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# Barriers to physical activity in adolescents. A multidimensional approach

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Abstract

During adolescence, physical activity (PA) decreases with potentially serious, long-term consequences for physical and mental health. Although barriers have been identified as an important PA correlate in adults, research on adolescents' PA barriers is lacking. Thus reliable, valid scales to measure adolescents' PA barriers are needed. We present two studies describing a broad range of PA barriers relevant to adolescents with a multi-dimensional approach. In Study 1, 124 adolescents (age range: 12-24 years) reported their most important PA barriers. Two independent coders categorized those barriers. The most frequent PA barriers were incorporated in a multi-dimensional questionnaire. In Study 2, 598 adolescents (age range: 13-21 years) completed this questionnaire and reported their current PA, intention, self-efficacy, and negative outcome expectations. Seven PA barrier dimensions (leisure activities, lack of motivation, screen-based sedentary behavior, depressed mood, physical health, school workload, and preconditions) were confirmed in factor analyses. A multi-dimensional approach to measuring PA barriers in adolescents is reliable and valid. The current studies provide the basis for developing individually-tailored interventions to increase PA in adolescents.

Key words: Barriers - physical activity - adolescents - questionnaire - validation

Zusammenfassung

Im Jugendalter sinkt die körperliche Aktivität mit potenziell schwerwiegenden, langfristigen Konsequenzen für die körperliche und psychische Gesundheit. Obwohl Barrieren als wichtiges Korrelat körperlicher Aktivität von Erwachsenen gelten, sind sie bei Jugendlichen kaum untersucht. Eine Quantifizierung der Barrieren Jugendlicher durch reliable, valide Messinstrumente ist folglich unabdingbar. In zwei Studien wurde ein breites Spektrum von Barrieren körperlicher Aktivität von Jugendlichen anhand eines mehrdimensionalen Ansatzes untersucht. In Studie 1 berichteten 124 Jugendliche (Altersbereich: 12-24 Jahre) die für sie wichtigsten Barrieren körperlicher Aktivität. Diese wurden von zwei unabhängigen Kodierern kategorisiert. Die am häufigsten genannten Barrieren gingen in die Konstruktion des mehrdimensionalen Fragebogens ein. In Studie 2 beantworteten 598 Jugendliche (Altersbereich: 13-21 Jahre) diesen Fragebogen; zudem berichteten sie ihre aktuelle körperliche Aktivität, Intention, Selbstwirksamkeit und negativen Konsequenzerwartungen. Sieben Barrieren-Dimensionen wurden mittels Faktorenanalysen bestätigt (Freizeitaktivitäten, mangelnde Motivation, Medienkonsum, depressive Stimmung, körperliche Gesundheit, schulische Arbeitsbelastung, Voraussetzungen). Die Ergebnisse zeigen, dass im Jugendalter Barrieren körperlicher Aktivität anhand eines mehrdimensionalen Ansatzes reliabel und valide erfasst werden können. Die vorliegenden Studien bilden die Grundlage, um individuell auf die Barrieren von Jugendlichen zugeschnittene Interventionen zur Steigerung ihrer körperlichen Aktivität zu entwickeln.

Schlagwörter: Barrieren - körperliche Aktivität - Jugendliche - Fragebogen - Validierung

## Barriers to Physical Activity in Adolescents[1]: A Multi-Dimensional Approach

Regular moderate-to-vigorous physical activity (MVPA) in adolescents is associated with better physical and mental health, including better cardiometabolic parameters (e.g., systolic blood pressure, fasting triglycerides, high-density lipoprotein cholesterol, and insulin) and lower levels of depression and anxiety (Ekelund et al., 2012; for a review see Janssen & LeBlanc, 2010). However, during adolescence, MVPA decreases continuously (Nader, Bradley, McRitchie, Houts & O'Brien, 2008) with 90% of adolescents not reaching the 60 min MVPA per day that age-specific guidelines recommend (Jekauc, Reimers, Wagner & Woll, 2012; Troiano, Berrigan, Mâsse, Tilert & McDowell, 2008).

### *What Keeps Adolescents from Being Physically Active?*

What barriers do adolescents encounter in everyday life? The importance of barriers has been explicitly or implicitly noted by most theories of health behavior change since the 1980s. However, the definitions and theoretical roles of PA barriers vary across models, as reviewed by Brawley, Martin, and Gyurcsik (1998). Barriers (i.e., constraints that might hamper or impede an individual's engagement in a health behavior; Jackson, 1988) have been studied related to self-efficacy (i.e., beliefs about one's capability to perform a health behavior even despite the presence of barriers; Bandura, 1997), negative outcome expectations (i.e., anticipated possible negative consequences of a health behavior; Bandura, 2004; Krämer, 2014), and negative outcome experiences (i.e., actual costs of a given behavior). As Krämer and Fuchs (2010) pointed out, barriers and negative outcome expectations are distinct constructs. Negative outcome expectations, mostly conceptualized as if-then sentences (e.g., "If I am physically active, I will get laughed at"), are pre-intentional, motivational processes that emerge before an intention is formed, whereas barriers are post-intentional, volitional processes that occur before or while an intention is

[1]Following a comprehensive review published in Lancet by Sawyers and colleagues (2012), we define the term "adolescents" as those people who are between 10 and 24 years of age.

translated into a health behavior (Krämer, 2014; Krämer & Fuchs, 2010). Moreover, negative outcome expectations are distinct from negative outcome experiences. Expectations are solely anticipated, whereas experiences actually occur. In addition, negative outcome experiences can only be reported after a health behavior has been performed; barriers, however, are perceived before or while a health behavior is carried out.

In the health belief model (Janz & Becker, 1984) barriers were conceptualized as negative outcome expectations. Within the social cognitive theory (SCT), Bandura (2004) distinguished various categories of barriers (e.g., personal, social, environmental, or structural) and emphasized that self-efficacy influences a health behavior through its impact on barriers. In addition, Bandura (2006) stated that self-efficacy requires the presence of barriers because without barriers a target behavior could be performed easily and all individuals would be self-efficacious. The theory of planned behavior (TPB; Ajzen, 1985) regarded barriers as part of perceived behavioral control that is determined by an individual's control beliefs (i.e., beliefs about the presence of factors that could facilitate or impede a health behavior). Within the first published version of the health action process approach (HAPA; Schwarzer, 1992), barriers were located in the perceived and actual environment (e.g., lack of social support) and were conceptualized as post-intentional, volitional constructs. Since then, barriers have always played an important part in the HAPA. However, the most current version of the HAPA (Schwarzer, 2008; Schwarzer, Lippke & Luszczynska, 2011) integrates barriers predominantly with (action, coping, and barrier) self-efficacy with the result that barriers are measured exclusively within the framework of self-efficacy and not as a distinct construct. Following the HAPA (Schwarzer, 1992, 2008; Schwarzer et al. 2011), in Study 1 and 2 we locate adolescent-generated PA barriers within the post-intentional, volitional phase of the HAPA and studied mainly those PA barriers closely linked to barrier self-efficacy. Although barriers have been identified as important PA correlates in adults (Bauman et al., 2012), the findings in adolescents for the link between PA barriers and behavior are mixed (e.g., Biddle, Atkin, Cavill & Foster, 2011; Sallis, Prochaska & Taylor, 2000; Uijtdewilligen et al. 2011; Van der Horst, Paw, Twisk & van Mechelen, 2007).

