positive AEE, whereas less active participants exhibited rather negative AEE.

Another study using an evaluative priming task (Brand & Schweizer, 2015) demonstrated that situated decisions about behavioral alternatives (exercising or other activities) mediated the relationship between AEE and exercise behavior.

Conroy, Hyde, Doerksen and Ribeiro (2010) assessed AEE using a Single-Category Implicit Association Test (SC-IAT) and demonstrated that taking into account AEE improved predictions of daily step counts, after controlling for social cognitive parameters such as efficacy beliefs. Antoniewicz and Brand (2014) assessed AEE with an affect misattribution procedure (AMP) in a study which investigated the relationship between AEE and exercise setting preference in frequent exercisers. Following subliminal presentation of fitness center cues exercisers for whom this was the preferred exercise setting had positive AEE, whereas exercisers who reported an explicit dislike of fitness centers did not. Using a SC-IAT Hyde et al. (2012) showed that the associations between AEE and physical activity were complex and temporally variable in part. Participants whose initially negative AEE improved over a one-week period demonstrated a bigger increase in physical activity than those whose AEE remained negative.

We draw a number of conclusions from these recent studies. Researchers have used different (usually reaction-time based) methods to assess AEE. Positive AEE are associated with greater amounts of physical activity than negative or neutral AEE and the relationship between AEE and exercise behavior appears similar. AEE has been shown to be correlated with self-reports of exercise and physical activity as well as with objective measurements of physical activity. AEE have been shown to predict future physical activity and are also related to physical activity history. AEE consist of both stable and unstable components. In

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highly frequent exercisers AEE is related to setting preference and to situated decisions about exercising in ambivalent situations. The extant research has consistently shown that AEE are associated with exercise behavior, but there are no data which allow us to draw conclusions about the direction of the relationship and none of the studies published to date have systematically manipulated AEE.

We endorse the conclusion drawn by Nosek, Hawkins and Frazier (2011); the time seems right for extension and innovation in this area of research, in particular for experimental research based on manipulations of AEE.

Altering Automatic Evaluations Using Evaluative Conditioning

Learning theory assumes that repeatedly pairing a specific behavior with positive stimuli can shift evaluations of that behavior in a positive direction. People who are physically inactive may not experience this contingency, or may not experience it sufficiently frequently, and may therefore benefit from the exposure to such contingencies that evaluative conditioning (EC) procedures provide.

Hofmann, De Houwer, Perugini, Baeyens and Crombez (2010, p. 390) described EC as “a change in the liking of a stimulus (conditioned stimulus; CS) that results from pairing that stimulus with other positive or negative stimuli (unconditioned stimulus; US).” In the terminology of learning theory pleasurable feelings which follow, or are associated with, exercise represent a form of positive reinforcement for exercise behavior. Exercise-related EC procedures pair exercise (the CS) with positive stimuli (the US) thereby altering the associations evoked by exercise, and increasing the subject’s propensity for exercise. EC is of interest in the context of efforts to promote health and exercise because it potentially offers a way of altering behavior as well as attitudes to, or evaluations of exercise.

So far only very few studies have investigated the impact of EC on health-related

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automatic evaluations and health behavior. Walsh and Kiviniemi (2014) manipulated participants' automatic evaluations of fruit by repeatedly pairing pictures of apples or bananas with word and picture stimuli evoking positive, negative or neutral affect. Participants in the positive EC condition were three times more likely to select the piece of fruit than those in the negative EC condition and twice as likely to do so compared with those in the control condition. In a similar study by Hollands, Prestwich and Marteau (2011) participants were presented with images of energy-dense snack foods e.g. chocolate biscuits (the CS) followed by a blank screen (control condition) or aversive body images (intervention condition; the US). After this EC treatment participants in the intervention condition had more negative automatic evaluations; the largest effect was observed in participants whose initial automatic evaluation of the snacks had been rather positive. Participants in the intervention group were also more likely to choose a fruit in the food choice task. Houben, Havermans and Wiers (2010) investigated whether EC could alter automatic evaluations of alcohol and change drinking behavior. After the EC treatment participants in the experimental condition had more negative automatic evaluations of alcohol and consumed less alcohol than control participants.

In summary, these findings indicate that EC has potential as a technique for altering AEE and that it might be capable of influencing subsequent exercise behavior. Corresponding results in exercise research would provide evidence to support the argument for developing exercise and health promotion programs which target AEE *directly* (Marteau et al., 2012).

This Research

We conducted two studies which were designed to address the gaps in understanding and evidence which we have identified above. Our first study investigated whether specific exercise-related EC was capable of altering AEE. We hypothesized that systematically

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pairing exercise-related CS with US which evoke pleasant feelings and bodily sensations, and non-exercise related CS with US which evoke unpleasant feelings and bodily sensations would induce positive AEE.

The second study investigated the behavioral consequences of AEE manipulation and was designed to provide information about the causal relationship between AEE and exercise behavior. We hypothesized that learning positive AEE would influence subsequent observable behavior and predicted that EC would influence choice of intensity in a subsequent bike ergometer task: we anticipated that the positive AEE group would select higher intensities than the control group whilst the negative AEE group would selected lower intensities.

Study 1: Effects of Evaluative Conditioning on Automatic Evaluations of Exercise

Positive AEE are correlated with exercise, so it seems reasonable to seek to improve AEE as a means of increasing exercise behavior. Other health-related research indicates that EC (in our study this involved systematically pairing images designed to evoke positive or negative affect with images of exercise) is an effective method of altering AEE. EC is capable of shifting automatic evaluations in both directions e.g. towards a more positive evaluation of fruit (Hollands et al., 2011) or towards a more negative evaluation of alcohol (Houben et al., 2010). To date EC has not been used in the context of automatic evaluations to exercise. Study 1 was therefore designed to assess the effect of an exercise-specific EC task on AEE. We hypothesized that AEE are amenable to manipulation and hence that the EC treatment would produce group differences in AEE. We predicted that after the EC treatment (i) the group subjected to positive EC, i.e. the pairing of exercise-related stimuli with positive images – the acquisition of positive associations (APA) group – would have more positive AEE than the control group and (ii) the group subjected to negative EC, i.e. pairing of

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exercise-related stimuli with negative images – the acquisition of negative associations (ANA) group – would have more negative AEE than the control group.

Method

Participants

Sixty-five undergraduate sports students participated in return for course credit. The data for one participant were incomplete, so the final sample consisted of 64 participants (27 women; M age = 23.02 ± 2.44 years). Descriptive statistics of the sample are given in Table 1. Participants in the experimental groups (APA and ANA: exercise-related stimuli systematically paired with images designed to evoke positive or negative affect respectively) and the control group (exercise-related stimuli paired with neutral images) did not differ with regard to age, $F(2,61) = 1.70, p = .19, \eta^2_{\text{part.}} = .05$ or gender, $\chi^2(2, N = 64) = 1.41, p = .49, \phi = .15$. Self-reports of weekly amount of exercise and time spent for training and practice in university courses (minutes per week) indicated that participants in all groups were similarly highly active, $F(2,61) = 0.84, p = .44, \eta^2_{\text{part.}} = .03$.

Materials and Measures

Automatic evaluations. AEE was assessed using a SingleTarget-IAT (Bluemke & Friese, 2008). This test measures the strength of the associations between a target concept (in this case *exercise*) and attributes falling into two broad evaluative categories (in this case *good* and *bad*) using a computerized classification task.

In this ST-IAT the attribute words were related to feelings or bodily sensations (see Bluemke et al., 2010). The words used were ‘beautiful’, ‘fantastic’, ‘magnificent’, ‘pleasurable’, ‘happy’, ‘delightful’ (*good*) and ‘horrible’, ‘tragic’, ‘awful’, ‘agonizing’, ‘painful’, ‘terrible’ (*bad*). The target concept (*exercise*) was represented by six photographs depicting typical exercise scenarios (e.g. doing push-ups in a fitness center). Target images

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contained no specific affective content, e.g. smiling faces, and were pre-tested on an unrelated sample of participants. Words and pictures were paired randomly.

In the first phase of the task (a block of 20 practice trials) participants were required to classify attribute words as 'good' or 'bad' by pressing the 'E' or 'I' key respectively on a standard QWERTZ keyboard. Each stimulus remained in the center of the screen until the participant categorized it. The inter-trial interval was 250ms. In the next two blocks participants were asked to assign attribute words and target pictures to one of two categories which related 'exercise' either to 'good' or 'bad' (e.g. exercise+good vs. bad or exercise+bad vs. good). Each block consisted of 40 trials and was preceded by a block of 20 practice trials. When a stimulus was wrongly classified a red 'X' was displayed and the participant had to correct his or her response before the next trial began. Inquisit™ 2.0 software was used to control stimulus presentation and log responses and reaction times. Participants were instructed to respond as quickly and accurately as possible.

The principle behind the ST-IAT is that people will respond more quickly and more accurately to stimulus configurations which represent strongly associated concepts. Fast responses to exercise stimuli in the exercise+good block indicate a strong association between the concept of 'exercise' and the evaluation 'good'. We calculated between-block difference score (*D*-Score; Greenwald, Nosek & Banaji, 2003) as an indicator of AEE. *D*-Scores can range from -2 to +2; positive values represent more positive AEE.

Evaluative conditioning. We used six exercise-related CS (images of exercisers engaged in various individual and team sports e.g. swimming and basketball) and six non-exercise-related CS (images of individuals or groups engaged in a non-physical activity e.g. watching TV or playing on a game console). None of the images had any affective content (e.g. people with happy or unhappy faces). In contrast the six positive and six negative US

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depicted people displaying strong positive or negative feelings, or experiencing pleasant or unpleasant bodily sensations (e.g. relaxing in the sun, feeling the tension in one's neck).