## How to Assess Barriers to Physical Activity in Adolescents?

Two limitations of the research on the PA barrier-behavior link in adolescents could contribute to these mixed findings: the use of varying assessment approaches and varying theoretical models. First, studies of PA barriers in adolescents have mainly relied on

researcher-generated scales originally developed for adults (e.g., De Bourdeaudhuij & Sallis, 2002). Among the most commonly studied PA barriers in adults are lack of time due to work and family obligations, lack of motivation, health problems, access (lack of money and equipment, distance to facilities), and lack of skills (Gyurcsik, Spink, Bray, Chad & Kwan, 2006; Withall, Jago & Fox, 2011). There are several questionnaires addressing PA barriers in adults (e.g., Brown, 2005; Heesch, Mâsse & Dunn, 2006; for a German questionnaire, see Krämer & Fuchs, 2010). However, adolescence is a developmental period with specific challenges. Developing close peer relationships, renegotiating relationships with parents, establishing a unique sense of identity, expressing more complex and intensive emotions, managing multiple demands, and taking over responsibility are among the most important developmental tasks throughout adolescence (Dreher & Dreher, 1985; Havighurst, 1948). It is plausible that adults and adolescents show some overlap in PA barriers (e.g., lack of motivation or lack of skills), merely adapting adult-reported PA barriers to adolescents, however, does not do justice to this particular developmental period and appears to be inappropriate.

Qualitative research highlighted additional PA barriers in adolescents: meeting up with peers, competing interests, involvement in technology-related activities, and school workload (e.g., Dwyer, Allison, Goldenberg, Fein, Yoshida & Boutilier, 2006; for an overview see Pate, Saunders, O'Neill & Dowda, 2011). But reliable and valid scales for assessing PA barriers relevant to adolescents' everyday life are missing. If researchers succeed in assessing adolescents' PA barriers in a reliable and valid way, targeted interventions implementing specific barrier management strategies could be developed. Depending on the PA barriers that an adolescent perceives, personally tailored barrier management strategies and coping plans could be provided to improve PA in this age group being at risk for developing an inactive lifestyle.

## Theoretical Models of Barriers to Physical Activity

Second, the theoretical models used so far ranged from assuming single, dual, to multiple barrier dimensions and this could also contribute to the mixed findings for the link between PA barriers and behavior in adolescents. Unidimensional (i.e., general barrier) models treat all barriers as equal resulting in a mean barrier score. However, the assumption that each PA barrier will contribute equally to the prediction of behavior seems to be unlikely (De Bourdeaudhuij, Sallis & Vandelanotte, 2002). Two-dimensional (i.e., internal and external barriers) models have challenged the assumptions of unidimensional models. One qualitative

study in a sample of high-school students differentiated internal (i.e., personal) PA barriers such as lack of motivation from external (i.e., environmental) PA barriers such as having a heavy workload (Allison, Dwyer & Makin, 1999). Although this study provided a more detailed view of PA barriers than studies using a unidimensional model, both uni- and two-dimensional barrier models appear to be too unspecific for developing targeted PA interventions by reducing PA barriers in adolescents (Gyurcsik et al., 2006).

Consequently, investigating more and varying PA barriers by applying a multi-dimensional approach is particularly needed. In recent years, models of PA promotion with multiple interacting levels (personal, social, environmental, organizational, and policy-related) have received increasing attention (Sallis, Owen & Fisher, 2008; Sherar et al., 2009). In their qualitative examination of adolescents' PA barriers, Gyurcsik and colleagues (2006) assigned adolescents' answers to open-ended questions to either intrapersonal (e.g., lack of motivation), interpersonal (e.g., inactive friends), institutional (e.g., school workload), community-based (e.g., lack of transportation), environmental (e.g., lack of safety), or public policy-related PA barrier categories (e.g., laws that prohibit playing soccer in parks). Adolescents mainly reported intrapersonal, interpersonal, and institutional PA barriers. They rarely mentioned community-based and environmental PA barriers, and public policy-related PA barriers not at all (Gyurcsik et al., 2006). Interestingly, adolescents considered only three PA barrier categories as relevant to their everyday life. Considering that particularly the intrapersonal barrier category includes everything from lack of motivation and lack of skills to lack of money to health problems, a more fine-grained assessment would be more suitable to develop targeted PA barrier management strategies.

### *Research Aims and Hypotheses of the Current Studies*

To address the shortcomings of previous studies, we conducted two studies. In Study 1 (item generation and questionnaire development), adolescents generated their most important PA barriers. Two independent coders categorized the content of all adolescent-generated PA barriers. Based on the most frequently mentioned PA barriers in Study 1, Study 2 (questionnaire validation) examined the dimensional structure of these PA barriers by conducting factor analyses as well as their relationship with PA and established PA correlates. To establish criterion validity, we studied the link between the derived PA barrier dimensions and PA and intention, respectively. To determine discriminant validity, we investigated the association between PA barrier dimensions and self-efficacy and negative outcome expectations, respectively. Besides PA barriers, intention, self-efficacy, and

negative outcome expectations are among the most commonly studied PA correlates (Bauman et al., 2012). Barriers are known to have a negative impact on intention (Ajzen, 1985) and self-efficacy (Schwarzer, 2008). Moreover, there is evidence that particularly vigorous PA is inversely related to adolescents' PA barriers (Allison et al., 1999; Biddle et al., 2011; Gyurcsik, Bray & Brittain, 2004). Study 2 tested the following hypotheses: We expected that a model with several discrete PA barrier dimensions would show better fit to the data than uni- and two-dimensional models (Hypothesis 1). Moreover, we expected that the derived PA barrier dimensions would correlate negatively with moderate, moderate-to-vigorous, and vigorous PA, in particular, as well as with intention to PA (criterion validity; Hypothesis 2). In addition, we expected that the derived PA barrier dimensions would correlate negatively with PA self-efficacy and negative outcome expectations of PA (discriminant validity; Hypothesis 3).

## Study 1: Item Generation and Questionnaire Development

### *Methods*

#### *Participants*

In Study 1, which was part of a daily diary study on the link between accelerometer-based PA and affect, 124 adolescents participated; 118 participants reported at least one PA barrier (age: $M$ = 18.17±3.08 years, range: 12-24 years; 68% males). All participants attended public secondary schools (grades 7-12) in a large urban area in Germany, with 89% aiming at a higher education entrance qualification. Most participants (85%) were born in Germany; 56% had at least one parent born in another country; 50% had at least one parent with a college education or higher, of whom 33% had a university degree. Based on accelerometry, participants ($n$ = 84) spent on average 78.23± 37.01 min per day with MVPA; 64% of participants reached the MVPA guidelines for this age group (World Health Organization, WHO, 2010).

#### *Procedure*

Participants were assured that their participation would be voluntary and their answers would remain confidential. The research protocol was approved by the local Institutional Review Board. Data were collected between September and December 2011. All participants provided written informed consent.

*Measures*

Participants were asked to generate PA barriers with an open-ended format. Participants were instructed to write down up to six situations, events, people, thoughts, or feelings that kept them from being physically active in the past week.

*Analyses*

Following the approach by Gyurcsik and colleagues (2006), similar PA barriers were grouped together and labeled (preliminary categories: cognitive, emotional, motivational, physical, social, environmental, institutional PA barriers as well as lack of equipment and money, other leisure activities, and sedentary activities). Preliminary categories were based on the current literature on PA barriers in adolescents (e.g., Goh et al., 2009; Gyurcsik et al., 2006; Pate et al., 2011). Two coders categorized 10% of all open-ended answers and resolved disagreements by discussion. Then, both coders categorized the remaining 90% independently (Cohen's Kappa $\kappa = .96$).

*Results*

In Study 1, participants generated a total of 602 actually perceived PA barriers with a great overlap of responses (on average 5.02 PA barriers per participant). The selection process was guided by two criteria: adolescent-generated PA barriers should cover a broad range and should be salient to most adolescents of Study 1. We excluded very unusual PA barriers (e.g., "Smoking a joint", "Driving test"), non-specific PA barriers (e.g., "Me", "Lack of time"), or ambiguous PA barriers (e.g., "Prioritization", "Other things"). Thus, we selected the 46 *most frequently* reported, actually perceived PA barriers for Study 2.

## Study 2: Questionnaire Validation

*Methods*

*Participants*

In Study 2, 598 adolescents participated (age: $M = 17.44 \pm 1.98$ years, range: 13-21 years; 68% males). All participants attended public secondary schools (grades 8-13) in a large urban area in Germany, with 81% aiming at a higher education entrance qualification. Most participants (90%) were born in Germany; 43% had at least one foreign-born parent; 47% had at least one parent with a college education or higher, of whom 28% had a university degree. Based on the International Physical Activity Questionnaire – Short Form (IPAQ-SF, Craig et al., 2003), participants spent on average 91.35± 82.56 min per day with MVPA; 56% of participants accomplished the MVPA guidelines for this age group (WHO, 2010).

*Procedure*

In Study 2, data were collected between March and May 2012. Trained research assistants informed adolescents about the study in class, handed out a written study description, and encouraged them to ask questions. Adolescents were assured that their participation would be voluntary and their answers would remain anonymous. Participating adolescents provided verbal informed consent. They were taken to the school hall where each participant completed a package of measures at a single desk. The research protocol was approved by the local Institutional Review Board.

*Measures*

*Barriers to physical activity.* Participants rated 46 PA barriers (e.g., "I rather watched TV") which they might have actually experienced using a 4-point scale ranging from 1 (*not at all*) to 4 (*very much*) with the following instruction: "Several situations are listed below that may keep adolescents from being physically active. Please indicate how strongly each barrier kept you from being physically active *during the last week*".

*Physical activity.* We assessed PA through the 7-items version of the IPAQ, the IPAQ-SF—a frequently used, self-administered PA questionnaire, suitable for the assessment of PA in adolescents (Lopes, Gabbard & Rodrigues, 2013). Participants were asked to indicate the frequency (days per week) and duration (min per day) of moderate and vigorous PA as well as walking with reference to the past seven days. In addition, participants reported the duration of sitting for that particular time frame. We computed min per week of moderate and vigorous PA, as well as MVPA and walking. Validation studies have shown correlations between IPAQ walking and step counts as well IPAQ vigorous PA and maximal oxygen consumption, an indicator of an individual's cardiorespiratory fitness (for a review, see Lee, Macfarlane, Lam & Stuart, 2011). With regard to adolescents, the IPAQ-SF shows an acceptable correlation between light-to-vigorous PA as well as vigorous PA and maximal oxygen consumption (Rangul, Holmen, Kurtze, Cuypers & Midthjell, 2008).

*Intention, self-efficacy, and negative outcome expectations.* Following Krämer and Fuchs (2010), we measured PA intention with a single item ("Regarding last week, how strong was your intention to be physically active?") using a 4-point scale ranging from 1 (*not at all strong*) to 4 (*very strong*) and PA self-efficacy with three items ("I think I will be able to start being physically active," "to maintain PA for several months," and "to start being physically active again after a long pause") using a 6-point scale ranging from 1 (*not at all true*) to 6 (*exactly true*). For PA self-efficacy, Cronbach's alpha was $\alpha = .79$. Following

Fuchs (1994), we assessed negative outcome expectations of PA with 13 items (e.g., "If I am physically active, I will get laughed at") on a 4-point scale ranging from 1 (*not at all true*) to 4 (*completely true*). For negative outcome expectations of PA, Cronbach's alpha was $\alpha$ = .76.

*Analyses*

In Study 2, we divided the sample ($N$ = 598) into two random subsamples (Subsample A: $n$ = 400; Subsample B: $n$ = 198) and conducted the main analyses with Mplus 7.0 in three basic steps. First, we performed an exploratory factor analysis (EFA) with maximum likelihood (ML) estimation and oblimin rotation in Subsample A. An advantage of using Mplus is that results of EFA can be interpreted by means of established continuous fit indices enabling researchers to make an informed choice about the number of factors to extract (for a review see Fabrigar, Wegener, MacCallum & Strahan, 1999). Model fit was evaluated with the $\chi^2$-test, the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). We chose the first solution with a good model fit resulting in a minimum number of factors. Item selection was based on EFA results. Only items showing their highest and significant EFA loading on a barrier factor were selected to represent that factor.

Second, we tested the resulting model with a confirmatory factor analysis (CFA) in Subsample B by using MLR estimation (ML with robust standard errors). We evaluated the model fit by using $\chi^2$-test, CFI, RMSEA, and SRMR (Beauducel & Wittmann, 2005). For model identification, we fixed the first loading of each factor to one. We allowed all factors to correlate. To underline the strength of our CFA results, we also provided a bootstrapped version of the CFA. We decided to use a subsample of two-third of all participants for the EFA and one-third for the CFA, as the exploratory part includes all items and is the basis for item selection. Both subsamples fulfill common sample size suggestions for EFA and CFA, respectively (e.g., Bühner, 2011).

Third, we correlated all barrier factors with validity criteria (PA and PA intention to establish criterion validity, PA self-efficacy and negative outcome expectations of PA to examine discriminant validity) by means of MLR estimation (Subsample B). To examine the quality of each barrier item, we performed an item analysis by using SPSS 21.0. Internal consistencies (Cronbach's alpha) were computed.