Twelve colored rectangles served as neutral stimuli. All stimuli were pretested on an unrelated sample.

Participants were told that they would see a sequence of pictures, and that pictures would be presented in one of the four quadrants of the screen. They were instructed to use the computer mouse to click on the first picture presented (CS) and told that this would result in a second picture (US) being displayed briefly (for 400ms) in the same quadrant as the first. One hundred and twenty random CS-US pairs were presented in random order. Sixty trials involved exercise-related CS and 60 trials involved non-exercise-related CS. The CS were systematically paired with US pictures representing positive or negative feelings or bodily sensations (APA; ANA) or neutral stimuli (control condition). For the APA group exercise-related CS were always paired with positive US and non-exercise-related CS with negative US; the opposite contingencies were used for the ANA group. For the control group both types of CS were paired with the neutral US (the colors).

Procedure

This study was carried out in accordance with the recommendations of the ethical committee of the University of Potsdam. All participants were tested individually in the laboratory and gave written informed consent before the study started. Participants were assigned to one of the three EC groups by simple randomization. Participants then started to work through their EC task (APA, ANA or control condition). Next they completed the ST-IAT. Finally they completed a questionnaire, which assessed habitual exercise volume with a single question (see Antoniewicz & Brand, 2014; Brand & Schweizer, 2015) and collected basic socio-demographic information (age and gender).

Tests and Statistical Methods of Analysis

The dependent variable was AEE as measured with the ST-IAT. The data of two participants in the APA condition, one in the ANA and one in the control condition were excluded because of outlier values in the ST-IAT *D*-Score which meant that 60 participants were included in the analysis.

Group differences were assessed using one-way analysis of variance with *D*-Score and mean block reaction times as dependent variables and the EC condition as a between-subjects factor. Planned contrasts reflecting our hypotheses about group differences were added to the statistical model (ANOVA).

Results

Analysis of ST-IAT *D*-Scores revealed a large group effect on AEE, $F(2,57) = 3.51, p = .04, \eta^2_{\text{part.}} = .11$. Planned contrasts indicated that there was a difference between the control group and the APA group, $t(57) = 2.59, p = .01, d = 0.77$, but not between the control group and the ANA group, $t(57) = 1.58, p = .12, d = 0.05$ (descriptive data are given in Table 2).

In-depth analyses revealed that the group effect on ST-IAT *D*-Score was mainly driven by longer mean reaction times in the test block combining ‘exercise’ and ‘bad’, $F(2,57) = 3.22, p = .05, \eta^2_{\text{part.}} = .10$, not in the block combining ‘exercise’ and ‘good’, $F(2,57) = 0.83, p = .44, \eta^2_{\text{part.}} = .03$. Planned contrasts of mean reaction times in the exercise+bad block revealed a difference between the APA and control groups, $t(57) = 2.40, p = .02, d = 0.83$, but not between the ANA and control groups, $t(57) = 0.22, p = .83, d = 0.06$.

Discussion

In line with our predictions the EC task had a medium to large effect on participants’

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AEE. After the EC task participants in the APA group had the most positive *D*-Score; these participants' reaction times were longer than reaction times in the control group when exercise pictures were paired with words indicating negative feelings and bodily sensations, whereas these associations remained unaffected in the ANA group and were similar to those of the control group. Because the ST-IAT only involves associating stimuli related to one target concept with attribute stimuli related to the evaluative categories it allows one to distinguish more precisely between the origins of positive or negative AEE effects than, for example, standard IATs with two target concepts (Greenwald, McGhee & Schwartz, 1998).

The finding that only one of the two predicted contrasts – the difference between the APA condition and the control group – reached significance is consistent with the results of at least two other studies (Hollands et al., 2011; Houben et al., 2010). These studies also found that EC was only effective in shifting automatic evaluations towards the healthy pole e.g. making attitudes to alcohol more negative, reducing the preference for energy-dense snacks. Our data indicate that systematic reinforcement of the association between (here) exercise and positive feelings leads to a complementary relative dissociation (i.e. a weakening) of the association between exercise and negative feelings. In other words although the AEE of sport and exercise students did not get more positive in the phase combining 'exercise' and 'good' in the ST-IAT (for which a ceiling effect is the most likely explanation), they were slower to categorize stimuli when exercise-related stimuli were paired with a negative attribute.

This corresponds well with our explanation – sample characteristics – for the relatively neutral *D*-Score of participants in the control group. Sports students' most likely global evaluation of exercising is positive. But according to personal preferences some of the courses all sports students have to visit as a part of their studies can entail negative

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associations (e.g. a student who loves playing tennis but is very unhappy with now being compelled to learn gymnastics). Thus especially in samples of sports students, positive associations with exercise in general on the one side can be accompanied with negative associations on the other side; leading to a relatively neutral *D*-Score in consequence. As the time reported for exercise in our study included the time sports students have to spend for training and practice in various sport disciplines this also accounts for the relatively high level of physical activity in this sample although AEE (as expressed by the SC-IAT *D*-Score) were relatively neutral. Similar i.e. relatively neutral AEE in sport students were reported by Bluemke et al. (2010).

In conclusion we think that investigating the effects of EC on AEE by means of a ST-IAT helped to identify the different potentials for change in the two associative foci (Sriram & Greenwald, 2009) i.e. exercise with positive and negative feelings. This experiment is the first study to demonstrate that EC can be used to manipulate AEE. An effective method of manipulating AEE was a prerequisite for development and assessment of interventions to increase exercise; this was the next step in our research.

Study 2: Influence of Targeted Evaluative Conditioning on Choice of Exercise Intensity

Study 1 provided empirical evidence for the plasticity of AEE. The central purpose of study 2 was to examine how experimentally induced changes in AEE influenced subsequent exercise behavior. By manipulating AEE and measuring subsequent exercise behavior we hoped to assess whether there was a causal relationship between changed AEE and exercise behavior. Previous research suggested that positive AEE predicted situated decisions about starting an exercise regime (Brand & Schweizer, 2015) and the exercise setting preferences of frequent exercisers (Antoniewicz & Brand, 2014). The aim of study 2 was to investigate whether choice of exercise intensity was affected by exercise-related EC. Participants were

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asked to select the intensity of a short workout on a bicycle ergometer.

Participants were assigned to EC groups according to their baseline AEE. Those with negative baseline AEE were assigned to the APA group and participants with positive baseline AEE to the ANA group. This approach was based on research indicating that the effects of EC are greatest when the participant's baseline association is of the opposite valence e.g. negative EC for energy-dense snack foods was most effective in reducing preference for such snacks in participants with a high baseline positive evaluation or preference for energy-dense snacks (Hollands et al., 2011). It has been recommended that health behavior interventions should address participants' motivation and be tailored to individual needs (e.g. Keele-Smith & Leon, 2003).

We hypothesized that on the exercise task the APA group would select higher intensities than the control group whilst the ANA group would select lower intensities than the control group.

Method

Participants

Fifty-eight psychology students participated in this study in return for course credit. Eight participants provided incomplete data or did not finish the EC phase, reducing the sample to 50 participants (41 women; M age = 23.78 ± 4.36 years). The distribution of genders in psychology students at our university is very uneven and this was reflected in our sample; because the gender distribution was so uneven we decided to exclude the nine male participants from the analyses. The three groups were similar with respect to age, $F(2,38) = 0.85$, $p = .44$, $\eta^2_{\text{part.}} = .04$, and self-reported weekly amount of exercise, $F(2,38) = 1.81$, $p = .18$, $\eta^2_{\text{part.}} = .09$. More detailed descriptive statistics for the sample are given in Table 3.

Materials and Measures

Automatic evaluations. An evaluative priming task described by Bluemke et al. (2010) was used to measure AEE. This was mainly because previous studies using this task (Bluemke et al., 2010; Brand & Schweizer, 2015) indicated that it is suitable for the assessment of AEE in physically active students who are not specializing in sport.

The evaluative priming task is a computerized task in which verbs related to exercise (e.g. [to] swim; [to] work out) or to non-physical activities (e.g. eat; read) were displayed as priming stimuli. The target stimuli were adjectives describing positive or negative exercise-related feelings or states (e.g. relaxed; exhausted). At the start of a trial a fixation cross is displayed in the middle of the screen for 1000ms. Next a priming stimulus is presented for 100ms. This is followed by a blank screen (100ms) and then presentation of a target stimulus. The participant is required to categorize the target as positive or negative, as quickly and accurately as possible, without reference to the previously presented prime word. The target remains in the middle of the screen until the participant indicates its affective valence (positive or negative) by pressing the 'E' or 'I' button on a computer keyboard. The trial ends with presentation of a blank screen (200ms). There were ten words in each prime and target category, giving a total of 40 stimuli. The task consisted of 10 practice trials followed by a block of 120 test trials. InquisitTM 2.0 software was used for stimulus presentation and response logging.

The priming stimuli elicit an automatic evaluation, which can be positive or negative. The response to the target stimulus which follows a prime is facilitated or inhibited, depending on whether the valence of the target is congruent or incongruent with that of the prime. Priming scores are calculated as suggested by Bluemke et al. (2010), positive test scores represent relatively positive automatic evaluations of exercising.

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Evaluative conditioning. The EC procedure was similar to that used in study 1. The number of trials, stimulus presentation period and positions and instructions were the same; the only change was the number of images per category, which was reduced from six to four.