*Results*

In Study 2, in a first step, we conducted an EFA with ML estimation and oblimin rotation with all 46 barrier items in Subsample A ($n$ = 400). Fit indices for one- to eight-factor models are shown in Table 1. The fit of a one-factor solution up to a five-factor solution was unacceptable. Naturally the fit becomes better with more factors being extracted. We aimed at identifying the first model with an acceptable fit but the most parsimonious model according to the number of factors. The six-factor model tended towards a satisfactory fit, but the CFI was still under .90. The seven-factor model was the first with an acceptable fit in all indices. To prevent over-factoring, we specified that (a) all factors had to be represented by at least three significant items showing their highest loading on that factor and (b) all items of a factor should theoretically integrate to a plausible dimension. As the seven-factor solution did fully meet these criteria, we extracted seven factors (leisure activities, lack of motivation, screen-based sedentary behavior, depressed mood, physical health, school workload, and preconditions). All eigenvalues were above one, with the smallest eigenvalue 1.49 for physical health. Only items showing their highest significant loading on a factor were selected to represent that factor resulting in 25 out of 46 items with factor loadings between .35 and .86.

[TABLE 1 INSERT HERE]

In a second step, we conducted a CFA with MLR estimation in Subsample B ($n$ = 198). We used the seven-factor solution of the EFA resulting in 25 items. The model showed a descriptively acceptable fit, $\chi^2(df = 254) = 391.90$, $p < .01$, CFI = .90, RMSEA = .05 (90% CI = .04-.06), and SRMR = .06. All factors had meaningful variances and all standardized factor loadings were significant and over .48. Significant factor intercorrelations ranged between .24 (screen-based sedentary behavior and physical health) and .79 (leisure activities and lack of motivation), implying discrete but dependent dimensions (Figure 1). The factor correlation of .79 was the only one high enough to question the uniqueness and necessity of both factors. However, fixing the factor correlation to 1 resulted in a significantly worse model fit ($\Delta \chi^2$ ($df$ =1) = 22.74, $p < .01$; Satorra-Bentler scaled $\chi^2$-difference test; Satorra & Bentler, 2001), implying that both factors cannot be subsumed to one.

For the presentation of results, we bootstrapped the CFA three times with a Bollen-Stine bootstrap. We extracted 200, 250, and 300 draws from Subsample B. All requested draws were completed in all three sequences. The new model fit was $\chi^2(df = 254) = 464.39$, $p = .06$, CFI = .89, RMSEA = .07 (90% CI = .06-.07), and SRMR = .06 for the three draws. The

bootstrap *p*-value was insignificant three times, indicating an acceptance of our CFA model. All factor loadings were significant ($p < .01$) in all three draws. Therefore, the bootstrapped CFA was in line with the MLR estimation.

[FIGURE 1 INSERT HERE]

We also investigated the fit of a uni- (i.e., general barriers) and a two-dimensional model (i.e., internal and external barriers) to the selected 25 items and tested both against our seven-factor model (Subsample B, MLR estimation). A one-factor model revealed an unacceptable fit, $\chi^2(df = 275) = 985.85$, $p < .01$, CFI = .50, RMSEA = .11 (90% CI = .11-.12), and SRMR = .12, as did a two-factor model with internal and external barriers, $\chi^2(df = 274) = 781.97$, $p < .01$, CFI = .64, RMSEA = .10 (90% CI = .09-.11), and SRMR = .12. Both, the uni- and the two-factor model, were significantly worse than the seven-factor comparison model, $\Delta \chi^2 (df = 21) = 394.59$, $p < .01$ (for the one-factor model) and $\Delta \chi^2 (df = 20) = 267.63$, $p < .01$ (for the two-factor model; Satorra-Bentler scaled $\chi^2$-difference test).

We then correlated the seven barrier factors with three validity criteria (Subsample B, MLR estimation). Vigorous PA correlated negatively with all barrier factors, except preconditions and physical health. PA intention and self-efficacy were negatively associated with the barrier dimensions leisure activities, lack of motivation, screen-based sedentary behavior, and depressed mood. PA self-efficacy was also inversely related to the barrier dimension of preconditions. There was no significant association between PA intention and self-efficacy to the barrier dimensions of school workload and physical health. Negative outcome expectations of PA correlated positively with all barrier dimensions. Correlations between PA barriers and PA, PA intention, PA self-efficacy, and negative outcome expectations are described in Table 2. Results of the item analysis can be found in Table 3.

[TABLE 2 INSERT HERE]

[TABLE 3 INSERT HERE]

## General Discussion

Study 1 and Study 2 aimed to gain a better insight into PA barriers relevant to adolescents. We developed (Study 1) and validated (Study 2) a multi-dimensional PA barrier questionnaire, particularly adapted for this age group. In Study 1, adolescents generated PA barriers. After two independent coders categorized all adolescent-generated PA barriers based on the current literature, 46 common PA barriers covering a broad range were selected for Study 2. In Study 2, we found a multi-dimensional structure of PA barriers indicating that adolescents perceive a wide range of barriers. In line with Hypothesis 1, a multi-

dimensional PA barrier model outperformed a uni- and a two-dimensional model suggesting that both approaches (i.e., treating all PA barriers as equal, unidimensional model; dividing PA barriers into internal and external categories, two-dimensional model) are suboptimal ways to measure PA barriers in adolescents. We confirmed seven discrete but related barrier dimensions comprising 25 PA barriers: leisure activities, lack of motivation, screen-based sedentary behavior, depressed mood, physical health, school workload, and preconditions.

Barrier Dimension 1, leisure activities, included meeting with peers, other favored weekend activities, and other favored hobbies. During adolescence, developmental tasks like developing close and stable peer relationships and establishing a unique sense of identity (like exploring varying leisure activities within a peer social network) become increasingly important. As leisure time priorities are known to change during adolescence (Slater & Tiggemann, 2010; Whitehead & Biddle, 2008), a discrete barrier dimension capturing leisure activities appears to be particularly needed for this age group. In line with De la Haye, Robins, Mohr and Wilson (2011), there is also evidence that adolescents tend to adopt their friends' PA behavior. Thus, meeting with less active peers presents a central PA barrier on its own for adolescents. Barrier Dimension 2, lack of motivation, corresponded to adolescents' feelings of fatigue and laziness (not feeling like it, being too tired, and being too lazy), a common PA barrier in adolescents (Saxena, Borzekowski & Rickert, 2002). Screen-based sedentary activities (surfing the internet, watching TV, and playing computer games), Barrier Dimension 3, are popular recreational activities of adolescents known to compete with their PA behavior (Dwyer et al., 2006; Wong et al., 2010). Barrier Dimension 4, depressed mood (feeling blue, mulling things over, and bad mood) and mood swings are associated with the developmental task of expressing more complex and intense emotions, making it harder for adolescents to engage in PA, consistent with previous research (Birkeland, Torsheim & Wold, 2009; Sabiston et al., 2013). Barrier Dimension 5 (physical health) contained illness and injuries. Health problems like asthma are known to be an important barrier to PA (Glazebrook et al., 2006), despite being less commonly reported by our sample. Barrier Dimension 6, school workload, encompassed large amounts of homework, long schooldays, and exam preparation. Managing school obligations is associated with graduating and preparing for the labor market. This central developmental task in adolescence is among the most important PA barriers in this age group (e.g., Allison et al., 1999). Barrier Dimension 7, preconditions, also less frequently reported by our sample, comprised high costs, long distance to recreational facilities, and low perceived

control over being physically active. These barriers are known to keep adolescents from PA, particularly those of low socioeconomic status (Withall et al., 2011).

As expected in Hypothesis 2, most PA barriers correlated negatively with vigorous PA, in line with previous research (Allison et al., 1999; Gyurcsik et al., 2004). Preconditions and physical health were not related to PA indicating that our participants may have had favorable conditions to PA and were in good health. Walking and moderate PA were less strongly associated with barriers suggesting that adolescents perceived vigorous PA as more demanding or as the prototype of PA when reporting PA barriers. Moreover, vigorous PA is perhaps more salient to adolescents since it is commonly pre-planned (e.g., playing basketball in a sports club at a definite time). PA intention was only negatively associated with leisure activities, lack of motivation, screen-based sedentary behavior, and depressed mood. PA self-efficacy was inversely related to all PA barrier dimensions except school workload and physical health. Interestingly, these PA barriers are predominantly open to adolescents' influence (as opposed to physical health and school workload being outside of adolescents' control) and, therefore, can be considered as intrapersonal in the broadest sense. As PA intention and PA self-efficacy are cognitive PA correlates, they can be referred to as intrapersonal as well. Hence, it may be not surprising that PA correlates that are considered intrapersonal and can basically be changed by adolescents themselves are interrelated. As expected, negative outcome expectations of PA were positively associated with all PA barrier dimensions. The low correlations we found between both variables correspond to previous research (Krämer & Fuchs, 2010) and support our assumption that PA barriers are actually distinct from negative outcome expectations of PA. Hence, both criterion validity (negative correlations between PA barriers and PA as well as between PA barriers and intention; Hypothesis 2) and discriminant validity (negative correlations between PA barriers and self-efficacy as well as positive correlations between PA barriers and negative outcome expectations; Hypothesis 3) of our multi-dimensional PA barrier questionnaire were largely supported.

Our two studies make a number of contributions. First, we focused on PA barriers that adolescents self-generated spontaneously. Participants of both studies lived in a large urban area in Germany with walkable, safe neighborhoods, and good opportunities for PA (Buehler, Pucher, Merom & Bauman, 2011). As such, these studies address PA barriers when the environment is favorable. These results are a good starting point for developing, improving, and testing psychosocial interventions (i.e., coping planning) to tackle the

adolescent-perceived PA barriers we found. Adolescents living in environments with less favorable conditions to PA will likely benefit from these psychosocial interventions, too, but will need complementary environmental interventions to encourage PA (De Meester, Van Dyck, De Bourdeaudhuij, Deforche & Cardon, 2013). Second, as Study 1 followed a qualitative research approach, only PA barriers particularly relevant to adolescents were investigated in Study 2. This means that in addition to numerous well-studied PA barriers (Pate et al., 2011) PA barriers like screen-based sedentary activities—central to adolescents' everyday life—were studied as well. Third, in Study 2, the validation of a multi-dimensional PA barrier questionnaire was based on a large sample of adolescents, comparable to those who participated in Study 1, with diverse social and ethnic backgrounds, allowing for increased generalizability. Fourth, as opposed to many other researchers, using predominantly principal component analysis (PCA), we conducted CFA to evaluate the multi-dimensional nature of adolescents' PA barriers. As opposed to PCA, CFA is the only suitable method for explaining item interrelations and testing, whether complex data fit a hypothesized model.

Despite its contributions, Study 2 has some limitations. First, adolescents retrospectively reported their PA barriers with reference to the last week. Self-report instruments can be biased. However, the short recall period should facilitate recall from memory and alleviate bias and heuristics use, leading to more valid results than longer or nonspecific reference periods in similar studies (e.g., "generally", Allison et al., 1999; De Bourdeaudhuij & Sallis, 2002; Krämer & Fuchs, 2010; "barriers within the last six months", Gyurcsik et al., 2006). Second, we did not assess adolescents' environmental conditions to PA such as neighborhood walkability, because the environment was universally walkable and safe (Buehler et al., 2011) and was very rarely reported as a PA barrier in Study 1. Environmental PA barriers may be more important for adolescents in neighborhoods less conducive to PA. However, our study shows that even in environments that are walkable and safe adolescents still encounter psychosocial barriers that keep them from being active and thus deserve research attention. Third, as most other PA self-report questionnaires (Adamo, Prince, Tricco, Connor-Gorber & Tremblay, 2009; Prince et al., 2008), the IPAQ-SF (Craig et al., 2003) tends to overestimate the actual amount of PA. Probably due to the reference period (i.e., the last seven days), the IPAQ-SF shows a low test-retest reliability. It can be assumed that PA may vary considerably from week to week, especially among younger adolescents (Rangul et al., 2008). However, light-to-vigorous PA as well as vigorous PA as measured by

the IPAQ-SF show an acceptable correlation with cardiorespiratory fitness in adolescents (Rangul et al., 2008). A next step of this research program will be the assessment of PA with accelerometers in addition to self-report. In both studies participants tended to be rather physically active. In future studies, more physically inactive participants should be included to test whether physically inactive participants report qualitatively other PA barriers compared to physically active participants. Fourth, when studying a broad age range as was the case in the current studies, it would be desirable to examine larger and equally sized age groups. Fifth, when studying PA barriers and their association with other social-cognitive variables in future studies, three further aspects should be considered. Recent models of health behavior change such as the HAPA (Schwarzer, 2008; Schwarzer et al., 2011) differentiate social-cognitive processes that lead to forming a goal (motivational processes) from processes after a goal has been set (volitional processes). Thus, the phase-specificity of social-cognitive variables including PA barriers should be examined more carefully in future research. Future studies should investigate action, coping, and barrier self-efficacy together to distinguish their specific relationships with various PA barriers. However, in Study 1, adolescents self-generated solely those PA barriers closely linked to the concept of barrier self-efficacy (e.g., “I am confident that I will engage in regular PA, even if I feel depressed”; Renner et al., 2012). Barriers that are addressed by action self-efficacy (i.e., lack of goal setting and planning ability; e.g., “I am confident that I will engage in regular PA, even if I have to make a detailed plan”; Renner et al., 2012) and coping self-efficacy (i.e., lack of perseverance and social support; e.g., “I am confident that I will engage in regular PA, even if I have to try several times until it works”; Renner et al., 2012) did not cross adolescents’ minds when being asked to report their most important PA barriers. Nevertheless, examining PA barriers that are related to action and coping self-efficacy seems promising and it would be very interesting to study whether adolescents can become more aware of these types of barriers. Moreover, measuring self-efficacy more comprehensively with multiple items and differentiating action, coping, and barrier self-efficacy (Renner et al., 2012; Scholz et al., 2005; Schwarzer & Renner, 2000) could lead to even higher correlations between barriers and self-efficacy than those found in Study 2. Moreover, besides negative outcome expectations (in the motivational phase), negative outcome experiences (i.e., actual costs) of being physically active (in the volitional phase) should also be measured to differentiate negative outcome experiences from barriers of PA. Finally, further health-related cognitions that emerge in the volitional phase such as action planning (i.e., a person specifies where,

when, and how he or she will be physically active) and coping planning (i.e., a person anticipates possible PA barriers and considers an alternative behavior to overcome these PA barriers) should be assessed as additional validity criteria in future research (Renner et al., 2012).