Exercise task. Participants were asked to ride a bicycle ergometer for two minutes and to choose an intensity (power setting) for this short bout of exercise. Before the bout participants were invited to familiarize themselves with the ergometer, adjust the saddle height and to try out the different power settings. The power could be set to between 40 and 250 watts and adjusted in five-watt increments.

Procedure

This study was carried out in accordance with the recommendations of the ethical committee of the University of Potsdam. Participants gave written informed consent prior to the study and were tested individually in the laboratory. The first step was the assessment of AEE, as this was the criterion for group assignment. Participants worked through the evaluative priming task and then answered the questionnaire used to collect data on habitual exercise volume, age and gender. AEE data from this assessment were analyzed within a week and used to assign participants to the three EC groups. One third of the participants were randomly assigned to the control group ($n = 14$, $M = -30.03 \pm 81.76$). The remainder of the participants was assigned to the APA group if their AEE was negative (i.e. scores lower than zero; $n = 13$, $M = -73.39 \pm 90.23$) or the ANA group if their AEE was positive ($n = 14$, $M = 58.56 \pm 50.17$). The EC and exercise tasks were completed exactly seven days after AEE assessment at the same time of the day. This time lag was unavoidable as, unlike in the ST-IATs used in study 1, the statistical analyses for calculating test scores in the evaluative priming task were not automatized and performed on a case-by-case basis instead. Participants worked through the EC task twice to maximize the effects of conditioning; an

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irrelevant five-minute filler task separated the first and second blocks of EC. After the second EC block participants were informed that it was now necessary, to do some physical exercise before completing the final part of the experiment: this was their introduction to the exercise task. After completing the two-minute bout of exercise, participants completed the questionnaire used to collect data on habitual exercise volume, age and gender. They were then debriefed about the purpose of the experiment.

Tests and Statistical Methods of Analysis

Exercise intensity on the bicycle ergometer task was the dependent variable. One-way between-groups analysis of variance was used to assess the effects of EC group. Planned contrasts were used to assess differences between the control group and the positive and negative EC groups.

Results

There was a large group effect on choice of exercise intensity, $F(2,38) = 7.84, p < .001, \eta^2_{\text{part.}} = .29$ (Figure 1). Planned contrasts revealed that the APA group selected significantly higher intensities than the control group (APA $M = 65.38W \pm 15.61$, control $M = 51.43W \pm 15.98$), $t(38) = 2.66, p = .01, d = 0.88$. The difference between the intensities selected by the control group and the ANA group (ANA $M = 45.00W \pm 7.85$) was not significant, $t(38) = -1.25, p = .22, d = -0.51$.

Discussion

EC influenced choice of intensity in the subsequent bike ergometer task. Participants in the APA group chose intensities which were, on average, 21.54% higher than those selected by the control group. We believe that this study is the first to demonstrate that EC has an effect on subsequent exercise behavior.

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The aim of this study was to investigate the behavioral consequences of manipulations of AEE. This study enables us to draw the following conclusions. First, changes in AEE as a result of EC do influence exercise behavior. This allows for further interpretations on a causal relationship between AEE and exercise behavior. Strengthening associations between the concept of exercising and positive feelings leads to immediate changes in exercise-related decisions and connected behavior. This finding corroborates the model presented by Brand and Schweizer (2015), which introduced the concept of situated behavioral decisions. This study extends their work. On the one hand, the experimental approach of our study extends the correlational findings of Brand and Schweizer (2015). On the other hand, rather than asking participants how they would choose between (hypothetical) behavioral alternatives, we observed their decisions i.e. their behavioral choices.

Second, the manipulation's influence was statistically significant only in participants with a negative baseline AEE who were subjected to positive EC. Although exercise intensities chosen by individuals in the negative EC group seemed to be considerably lower than the intensities chosen in the control group (as indicated by the medium effect size of $d = -0.51$), this difference was not significant. One explanation for this finding is that our sample size was not large enough to statistically detect this true effect. Another explanation is that the observed medium effect size is caused by sampling error and thus random. This interpretation is in line with the finding from study 1 where the alteration of AEE in the negative direction was not successful either. Replication studies are needed to check which of the two interpretations apply better.

The finding that learning more positive AEE led to the selection of higher exercise intensities however corresponds well to likely scenarios in real life exercise promotion interventions and suggests that relatively inactive participants with negative AEE could be

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encouraged to take more exercise using EC. This kind of evidence makes an important contribution to the development and evaluation of exercise interventions.

General Discussion

Study 1 showed that AEE can be altered using an EC procedure in which exercise-related images are consistently paired with images evoking positive exercise-related feelings and images of non-physical activities are paired with images evoking negative feelings or vice versa. Study 2 showed that the EC treatment did have an impact on exercise behavior; the APA group selected significantly higher intensities than the control group. This result image appeared in psychology students who were allocated to EC groups on the basis of their baseline AEE (participants with a negative AEE were assigned to the positive EC group; those with a positive AEE were assigned to the negative EC group; the control group contained participants with positive and negative AEE). Taken together these results suggest that strengthening associations between the cognitive concept of exercise and positive feelings can have a positive influence on exercise behavior in participants whose initial AEE is negative.

Our findings extend understanding of the relationship between AEE and exercise behavior in several ways. Most importantly, our experimental approach represents a departure from studies, which have analyzed correlations between AEE and behavior. Evidence from experimental designs is a rational if not necessary prerequisite for designing future exercise interventions, which target the alteration of exercise related automatic processes (Marteau et al., 2012; Sheeran et al., 2013). At present interventions focus on changing participants' reflective thoughts about exercising, and, for example, try to strengthen participants' exercise-related self-efficacy (Webb & Sheeran, 2006). The findings presented here illustrate how manipulations of AEE can be used to change exercise behavior.

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Basic social cognition research (Perugini, Richetin, & Zogmaister, 2010) and research on exercise and physical activity (Brand & Schweizer, 2015; Conroy et al., 2010; Hyde et al., 2010) have suggested that automatic and reflective processes influence behavior independently. This suggests that targeting automatic processes could improve the efficacy of exercise promotion interventions.

Secondly, our findings contribute to the theoretical debate about the stability of automatic evaluations. Hyde et al. (2012) stated that AEE consist of both stable and temporally variable components. It is assumed that the stable components reflect early experiences of physical activity, whilst the temporally variable components are related to recent experiences. Future research should investigate whether the effects of EC procedures like the one used in our studies are confined to the relatively plastic components of AEE or can extend to the more stable components of AEE. At present it is unclear how variable the proportions of stable and unstable AEE components are, and whether, for example, frequent exercisers have a smaller proportion of unstable components than non-exercisers. In our view the findings presented here suggest that EC is suitable for use with rather inactive people, as we assume they have less stable, more plastic AEE. Randomized controlled trials with larger samples would be needed to investigate this. It is also important to investigate whether manipulations of AEE are effective in altering the exercise behavior of non-exercisers with negative AEE.

Our findings also contribute to understanding of the role that AEE can play in changing exercise behavior. To date research on the relationship between AEE and exercise behavior has focused on the connection between physical activity or exercise habits and AEE (e.g. Bluemke et al., 2010; Conroy et al., 2010). We argue, however, that when the role of automatic cognitive processes shall be explained, the immediacy of AEE and the resulting

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immediate consequences have to be considered. In our second study the EC treatment influenced decisions about exercise made immediately afterwards.

Whilst we agree that treatments which alter AEE have an immediate impact on exercise behavior, we also think that they can have long-term influences on exercise behavior. We suggest that the view, that AEE is mainly a predictor of short-term patterns in exercise behavior, may reflect publication bias, as all the published studies of the relationship between AEE and exercise or physical activity looked at coherences or changes over short time periods (e.g. Conroy et al., 2010). There is evidence that AEE have an enduring impact on eating behavior (Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010). At present there is a lack of research into the long-term impact of AEE (which could be the target of an intervention) on exercise behavior.

Our findings also allow us to make at least one preliminary recommendation to exercise instructors. We suggest that instructors should pay particular attention to their clients' immediate affective responses to exercise activities. Exercising is not always a pleasant experience (e.g. sweating or feeling exhausted after a bike ride) and it seems that working to ensure that clients feel positive about the exercise experience at the time or shortly afterwards has a beneficial effect on subsequent exercise behavior (see Ekkekakis, Parfitt, & Petruzzello, 2011).

Limitations and Directions for Future Research

One limitation of the two studies is that although we did check the effectiveness of the EC treatment in study 1, in study 2 – in which we assessed the behavioral consequences of the EC treatment using the bicycle ergometer task – we did not check whether the EC procedure had altered participants' AEE in the expected direction. We can only assume that the EC treatment produced the expected changes in AEE and our data do not provide any

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evidence about how long these changes persisted. Our decision to not include a manipulation check (in the form of a complex reaction-time based task immediately after the EC treatment) was based on methodological considerations. We tried to minimize the interval between the EC treatment and the assessment of exercise behavior in order to limit the potential confounding effect of deliberative cognitive processing.

The temporal delay between AEE assessment and EC intervention in study 2 carried the risk of interim changes in our participants' AEE. According to Hyde et al. (2012) AEE include stable and temporal variable components. We argue that our chosen sample of fairly active psychology students resembles one with rather consolidated not volatile AEE. However future research should, unlike we did, control for possible experimentally unintended changes.

Another limitation of our work is that both samples consisted of rather frequent exercisers, and study 2 included only female participants. We believe that it is reasonable to generalize our findings to non-active populations and men; but it should be remembered that there is as yet no empirical evidence to confirm this. When interpreting the findings of study 1, one has to keep in mind, that the average of 564.98 minutes of exercise per week ($SD = 465.93$) in this sample of sport students comprises both, voluntary exercise and exercise spent in obligatory classes at the university. Future research endeavors should investigate whether the distinction between imposed and voluntary exercise leads to additional information when examining AEE.