Study 1 and Study 2 have important implications for the development of targeted PA interventions. Given the need for intervention programs and their limited success (Bauman et al., 2012; Metcalf, Henley & Wilkin, 2012) the development of PA barrier management strategies that are tailored to discrete PA barrier dimensions could be promising. Using a comprehensive barrier questionnaire as a step within PA interventions may help participants to become aware of a range of PA barriers—not only the most salient ones. Adolescents could then also generate additional barriers that are too infrequent to include in a questionnaire. Coping planning as well as using facilitators such as social support could be intervention strategies to address these barriers. Using planning not only to react to barriers once they occur but rather to preventively circumvent potential PA barriers could improve intervention effects further (Stadler, Oettingen & Gollwitzer, 2009). Study 2 has additional theoretical implications. Barrier self-efficacy emerges primarily in the volitional phase of the HAPA, that is, during the period of adaption and maintenance of a target health behavior (Renner et al., 2012). But some barriers could also impede the formation of intentions. Future studies should examine if some barriers emerge predominantly in the motivational phase (e.g., lack of planning ability, lack of motivation, chronic illness) and impact most likely the formation of an intention, while others rather impact volitional processes (e.g., lack of social support or perseverance, heavy school workload, acute illness), i.e., the adaptation and maintenance of a health behavior.

To conclude, both studies revealed that a multi-dimensional approach to measuring PA barriers in adolescents is reliable and valid. Hence, the current studies will contribute to a better understanding of how to address a broad range of adolescents' PA barriers in health research and practice.

References

Adamo K. B., Prince, S. A., Tricco, A. C., Connor-Gorber, S. & Tremblay, M. (2009). A comparison of indirect versus direct measures for assessing physical activity in the pediatric population: A systematic review. *International Journal of Pediatric Obesity, 4*, 2–27.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action control: From cognition to behavior* (pp. 11-40). Berlin: Springer.

Allison, K. R., Dwyer, J. J. M. & Makin, S. (1999). Perceived barriers to physical activity among high school students. *Preventive Medicine, 28*, 608–615.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education and Behavior, 31*, 143–164.

Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. C. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 307–337). Greenwich, CT: IAP.

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J. F. & Martin, B. W. (2012). Correlates of physical activity: why are some people physically active and others not? *Lancet, 380*, 258–271.

Beauducel, A. & Wittmann, W. W. (2005). Simulation study on fit indices in confirmatory factor analysis based on data with slightly distorted simple structure. *Structural Equation Modeling, 12*, 41–75.

Biddle, S. J. H., Atkin, A. J., Cavill, N. & Foster, C. (2011). Correlates of physical activity in youth: a review of quantitative systematic reviews. *International Review of Sport and Exercise Psychology, 4*, 25–49.

Biddle, S. J. H. & Mutrie, N. (Eds.). (2008). *Psychology of physical activity: Determinants, well-being, and interventions*. New York, NY: Routledge.

Birkeland, M. S., Torsheim, T. & Wold, B. (2009). A longitudinal study of the relationship between leisure time physical activity and depressed mood among adolescents. *Psychology of Sport and Exercise, 10*, 25–34.

Brawley, L. R., Martin, K. A. & Gyurcsik, N. C. (1998). Problems in assessing perceived barriers to exercise: Confusing obstacles with attributions and excuses. In J. L. Duda (Ed.), *Advances in measurement in sport and exercise psychology* (pp. 337-350). Morgantown, WV: Fitness Information Technology.

Brown, S. (2005). Measuring perceived benefits and perceived barriers for physical activity. *American Journal of Health Behavior, 29*, 107–116.

Buehler, R., Pucher, J., Merom, D. & Bauman, A. (2011). Active travel in Germany and the U.S. Contributions of daily walking and cycling to physical activity. *American Journal of Preventive Medicine, 41*, 241–250.

Bühner, M. (Ed.). (2011). *Einführung in die Test- und Fragebogenkonstruktion* [Introduction to test construction and questionnaire development]. München: Pearson Studium.

Craig, C. L., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E. et al. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise, 35*, 1381–1395.

De Bourdeaudhuij, I. & Sallis, J. F. (2002). Relative contribution of psychosocial variables to the explanation of physical activity in three population-based adult samples. *Preventive Medicine, 34*, 279–288.

De Bourdeaudhuij, I., Sallis, J. F. & Vandelanotte, C. (2002). Tracking and explanation of physical activity in young adults over a 7-year period. *Research Quarterly for Exercise and Sport, 73*, 376–385.

De la Haye, K., Robins, G., Mohr, P. & Wilson, C. (2011). How physical activity shapes, and is shaped by, adolescent friendships. *Social Science & Medicine, 73*, 719–728.

De Meester, F., Van Dyck, D., De Bourdeaudhuij, I., Deforche, B. & Cardon, G. (2013). Do psychosocial factors moderate the association between neighborhood walkability and adolescents' physical activity? *Social Science & Medicine, 81*, 1–9.

Dreher, E. & Dreher, M. (1985). Entwicklungsaufgaben im Jugendalter: Bedeutsamkeit und Bewältigungskonzepte [Developmental tasks in adolescence: Meaning and coping concepts]. In D. Liepmann & A. Stiksrud (Eds.), *Entwicklungsaufgaben und Bewältigungsprobleme in der Adoleszenz* (pp. 56–70). Göttingen: Hogrefe.

Dwyer, J. J., Allison, K. R., Goldenberg, E. R., Fein, A. J., Yoshida, K. K. & Boutilier, M. A., (2006). Adolescent girls' perceived barriers to participation in physical activity. *Adolescence, 41*, 75–89.

Ekelund, U., Luan, J., Sherar, L. B., Esliger, D. W., Griew, P. & Cooper, A. (2012). Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *Journal of the American Medical Association, 307*, 704–712.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C. & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*, 272–299.

Fuchs, R. (1994). Konsequenzerwartungen als Determinante des Sport- und Bewegungsverhaltens. *Zeitschrift für Gesundheitspsychologie, 2*, 269–291.

Glazebrook, C., McPherson, A. C., Macdonald, I. A., Swift, J. A., Ramsay, C., Newbould, R. et al. (2006). Asthma as a barrier to children's physical activity: implications for body mass index and mental health. *Pediatrics, 118*, 2443–2449.

Goh, Y.-Y., Bogart, L. M., Sipple-Asher, B. K., Uyeda, K., Hawes-Dawson, J., Olarita-Dhungana et al. (2009). Using community-based participatory research to identify potential interventions to overcome barriers to adolescents' healthy eating and physical activity. *Journal of Behavioral Medicine, 32*, 491–502.

Gyurcsik, N. C., Bray, S. R. & Brittain, D. R. (2004). Coping with barriers to vigorous physical activity during transition to university. *Family & Community Health, 27*, 130–142.

Gyurcsik, N. C., Spink, K. S., Bray, S. R., Chad, K. & Kwan, M. (2006). An ecologically based examination of barriers to physical activity in students from grade seven through first-year university. *Journal of Adolescent Health, 38*, 704–711.

Havighurst, R. J. (1948). *Developmental task and education*. Chicago, IL: University of Chicago.

Heesch, K., Mâsse, L. & Dunn, A. (2006). Using Rasch modeling to re-evaluate three scales related to physical activity: Enjoyment, perceived benefits and perceived barriers. *Health Education Research, 21*, 58–72.

Jackson, E. L. (1988). Leisure constraints: A survey of past research. *Leisure Sciences, 10*, 203–215.

Janssen I. & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity, 7*(40).

Janz, N. K. & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly, 11*, 1–47.

Jekauc, D., Reimers, A. K., Wagner, M. O. & Woll, A. (2012). Prevalence and socio-demographic correlates of the compliance with the physical activity guidelines in children and adolescents in Germany. *BMC Public Health, 12*(714).

Krämer, L. (2014). Barrieren, gesundheitsbezogene [barriers, health-related]. In M. A. Wirtz (Ed.), *Dorsch - Lexikon der Psychologie* (pp. 238). Bern: Huber.

Krämer, L. & Fuchs, R. (2010). Barrieren und Barrierenmanagement im Prozess der Sportteilnahme: Zwei neue Messinstrumente [Barriers and barrier management in physical exercise: introduction of two new assessment instruments]. *Zeitschrift für Gesundheitspsychologie, 18*, 170–182.

Lee, P. H., Macfarlane, D. J., Lam, T. H. & Stuart, S. M. (2011). Validity of the International Physical Activity Questionnaire Short Form (IPAQ-SF): A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 8*(115).

Lopes, V. P., Gabbard, C. & Rodrigues, L. P. (2013). Physical activity in adolescents: examining influence of the best friend dyad. *Journal of Adolescent Health, 52*, 752–756.

Luszczynska, A. & Schwarzer, R. (2003). Planning and self-efficacy in the adoption and maintenance of breast self-examination: A longitudinal study on self-regulatory cognitions. *Psychology and Health, 18*, 93–108.

Metcalf, B., Henley, W. & Wilkin, T. (2012). Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes. *British Medical Journal, 345*(e5888).

Nader, P. R., Bradley, R. H., McRitchie, S. L., Houts, R. M. & O'Brien, M. (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *Journal of the American Medical Association, 300*, 295–305.

Pate, R. R., Saunders, R. P., O'Neill, J. R. & Dowda, M. (2011). Overcoming barriers to physical activity: helping youth be more active. *ACSM's Health and Fitness Journal, 15*, 7–12.

Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Connor Gorber, S. & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: A systematic review. *International Journal of Behavioral and Nutrition and Physical Activity, 5*(56).

Rangul, V., Holmen, T. L., Kurtze, N., Cuyper, K. & Midthjell, K. (2008). Reliability and validity of two frequently used self-administered physical activity questionnaires in adolescents. *BMC Medical Research Methodology*, *8*(47).

Renner, B., Hankonen, N., Ghisletta, P. & Absetz, P. (2012). Dynamic psychological and behavioral changes in the adoption and maintenance of exercise. *Health Psychology, 31*, 306–315.

Sabiston, C. M., O'Loughlin, E., Brunet, J., Chaiton, M., Low, N. C., Barnett, T. et al. (2013). Linking depression symptom trajectories in adolescence to physical activity and team sports participation in young adults. *Preventive Medicine, 56*, 95–98.

Sallis, J. F., Owen, N. & Fisher, E. B. (2008). Ecological models of health behavior. In K. Glanz, B. K. Rimer & K. Viswanath (Eds.), *Health behavior and health education: Theory, research, and practice* (pp. 465–485). San Francisco, CA: Wiley.

Sallis, J. F., Prochaska, J. J. & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine & Science in Sports & Exercise, 32*, 963–975.

Satorra, A. & Bentler, P. M. (2001). A scaled difference $\chi^2$ test statistic for moment structure analysis. *Psychometrika, 66*, 507–514.

Sawyer, S. M., Afifi, R. A., Bearinger, L. H., Blakemore, S.-J., Dick, B., Ezeh, A. C. et al. (2012). Adolescence: A foundation for future health. *Lancet, 379*, 1630–1640.

Saxena, R., Borzekowski, D. L. G. & Rickert, V. I. (2002). Physical activity levels among urban adolescent females. *Journal of Pediatric and Adolescent Gynecology, 15*, 279–284.

Scholz, U., Sniehotta, F. F. & Schwarzer, R. (2005). Predicting physical exercise in cardiac rehabilitation: The role of phase-specific self-efficacy beliefs. *Journal of Sport & Exercise Psychology, 27*, 135–151.

Schwarzer, R. (1992). Self-efficacy in the adoption and maintenance of health behaviors: Theoretical approaches and a new model. In R. Schwarzer (Ed.), *Self-efficacy: Thought control of action* (pp. 217–243). Washington, DC: Hemisphere.

Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: An International Review, 57*, 1–29.

Schwarzer, R., Lippke, S. & Luszczynska, A. (2011). Mechanisms of health behavior change in persons with chronic illness or disability: the Health Action Process Approach (HAPA). *Rehabilitation Psychology, 56*, 161–170.

Schwarzer, R. & Renner, B. (2000). Social-cognitive predictors of health behavior: Action self-efficacy and coping self-efficacy. *Health Psychology, 19*, 487–495.

Sherar, L. B., Gyurcsik, N. C., Humbert, M. L., Dyk, R. F., Fowler-Kerry, S. & Baxter-Jones, A. D. (2009). Activity and barriers in girls (8-16 yr) based on grade and maturity status. *Medicine & Science in Sports & Exercise, 41*, 87–95.

Slater, A. & Tiggemann, M. (2010). "Uncool to do sport": A focus group study of adolescent girls' reasons for withdrawing from physical activity. *Psychology of Sports and Exercise, 11*, 619–626.

Stadler, G., Oettingen, G. & Gollwitzer, P. M. (2009). Physical activity in women: effects of a self-regulation intervention. *American Journal of Preventive Medicine, 36*, 29–34.