More generally, it is important to remember that the laboratory context is very different from those in which health interventions are implemented. It would be interesting to use randomized controlled trials to examine the effectiveness of intervention programs designed to manipulate automatic cognitions in real life settings, which may be very different

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from the controlled setting of our experiments.

Conclusion

On the basis of the two studies reported here, we conclude that EC produces systematic improvements in AEE, and that this has beneficial consequences, at least in the very short term, i.e. with respect to choices made in a bout of exercise taking place immediately after the treatment. We began this report by asking whether going for regular bike rides was likely to be the consequence of a positive AEE, or whether it was going for regular bike rides which produced the positive AEE. These studies provide empirical support for the hypothesis that AEE do influence behavior, and should encourage the development of interventions which target AEE as a means of promoting exercise.

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References

- Antoniewicz, F. & Brand, R. (2014). Automatic Evaluations and Exercise Setting Preference in Frequent Exercisers. *Journal of Sport & Exercise Psychology, 36*(6), 631-636.
doi:10.1123/jsep.2014-0033
- Banting, L. K., Dimmock, J. A., & Lay, B. S. (2009). The role of implicit and explicit components of exerciser self-schema in the prediction of exercise behaviour. *Psychology of Sport and Exercise, 10*(1), 80-86.
doi:10.1016/j.psychsport.2008.07.007
- Bluemke, M., Brand, R., Schweizer, G., & Kahlert, D. (2010). Exercise might be good for me, but I don't feel good about it: Do automatic associations predict exercise behavior? *Journal of Sport & Exercise Psychology, 32*(2), 137-153.
- Bluemke, M. & Friese, M. (2008). Reliability and validity of the Single-Target IAT (ST-IAT): Assessing automatic affect towards multiple attitude objects. *European Journal of Social Psychology, 38*(6), 977-997. doi:10.1002/ejsp.487
- Brand, R. & Schweizer, G. (2015). Going to the gym or to the movies? Situated decisions as a functional link connecting reflective and automatic evaluations of exercise with exercising behavior. *Journal of Sport & Exercise Psychology, 37*(1), 63-73.
doi:[10.1123/jsep.2014-0018](https://doi.org/10.1123/jsep.2014-0018)
- Chaiken, S. & Trope, Y. (Eds.). (1999). *Dual-process theories in social psychology*. New York: Guilford.
- Calitri, R., Lowe, R., Eves, F. F., & Bennett, P. (2009). Associations between visual attention, implicit and explicit attitude and behaviour for physical activity. *Psychology & Health, 24*(9), 1105-1123. doi:10.1080/08870440802245306
- Conroy, D. E., Hyde, A. L., Doerksen, S. E., & Ribeiro, N. F. (2010). Implicit attitudes and

CHANGING AUTOMATIC EVALUATIONS

explicit motivation prospectively predict physical activity. *Annals of Behavioral Medicine*, 39(2), 112-118. doi:10.1007/s12160-010-9161-0

Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: Decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Medicine*, 41(8), 641-671. doi:10.2165/11590680-000000000-00000

Evans, J. St. B. T. & Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science*, 8(3), 223-241. doi:10.1177/1745691612460685

Eves, F. F., Scott, E. J., Hoppé, R., & French, D. P. (2007). Using the affective priming paradigm to explore the attitudes underlying walking behaviour. *British Journal of Health Psychology*, 12(4), 571-585. doi:10.1348/135910706X153775

Gawronski, B. & Bodenhausen, G. V. (2007). Unraveling the process underlying evaluations: Attitudes from the perspective of the APE model. *Social Cognition*, 25(5), 687-717. doi:10.1521/soco.2007.25.5.687

Greenwald, A. G., McGhee, D. E., & Schwartz, J. K. L. (1998). Measuring individual differences in implicit cognition: The Implicit Association Test. *Journal of Personality and Social Psychology*, 74(6), 1464-1480. doi:10.1037/0022-3514.74.6.1464

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, 85(2), 197-216. doi:10.1037/0022-3514.85.2.197

Hofmann, W., De Houwer, J., Perugini, M., Baeyens, F., & Crombez, G. (2010). Evaluative conditioning in humans: A meta-analysis. *Psychological Bulletin*, 136(3), 390-421.

CHANGING AUTOMATIC EVALUATIONS

doi:10.1037/a0018916

- Hollands, G. J., Prestwich, A., & Marteau, T. M. (2011). Using aversive images to enhance healthy food choices and implicit attitudes: An experimental test of evaluative conditioning. *Health Psychology, 30*(2), 195-203. doi:10.1037/a0022261
- Houben, K., Havermans, R. C., & Wiers, R. W. (2010). Learning to dislike alcohol: Conditioning negative implicit attitudes toward alcohol and its effect on drinking behavior. *Psychopharmacology, 211*(1), 79-86. doi:10.1007/s00213-010-1872-1
- Hyde, A. L., Doerksen, S. E., Ribeiro, N. F., & Conroy, D. E. (2010). The independence of implicit and explicit attitudes toward physical activity: Introspective access and attitudinal concordance. *Psychology of Sport and Exercise, 11*(5), 387-393. doi:10.1016/j.psychsport.2010.04.008
- Hyde, A. L., Elavsky, S., Doerksen, S. E., & Conroy, D. E. (2012). The stability of automatic evaluations of physical activity and their relations with physical activity. *Journal of Sport & Exercise Psychology, 34*(6), 715-736. doi:10.1037/t31330-000
- Keele-Smith, R. & Leon, T. (2003). Evaluation of individually tailored interventions on exercise adherence. *Western Journal of Nursing Research, 25*(6), 623-640. doi:10.1177/0193945903255404
- Marteau, T. M., Hollands, G. J., & Fletcher, P. C. (2012). Changing human behavior to prevent disease: The importance of targeting automatic processes. *Science, 337*(6101), 1492-1495. doi:10.1126/science.1226918
- Nederkoorn, C., Houben, K., Hofman, W., Roefs, A., & Jansen, A. (2010). Control yourself or just eat what you like? Weight gain over a year is predicted by an interactive effect of response inhibition and implicit preference for snack foods. *Health Psychology, 29*(4), 389-393. doi:10.1037/a0019921

CHANGING AUTOMATIC EVALUATIONS

- Nosek, B. A., Hawkins, C. B., & Frazier, R. S. (2011). Implicit social cognition: From measures to mechanisms. *Trends in Cognitive Sciences, 15*(4), 152-159.
doi:10.1016/j.tics.2011.01.005
- Perugini, M., Richetin, J., & Zogmaister, C. (2010). Prediction of behavior. In B. Gawronski, & B. K. Payne (Eds.), *Handbook of implicit social cognition* (pp. 255-277). New York, NY: The Guilford Press.
- Sheeran, P., Gollwitzer, P. M., & Bargh, J. A. (2013). Nonconscious processes and health. *Health Psychology, 32*(5), 460-473. doi:10.1037/a0029203
- Sriram, N. & Greewald, A. G. (2009). The Brief Implicit Association Test. *Experimental Psychology, 56*(4), 283–294. doi:10.1027/1618-3169.56.4.283
- Strack, F. & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8*(3), 220-247.
doi:10.1207/s15327957pspr0803_1
- Walsh, E. M., & Kiviniemi, M. T. (2014). Changing how I feel about the food: Experimentally manipulated affective associations with fruits change fruit choice behaviors. *Journal of Behavioral Medicine, 37*(2), 322-331. doi:10.1007/s10865-012-9490-5
- Webb, T. L. & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132*(2), 249-268. doi:10.1037/0033-2909.132.2.249

Table 1

Table 1.

Means and standard deviations of age and overall exercise for the two experimental groups and the control group of study 1

	<i>n</i>	<u>Age in years</u>		<u>Overall exercise in minutes per week^a</u>	
		<u><i>M</i></u>	<u><i>SD</i></u>	<u><i>M</i></u>	<u><i>SD</i></u>
Positive EC	19 (6 ♀)	22.42	1.80	456.67	234.80
Negative EC	20 (10 ♀)	23.80	3.00	659.00	578.36
Control EC	25 (11 ♀)	22.84	2.29	567.74	490.70
Total	64 (27 ♀)	23.02	2.44	564.98	465.93

Note. *n* = number of participants; ♀ = female; *M* = mean; *SD* = standard deviation.

^a Participants were sports students so that reported minutes of exercise include voluntary exercise as well as obligatory exercise in sports classes at their university.

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Table 2

Table 2.

Results of Study 1, analyzed by an one-way analysis of variance with the D-Score and ST-IAT blocks as dependent variables and the EC condition as a factor

<i>Dependent variables</i>	<i>Positive EC</i>	<i>Control EC</i>	<i>Negative EC</i>	<i>F</i>	$\eta^2_{part.}$
D-Score	0.56 ^b (0.78)	-0.01 (0.70)	0.03 (0.64)	3.51*	.11
good/exercise+bad block	707.01 ^a (51.59)	646.33 (90.54)	651.51 (81.76)	3.22*	.10
good+exercise/bad block	665.10 (52.36)	645.55 (83.72)	630.03 (93.37)	0.83	.03

Note. * = $p < .05$, standard deviations appear in parentheses below means.

^a Means are significantly different at the $p < .05$ level based on planned contrasts testing the respective EC group and the control group.

^b Means are significantly different at the $p < .01$ level based on planned contrasts testing the respective EC group and the control group.

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Table 3

Table 3.

Means and standard deviations of age and habitual exercise for the two experimental groups and the control group of study 2

	<i>n</i>	<u>Age in years</u>		<u>Habitual exercise in minutes per week</u>	
		<u><i>M</i></u>	<u><i>SD</i></u>	<u><i>M</i></u>	<u><i>SD</i></u>
Positive EC	13 (13 ♀)	24.54	4.01	218.65	85.65
Negative EC	14 (14 ♀)	22.57	2.34	178.93	109.83
Control EC	14 (14 ♀)	23.50	4.94	122.57	87.00
Total	41 (41 ♀)	23.51	3.90	172.28	135.01

Note. *n* = number of participants; ♀ = female; *M* = mean; *SD* = standard deviation.

Figure 1

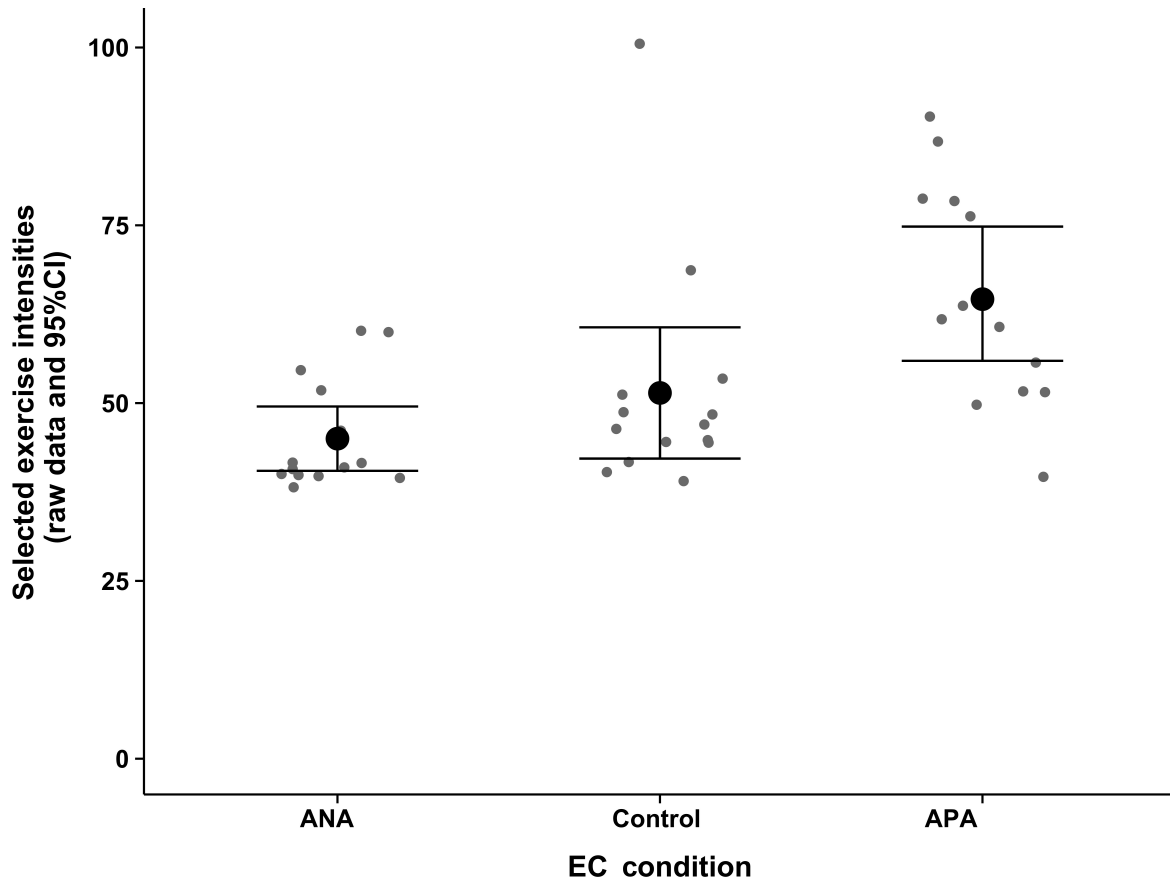


Figure 1. Selected exercise intensity in the exercise choice task of study 2. Depicted are the individually selected exercise intensities in watts and the corresponding 95% Confidence Intervals for the acquisition of negative associations (ANA), the acquisition of positive associations (APA) and the control group.

Dropping out or keeping up? Baseline automatic evaluations of exercise predict adherence to a fourteen-week exercise course

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Keywords: exercise adherence, automatic evaluations, BIAT, dropout, associations, affect.

Abstract

The aim of this study was to examine how automatic evaluations of exercising (AEE) varied according to adherence to an exercise program. Eighty-eight participants (24.98 years \pm 6.88; 51.1% female) completed a Brief-Implicit Association Task assessing their positive and negative AEE at the beginning of a three-month exercise program. Attendance data were collected for all participants and used in a cluster analysis of adherence patterns. Three different adherence patterns (52 maintainers, 16 early dropouts, 20 late dropouts; 40.91% overall dropouts) were detected using cluster analyses. Participants from these three clusters differed significantly with regard to AEE before the first course meeting ($\eta^2_{\text{part.}} = .07$). Discriminant function analyses revealed that positive AEE was a particularly good discriminating factor. This is the first study to provide evidence of the differential impact of positive and negative AEE on exercise behavior over the medium term. The findings contribute to theoretical understanding of evaluative processes from a dual-process perspective and may provide a basis for targeted interventions.

Introduction

Automatic evaluations of exercising (AEE; i.e. the spontaneous associations of exercising with either positive or negative affect) are a fairly well-researched phenomenon (e.g. Antoniewicz & Brand, 2014, Bluemke et al., 2010). Engagement in exercise is not just a consequence of

deliberate reasoning but also the result of unintentional, automatic evaluations. Most empirical research on AEE has focused on correlations between AEE and exercise volume (Bluemke et al., 2010, Conroy et al. 2010), the predictive power of AEE in relation to proximal episodes of physical activity (e.g. step counts for one week, Conroy et al., 2010) or decisions about exercising (Antoniewicz & Brand, 2014, Brand & Schweizer, 2015). Other research has investigated changes in AEE (Antoniewicz & Brand, under review; Markland et al., 2015); however the potential role of AEE in exercise maintenance has not been researched before.

Non-adherence to exercise programs is a well documented phenomenon (e.g. Marcus et al., 2000). Dropout rates of approximately 50% after only a couple months are not uncommon (Matsumoto & Takenaka, 2004). We think that research on the psychological variables that influence the behavioral decisions of maintainers and non-maintainers is crucial to designing and implementing successful exercise interventions.

This study aimed to address a significant research gap by (1) providing a theoretical account of the role of AEE in exercise adherence and (2) testing a hypothesis relating exercise adherence to AEE which was derived from this account.

The role of automatic evaluations of exercising in exercise maintenance

According to dual process models of social cognition evaluative reactions involve two interconnected evaluative processes: one spontaneous and automatic, the other rather thoughtful and deliberative (Chaiken & Trope, 1999; Kahnemann & Frederick, 2002). The Reflective Impulsive Model (RIM; Strack & Deutsch, 2004) represents one attempt to explain the distinction. According to this model, an individual who comes to the conclusion that the advantages of exercising today (e.g. feeling good afterwards) outweigh the disadvantages (e.g. exercise is time-consuming) will develop an intention to exercise that evening. The RIM assigns this process to the reflective system. The model further assumes that at the same time as the reflective processing AEE (e.g. doing aerobics is enjoyable) arise as a result of activation of an associative network which is part of the impulsive system, and these AEE elicit a corresponding

motivational orientation (e.g. I want to attend an aerobic session today). This aspect of social cognition – the role of the impulsive system – is central to our study.

AEE represent learnt associations, which serve as a “conceptual and procedural long-term memory, where associative weights between contents change slowly and gradually” (Deutsch & Strack, 2006, p. 167) and according to RIM the salience and accessibility of these associative clusters varies according to the frequency of their activation. One would expect a regular exerciser to have strong, easily accessible positive associations to exercising and weaker negative associations to exercising.

Exercising is massively associated with bodily sensations and evokes affective responses (Ekkekakis et al., 2011). Affective states provide information and can be registered in memory (Clore, 1992). External stimuli (e.g. the experience of entering the gym) and internal stimuli (e.g. thinking about exercising) can activate affective representations which serve as inputs to evaluative information processing. Findings from exercise psychology show that positive affect during and after exercise predicts future exercising (e.g. Ekkekakis et al., 2011), and that positive AEE, as well as unconnected evaluative judgments, influence immediate decisions about exercising (Brand & Schweizer, 2015). Repeated activation of stored affective representations by acute affective states, experienced during and shortly after exercise, reinforces their association with exercise (Deutsch & Strack, 2006) i.e. increases the strength of the association between mental representations of exercise behavior and affective evaluative concepts. Every time an individual has to decide whether or not to attend the exercise course that day, both reflective and impulsive evaluative processes contribute to the formation of a motivational orientation (in the impulsive system) and a behavioral intention (in the reflective system), and reinforce pre-existing affective representations associated with attending the exercise course. This learning cycle is the reason why we expected to find predominantly positive spontaneous AEE in persistent exercisers, i.e. empirical evidence of the role of positive AEE in exercise adherence.

Researching automatic evaluations of exercising

Individuals are often unaware of their automatic associations (Nosek et al., 2007) and data based on questionnaires that ask participants to introspect about such associations are therefore not an appropriate or valid measure of them, so over the past 20 years researchers have begun to investigate the validity of response time latency tasks (Fazio & Olson, 2003) as indicators of automatic associations. These indirect tests, e.g. the Affective Priming Task (Fazio et al., 1995) and the Implicit Association Test (Greenwald et al., 1998), infer the individuals' automatic associations from the speed with which they categorize word or picture stimuli into various categories.

The Implicit Association Test.

Over the past two decades the Implicit Association Test (IAT; Greenwald et al., 1998) has become recognized in social psychology as a standard measure of spontaneous associations between mental concepts (it should be noted, however, that there is active debate on the automaticity of the measured reactions; De Houwer et al. 2009). The standard version of the IAT uses sets of stimuli related to two complementary targets (e.g. 'exercise' vs. 'non-exercise') or two complementary evaluative categories ('good' vs. 'bad'). The respondent has to sort the stimuli as quickly and accurately as possible into combined categories which are varied systematically across blocks (e.g. stimuli representing 'exercise' or 'good' are moved to the left side whilst stimuli representing 'non-exercise' or 'bad' stimuli are moved to the right side in test block A; whereas in test block B 'exercise' and 'bad' stimuli have to be sorted to the left side and 'non-exercise' and 'good' stimuli are sorted to the right side). Research from exercise psychology indicates that there is no clear conceptual opposite of 'physical activity' (e.g. Rebar et al., 2015). The brief IAT (BIAT; Sriram & Greenwald, 2009) is a version of the IAT which addresses this issue. In the BIAT participants only have to pay attention to two out of four categories in each test block (i.e. detect whether stimuli represent the concepts of e.g. 'exercise' or 'good' in one test block and 'exercise' or 'bad' in the other). This makes features of the non-focal category ('non-exercise') less important. Another approach to addressing the lack of a complement to the target category is the Single Category (SC)-IAT (Karpinski & Steinman, 2006). In one SC-IAT block

respondents decide whether stimuli belong to the categories ‘exercise’ or ‘good’ *or* to the category ‘bad’; in the other test block they decide whether stimuli belong to the ‘exercise’ or ‘bad’ categories *or* to the evaluative category ‘good’.

The common assumption underlying all IATs is that when stimuli sharing the same response are compatible (e.g. for participants who evaluate exercising positively the same response is required to stimuli representing ‘exercise’ or ‘good’) stimuli are handled more quickly than when the categorization is incompatible with one’s automatic evaluation. Test scores are usually calculated by subtracting mean reaction times for the incompatible block from those for the compatible block – the two *associative foci* (Sriram & Greenwald, 2009) – divided by the pooled standard deviation across both blocks. The resulting relative score (*D*-score; Greenwald et al., 2003) is an effect size-like measure that is interpreted as an indication of the strength of the respondent’s positive or negative associations with the target concept (e.g. exercise).

Selected relevant studies.

A few exercise psychology studies have already used IATs to illustrate the relationships between automatic evaluations from various forms of physical activity (e.g. Conroy et al., 2010; Hyde, et al., 2012, Antoniewicz & Brand, under review).

Conroy et al. (2010) employed the SC-IAT to show that more positive *D*-scores (i.e. faster reactions to ‘good’ stimuli when the same response is required for stimuli belonging to the target category of exercise) were associated with higher physical activity (number of steps per day) after controlling for well-established predictors of physical activity (e.g. self-efficacy). The authors concluded that spontaneous physical activity behavior over a short timeframe - one week - was influenced by both reflective motivational processes and impulsive processes.

Hyde et al. (2012) used the same length of observation period, one week, and focused on the stability of participants’ automatic evaluations. At the beginning and end of the one-week period participants worked through a SC-IAT and reported their physical activity during the previous week. Changes in *D*-score indicating a shift to a more favorable AEE were accompanied by an increase in physical activity level. The authors concluded that AEE include stable and more

temporally variable components, both of which are related to physical activity behavior.

Antoniewicz and Brand (under review) investigated variability in AEE by manipulating participants' AEE with an Evaluative Conditioning Task. They assessed changes in SC-IAT *D*-scores immediately after the manipulation in three experimental groups (associating exercise with positive affect; associating exercise with negative affect; control condition). The manipulation was shown to be effective; *D*-scores were significantly higher in the group that learned positive AEE than in the control group. Drawing on theories positing that the impulsive system is based on associative processes (Deutsch & Strack, 2006) and the proposed interpretation of *D*-scores (Greenwald et al., 2003) the authors distinguished between two *D*-score components and analyzed their separate impacts on the associative weights within the two associative foci (i.e. associations between 'exercise-good' and 'exercise-bad'). This revealed that the observed learning was mainly driven by changes to the strength of the 'exercise-bad' association rather than the 'exercise-good' association. The authors interpreted this as an indication that amongst their sports student participants the 'exercise-good' association was relatively stable, whilst the 'exercise-bad' association was more susceptible to manipulation.

This Study

This study aimed to address a significant research gap by investigating the influence of AEE on adherence to a long-term exercise program. We monitored participants' adherence to a three-month program of exercise (classifying them according to adherence, e.g. dropouts vs. maintainers) and assessed their baseline spontaneous evaluative associations with exercise.

According to dual process theories such as the RIM, the motivational orientation towards exercise (e.g. approach or avoid exercise) is based on the difference between the weights of 'exercise-good' associations and 'exercise-bad' associations. There is no doubt that exercising can simultaneously have both positive and negative associations for an individual. Regular participation in an aerobics class might elicit positive affect when it evokes thoughts of the friends one meets there whilst also eliciting more negative affect related to the resulting muscle

ache. It is our contention that although a relative measure such as BIAT *D*-score might reflect AEE and hence capture differences between adherers and non-adherers, the component positive and negative associations underlying the *D*-score are more informative. We hypothesized that patterns of adherence would be associated with differences in the strengths of exercise-positive and exercise-negative associations as measured with a BIAT. We expected that at baseline (before the start of the exercise program) positive AEE would be stronger in participants who would subsequently persist with the program than in those who would drop out.

Methods and Materials

Participants

Sample

Data were collected from 121 participants. Data from some participants were excluded from analysis because of problems understanding the instructions for the tests ($n = 20$), because participants had left the exercise program ahead of schedule for health reasons ($n = 2$), because they had an error rate of more than 20% in BIAT sorting trials ($n = 7$) or because they reported before the program that they had little intention of finishing the program ($n = 4$). Intention to finish the program was assessed with a single question, “How committed are you to completing the exercise course?”, with answers given on a six-point Likert scale ranging from 0 = ‘no intention at all’ to 5 = ‘very strong intention’. Intending to finish the program (score of at least 4) was a pre-defined inclusion criterion. Final analyses were thus based on data from 88 participants (24.98 years \pm 6.88; 51.1% female).

Adherence clusters

In order to minimize bias in the data due to socially desirable responding (Kristiansen & Harding, 1984) and recall bias, attendance at the 14 exercise sessions was documented by the exercise instructor (present coded as ‘1’; absent coded as ‘0’) at the start of the session. The resulting data series (adherence data) was transformed into twelve simple moving averages (each based on three sessions) per participant. The resulting series of moving averages were examined with hierarchical cluster analyses to identify different patterns of adherence in our group of

Associations and exercise adherence participants. Three different adherence patterns emerged. Fifty-two participants were classified as ‘maintainers’, 16 as ‘early dropouts’ and 20 as ‘late dropouts’ (giving an overall drop-out rate of 40.91% for the course). The results of this analysis and the chronology of adherence patterns are illustrated in Figure 1. The adherence groups did not differ with regard to age ($F(2,82) = 1.28, p > .05$), gender ($\chi^2(2) = 1.31, p > .05$) or intention to participate in the course ($F(2,85) < 1$). Early dropouts ($M = 175.33$ mins, $SD = 112.75$), late dropouts ($M = 160.00$ mins, $SD = 95.59$) and maintainers ($M = 202.75$ mins, $SD = 119.75$) reported taking similar weekly volumes of exercise before the first course meeting ($F(2,83) = 1.13, p > .05$).

Materials

Positive and negative associations.

AEE in form of the participants’ positive and negative associations with exercise were measured with a pictorial BIAT. The stimuli depicted scenes representing the target category ‘exercise’ (e.g. running, playing soccer, playing tennis, doing gymnastics) or non-sports activities (e.g. sleeping, watching TV, reading, sitting) i.e. the non-focal category. All stimuli were without obvious affective content (e.g. smiling faces). The evaluative categories ‘good’ and ‘bad’ were represented by eight (four and four) different smileys and frownies. Stimuli were presented in the middle of the screen and remained there until the participant categorized them by pressing the ‘E’ or ‘I’ key on a standard QWERTZ keyboard. In test block A (positive associative focus) participants had to press the ‘E’ key if the stimulus belonged to either the target category ‘exercise’ or the evaluative category ‘good’; they were asked to press the ‘I’ key in response to all other stimuli in this block. In test block B (negative associative focus) ‘exercise’ and ‘bad’ stimuli were assigned to the ‘E’ key and all others to the ‘I’ key. Block order was counterbalanced between participants. All participants started with 24 practice trials, followed by 40 trials with response time logging (InquisitTM 2.0 software). They were instructed to categorize stimuli as quickly and accurately as possible.

Design and Procedure

Before the first exercise session potential participants were asked whether they were willing to take part in a study on ‘evaluations of exercising’. Participants completed their first BIAT immediately before the start of the first exercise session. Then they completed a short paper-pencil questionnaire containing questions on intention of finishing the exercise course, weekly volume of exercise (in minutes per week) and basic socio-demographic information (age and gender). Finally the course instructors documented the presence or absence of participants. Attendance was documented by instructors before each session throughout the fourteen weeks of the exercise course. Participants were fully debriefed, after the last exercise session. The study was carried out according to the recommendations of the ethical committee of the University of Potsdam.

Statistical Analyses

Group differences in *D*-scores were assessed using one-way analysis of variance (ANOVA) and group differences in positive and negative exercise associations were analyzed with one-way multivariate analysis of variance (MANOVA). Follow-up discrimination analysis (Field, 2013) was used to determine how best to separate the adherence groups. Adherence group (maintainer; early dropout; late dropout) served as the grouping variable and the values for positive and negative AEE were treated as independent variables.

Results

Full descriptive data are given in Table 1. ANOVA revealed that *D*-scores were similar for the three groups, $F(2, 85) = 0.57, p > .05$. However in the MANOVA there was an omnibus effect (Pillai’s trace) of adherence group on positive and negative exercise associations, $V = 0.15, F(4, 170) = 3.35, p < .01, \eta^2_{\text{part.}} = .07$. Discriminant function analysis revealed two functions, explaining 99.6% (canonical $R^2 = .16$) and 0.4% (canonical $R^2 < .01$) of the variance respectively. The combination of the two discriminant functions differentiated between the three groups, $L = 0.85, \chi^2(4) = 13.33, p < .01$. Removing the first function revealed that the second function did

not contribute significantly to the effect, $L = 0.99$, $\chi^2(1) = 0.52$, $p > .05$. Inspection of correlations between the independent variables and the two discriminant functions revealed that positive exercise associations were strongly positively loaded on the first function ($r = .97$) and weakly to moderately negatively loaded on the second function ($r = -.21$); negative exercise associations were strongly positively loaded on the second function ($r = .84$) and less strongly positively loaded on the first function ($r = .55$). These results suggest that the two associative foci are differently associated with adherence group

Discussion

The aim of this study was to examine individual differences in positive and negative associations with exercise in exercisers who started a three-month program of weekly exercise sessions. Analysis of adherence to the program uncovered three groups of exercisers, maintainers, early dropouts and late dropouts. We hypothesized that these patterns of adherence would be reflected in the strengths of positive and negative associations with exercise measured before the start of the exercise program. This hypothesis was corroborated. Discriminant function analysis revealed that a combination of the two underlying types of exercise association (positive and negative) was highly effective in discriminating between the three adherence groups. Positive exercise associations contributed more to adherence group classification. Early dropouts had the longest reaction times when responding to exercise-related stimuli in the same way as to positive stimuli. The three groups were identified empirically (we described whether our participants were present or not) after our measurement of AEE; we thus conclude that AEE in the positive focus (not in the negative focus) are helpful in predicting exercise course adherence.

Previous studies investigated the association between AEE and exercise behavior over a short time period (Conroy et al., 2010). Our findings extend understanding of the relationship between AEE and behavior in several ways. We suggest that adherence to a program of exercise can be described as a series of situated decisions of the form ‘do I attend my aerobics class today or watch TV instead?’ Earlier research has shown that AEE correlated significantly with situated

decisions about exercising (Brand & Schweizer, 2015). Our data corroborate the hypothesis that long-term adherence to a program of exercise, i.e. repeated decisions to engage in exercise, and positive AEE (associations between mental representations of 'exercise' and the evaluative category 'good') at the beginning of the course are correlated. This result is compatible with previous accounts of AEE and their role in physical activity behavior (e.g. Hyde et al., 2012).

In the terms of learning theory each exercise class represents a learning experience which influences the weights of associations between affective representations and exercise representations. A pre-existing positive AEE might act as a buffer against the effects of future exercise classes which might trigger predominantly negative affect. Strack and Deutsch (2006) posited that in long-term memory the weight of associations between, for example the concepts 'exercising' and 'good' change only slowly. If the stored evaluation of exercising is that it is 'enjoyable' i.e. there is a stored association between exercising and positive affect which is reflected in a general motivation to engage in exercise, then it is likely that even if the individual has recently had an unpleasant (negative) experience of exercising his or her overall motivation to exercise will remain high (i.e. he or she is likely to make situated decisions to exercise, rather than undertake an alternative activity). This view is consistent with other authors' findings on the correlation between directly assessed hedonic responses to exercise and adherence to a program of exercise (Ekkekakis, 2009; Kwan & Bryn, 2010; Williams et al., 2008). Williams et al. (2008, p. 232) concluded that "a positive affective response may lead to greater participation in physical activity programs" on the basis of an assessment of affective responses to an exercise session and follow-up tracking of physical activity for six months. We propose that the correlation between positive affect and exercise behavior is not only a matter of reflective evaluative judgments based on rational deliberation (e.g. 'no pain, no gain') but also automatic evaluations (i.e. spontaneous affective responses or 'gut feeling'; the output of the impulsive system). This implies that exercise intervention practitioners should attempt to facilitate immediate, positive affective responses to exercise for participants in order to reinforce exercise-positive associations which

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may influence both impulsive and reflective processing of exercise-related stimuli and choices.

Our findings also contribute to understanding of AEE measurement. We suggest that it is more appropriate to conceive AEE in terms of separate exercise-positive and exercise-negative associations rather than as an overall AEE, on a single linear continuum. It is noteworthy that it is the overall linear continuum model which provides the rationale for calculation of IAT *D*-scores. Co-existing positive and negative associations and learning experiences in everyday life (e.g. exercising makes me feel better but at the same time it is time-consuming) are the norm rather than the exception. Our behavior is guided by this complex interplay of reflective judgments and automatic associations; both factors should be assessed in more detail when assessing patterns of complex behavior such as exercise habit. Assessing positive and negative AEE separately supports a more nuanced interpretation of individual differences evaluations based on impulsive system processes. The lack of significant differences between the *D*-scores of maintainers and early and late dropouts reinforces the case for considering positive and negative automatic evaluations separately, particularly as differences between the adherence groups were detected when positive and negative associative foci were examined separately. Furthermore our results suggest that positive and negative exercise associations contribute differentially to patterns of exercise adherence. Given that we investigated individuals who already had decided to visit this exercise course it is unsurprising that most of them had positive associations involving exercise and that these positive associations had a significant impact on behavior. One would expect our participants to display strong or salient exercise-positive associations acquired as a result of numerous previous positive experiences of exercising (all opportunities for associative learning). As Strack and Deutsch (2006, p. 167) put it: “Frequently co-occurring perceptual features, valence, and behavioral programs form associative clusters, which vary in their accessibility according to the recency and frequency of their activation”. Future research should investigate inactive individuals in order to clarify the observed differential impact of positive and negative associative in individuals without the intention to exercise.

We also conclude that exercise behavior cannot simply be characterized in terms of volume (e.g. step counts or minutes per week). The observation that exercise volume correlates with AEE (e.g. Conroy et al, 2010; Eves et al., 2007) is certainly useful. This quantitative information neglects, however, qualitative differences in how similar volumes of exercise were acquired. In a fourteen-week exercise session, individuals could either participate in every second exercise session (and thus be classified as a maintainer) or stop attending to the exercise course after having been there for the first seven sessions (and thus be a member of the late-dropout group). The chronological analysis of attendance was fruitful and should stimulate further research and developments in the design of targeted exercise interventions (e.g. Keele-Smith & Leon, 2003).

Although the results of this study contributed to our understanding of AEE and their relationship with exercise behavior there are limitations to our study that need to be addressed. The regular exercisers in our sample all reported that they were likely to attend the sessions regularly and it is important to be cautious about generalizing the findings to less motivated individuals. The relationship between AEE and adherence to an exercise program in less motivated individuals is a question for future empirical research. It is also unclear whether the same results would have been obtained when investigating the relationship between AEE and exercise over longer or shorter time periods.

These limitations notwithstanding, we think that our study highlights the influence of AEE and the two underlying associations on adherence to a program of exercise. Our aim was to enrich understanding of the research issues in several ways. First, we have offered a plausible theoretical account of the relationship between situations-specific AEE and long-term adherence to an exercise program. This invites further reflections on integrating AEE into theories of exercise behavior. Dual-system models are one approach to doing so and provide a basis for future research into exercise habits. Second, we have provided evidence that AEE predict exercise behavior over the long term, thus extending previous findings which investigated exercise habits

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or exercise behavior over short time periods. Third, the decomposition of AEE into its components (i.e. exercise-positive and exercise-negative associations) was shown to be essential to understanding the relationship between exercise behavior and AEE. Our finding improves understanding of the concept of AEE and should lead to development of more effective exercise interventions. Mainstream research in exercise psychology should investigate automatic as well as reflective processes of behavior regulation in the future.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

- Antoniewicz, F. & Brand, R. (2014). Automatic Evaluations and Exercise Setting Preference in Frequent Exercisers. *J Sport Exerc Psychol*, 36, 631-636. doi: 10.1123/jsep.2014-0033
- Antoniewicz, F. & Brand, R. (under review). Learning to like exercising: Evaluative Conditioning changes automatic evaluations of exercising and influences subsequent exercising behavior. *J Sport Exerc Psychol*.
- Bluemke, M., Brand, R., Schweizer, G., & Kahlert, D. (2010). Exercise might be good for me, but I don't feel good about it: Do automatic associations predict exercise behavior? *J Sport Exerc Psychol*, 32, 137-153.
- Cavill, N., Kahlmeier, S., & Racioppi, F. (Eds.). (2006). Physical activity and health in Europe: evidence for action. World Health Organization.
- Chaiken, S., & Trope, Y. (Eds.). (1999). *Dual-process theories in social psychology*. New York: Guilford.
- Clore, G.L. (1992). Cognitive phenomenology: Feelings and the construction of judgement. In *The construction of social judgement*, ed L.L. Martin & A. Tesser, (Hillsdale, NJ: Lawrence Erlbaum Associations). 133-164..
- Conroy, D. E., Hyde, A. L., Doerksen, S. E., & Ribeiro, N. F. (2010). Implicit attitudes and

- explicit motivation prospectively predict physical activity. *Ann Behav Med*, 39(2), 112–118. doi:10.1007/s12160-010-9161-0
- De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: a normative analysis and review. *Psychol Bull*, 135(3), 347–368.
- Deutsch, R., & Strack, F. (2006). Duality Models in Social Psychology: From Dual Processes to Interacting Systems. *Psychol Inq*, 166-172. doi:10.1207/s15327965pli1703_2
- Ekkekakis, P., Parfitt, G., & Petruzzello, S.J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: Decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Med*, 41(8), 641- 671. doi: 10.2165/11590680-000000000-00000
- Ekkekakis, P. (2009). Let them roam free? Physiological and psychological evidence for the potential of self-selected exercise intensity in public health. *Sports Med*, 39, 857-888. doi: 10.2165/11315210
- Eves, F. F., Scott, E. J., Hoppe, R., & French, D. P. (2007). Using the affective priming paradigm to explore the attitudes underlying walking behaviour. *Brit J Health Psych*, 12, 571-585.
- Fazio, R.H., Jackson, J.R., Dunton, B.C. & Williams, C.J. (1995). Variability in automatic activation as an unobtrusive measure of racial attitudes: A bona fide pipeline? *J Pers Soc Psychol*, 69, 1013-1027.
- Fazio, R.H. & Olson, M.A. (2003). Implicit measures in social cognition research: their meaning and use. *Annu Rev Psychol*, 54, 297-327.
- Field, A. (2013). *Discovering statistics using IBM SPSS Statistics: and sex and drugs and rock 'n' roll* (fourth edition). London: Sage publications.
- Gawronski, B. & Bodenhausen, G.V. (2006). Associative and propositional processes in evaluation: an integrative review of implicit and explicit attitude change. *Psychol Bull*, 132, 692-731.
- Greenwald, A.G., McGhee, D.E: & Schwartz, J.L.K. (1998). Measuring individual differences in

- implicit cognition: The Implicit Association Test. *J Pers Soc Psychol*, 74, 1464-1480.
- Greenwald, A. G., Nosek, B. A., and Banaji, M. R. (2003). Understanding and using the implicit association test: I. An improved scoring algorithm. *J Pers Soc Psychol*, 85, 197–216. doi: 10.1037/0022-3514.85.2.197
- Hyde, A. L., Elavsky, S., Doerksen, S. E. & Conroy, D. E. (2012). The stability of automatic evaluations of physical activity and their relations with physical activity. *J Sport Exerc Psycho*, 34(6), 715-736.
- Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristic and biases: The psychology of intuitive judgment* (pp. 49–81). New York: Cambridge University Press.
- Karpinski, A., & Steinman, R. B. (2006). The single category implicit association test as a measure of implicit social cognition. *J Pers Soc Psychol*, 91, 16.
- Keele-Smith, R. & Leon, T. (2003). Evaluation of individually tailored interventions on exercise adherence. *Western J Nurs Res*, 25(6), 623-640. doi: 10.1177/0193945903255404
- Kristiansen, C. M. & Harding, C. M. (1984). The social desirability of preventive health behavior. *Public Health Rep*, 99(4), 384 - 388.
- Kwan, B. M., & Bryan, A. (2010). In-task and post-task affective response to exercise: Translating exercise intentions into behaviour. *Brit J Health Psych*, 15, 115-131. doi: 10.1348/135910709X433267
- Marcus, B. H., Dubbert, P. M., Forsyth, L. H., McKenzie, T. L., Stone, E. J., Dunn, A. L., & Blair, S. N. (2000). Physical activity behavior change: Issues in adoption and maintenance. *Health Psychol*, 19, 32–41.
- Markland, D., Hall, C.R., Duncan, L.R. & Simatovic, J. (2015). The effects of imagery intervention on implicit exercise attitudes. *Psychol Sport Exerc*, 17, 24-31.
- Matsumoto, H. & Takenaka, K. (2004). Motivational profiles and stages of exercise behavior

- change. *International Journal of Sport and Health Science*, 2, 89-96.
- Nosek, B.A., Greenwald, A.G. & Banaji, M.R. (2007). The Implicit Association Test at age 7: a methodological and conceptual review. In *Automatic processes in social thinking and behavior*, ed J.A. Bargh (Psychology Press). 265-292
- Rebar, A.L., Ram, Nilam & Conroy, D.E. (2015). Using the EZ-diffusion model to score a Single-Category Implicit Association Test of physical activity. *Psychol Sport Exerc*, 16, 96-105.
- Sheeran, P., Gollwitzer, P.M. & Bargh, J.A. (2013). Nonconscious processes and health. *Health Psychol*, 32(5), 460-473. doi:10.1037/a0029203
- Sriram, N. & Greenwald, A. G. (2009). The Brief Implicit Association Test. *Exp Psychol*, 56(4), 283–294. doi: 10.1027/1618-3169.56.4.283
- Strack, F. & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Pers Soc Psychol Rev*, 8(3), 220-247. doi:10.1207/s15327957pspr0803_1
- Williams, D. M., Dunsiger, S., Ciccolo, J. T., Lewis, B. A., Albrecht, A. E., & Marcus, B. H. (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychol Sport Exerc*, 9, 231-245. doi: 10.1016/j.psychsport.2007.04.002

Tables and figure legends**Table 1.**

Dependent Variables	Early dropouts	Late dropouts	Maintainers
Positive associative focus	753.43 (120.83)	597.28 (79.93)	671.89 (139.80)
Negative associative focus	998.37 (266.10)	792.67 (178.13)	905.11 (339.95)
D-Score	0.40 (0.47)	0.55 (0.28)	0.52 (0.51)
Intention	4.88 (0.34)	4.85 (0.37)	4.77 (0.40)

Note. Values in braces are the standard deviations of the adherence groups mean reaction times, D-Scores or intention measure.

Figure 1. Adherence groups with temporal development of course participation.

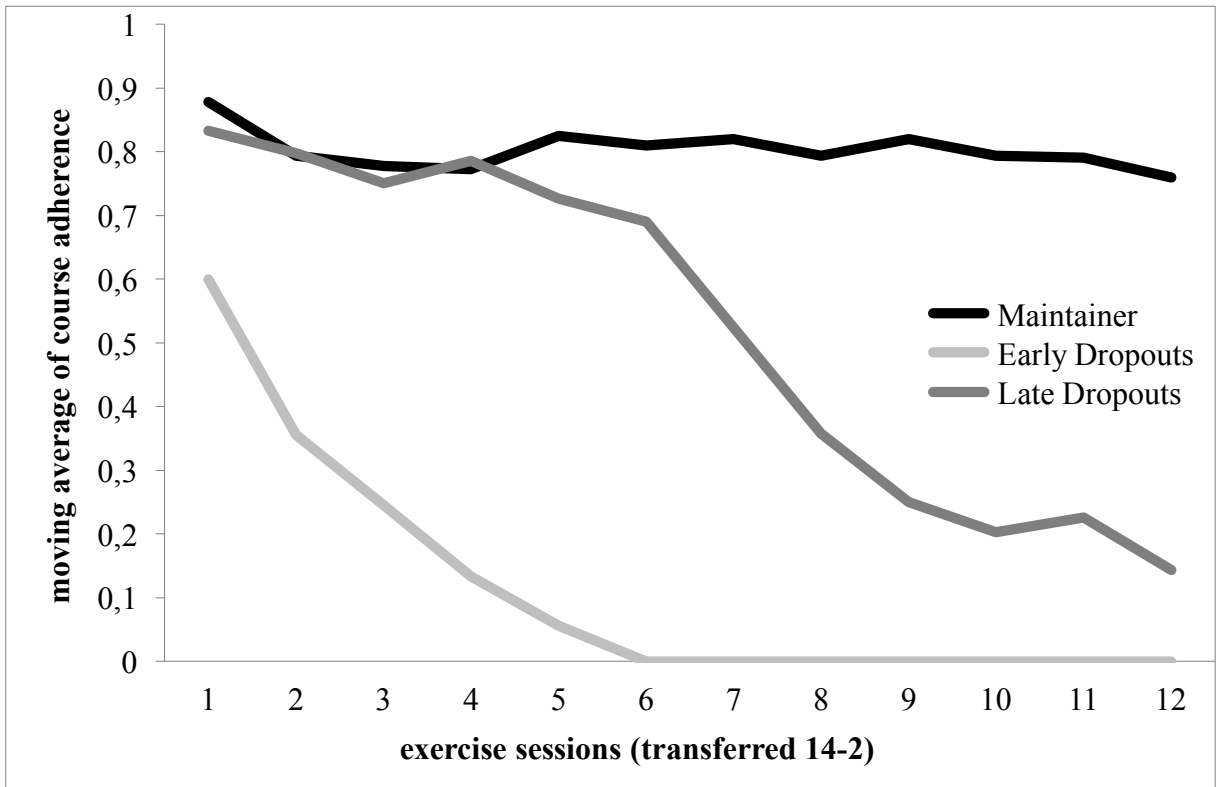


Figure 2. Mean reaction times in both BIAT Blocks.