Troiano, R. P., Berrigan, D., Mâsse, L. C., Tilert, T. & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine & Science in Sports & Exercise, 40*, 181–188.

Uijtdewilligen, L., Nauta, J., Singh, A. S., van Mechelen, W., Twisk, J. W. R., van der Horst, K. et al. (2011). Determinants of physical activity and sedentary behaviour in young people: a review and quality synthesis of prospective studies. *British Journal of Sports Medicine, 45*, 896–905.

Van der Horst, K., Paw, M. J., Twisk, J. W. & van Mechelen, W. (2007). A brief review on correlates of physical activity and sedentariness in youth. *Medicine & Science in Sports & Exercise, 39*, 1241–1250.

Whitehead, S. & Biddle, S. J. H. (2008). Adolescent girls' perceptions of physical activity: A focus group study. *European Physical Education Review, 14*, 243–262.

Withall, J., Jago, R. & Fox, K. R. (2011). Why some do but most don't. Barriers and enablers to engaging low-income groups in physical activity programmes: A mixed methods study. *BMC Public Health*, *11*(507).

Wong, B. Y., Cerin, E., Ho, S. Y., Mak, K.-K., Lo, W.-S. & Lam, T.-H. (2010). Adolescents' physical activity: competition between perceived neighborhood sport facilities and home media resources. *International Journal of Pediatric Obesity, 5*, 169–176.

World Health Organization. (2010). *Global recommendations on physical activity for health*. Geneva, Swiss: World Health Organization.

Titles of Figures

*Figure 1.* Seven-factor model of PA barriers.

*Note*. Digits represent item numbers (boxes), factor loadings (arrows), or latent factor correlations (curves). LEI = leisure activities; LAC = lack of motivation; SCR = screen-based sedentary behavior; DEP = depressed mood; PHY = physical health; SCH = school workload; PRE = preconditions.

* $p < .05$. ** $p < .01$. *** $p < .001$.

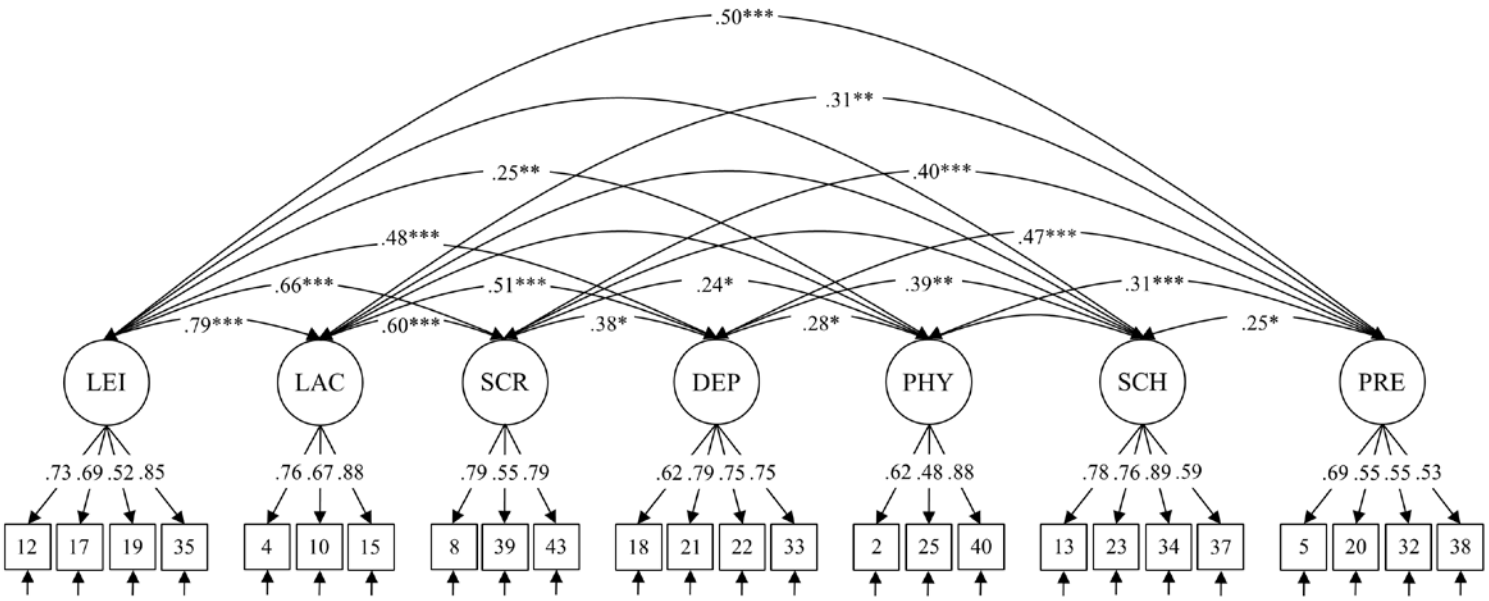

Table 1

*Model Fit in Exploratory Factor Analysis (n = 400)*

| Factors Extracted | $\chi^2$ | *df* | *p* | CFI | RMSEA | 90% CI | SRMR |
|---|---|---|---|---|---|---|---|
| 1 | 4139.06 | 989 | < .001 | .55 | .09 | .09-.09 | .09 |
| 2 | 3287.82 | 944 | < .001 | .66 | .08 | . 08-.08 | .07 |
| 3 | 2703.20 | 900 | < .001 | .74 | .07 | .07-.07 | .06 |
| 4 | 2304.37 | 857 | < .001 | .79 | .07 | .06-.07 | .05 |
| 5 | 1919.94 | 815 | < .001 | .84 | .06 | .06-.06 | .04 |
| 6 | 1630.96 | 774 | < .001 | .88 | .05 | .05-.06 | .04 |
| 7 | 1403.81 | 734 | < .001 | .90 | .05 | .04-.05 | .03 |
| 8 | 1243.80 | 695 | < .001 | .92 | .04 | .04-.05 | .03 |

*Note.* CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

Table 2

*Standardized Correlations between Barriers, Physical Activity, Intention, Self-Efficacy, and Negative Outcome Expectations (n = 198)*

| Barriers | WALK | MPA | VPA | MVPA | Intention | Self-efficacy | Negative outcome expectations |
|---|---|---|---|---|---|---|---|
| LEI | .03 | -.12** | -.25** | -.21** | -.43*** | -.23* | .50*** |
| LAC | -.07 | -.21** | -.33** | -.32** | -.46** | -.36*** | .44*** |
| SCR | -.12* | -.09* | -.20** | -.16** | -.39*** | -.29** | .29*** |
| DEP | -.01 | -.09* | -.16** | -.15** | -.33*** | -.29*** | .35*** |
| PHY | .02 | -.06 | -.08 | -.08 | -.01 | -.11 | .18** |
| SCH | -.05 | -.06 | -.09* | -.08* | .03 | -.01 | .18** |
| PRE | -.02 | -.01 | -.07 | -.05 | -.22 | -.36*** | .53*** |

*Note.* LEI = leisure activities; LAC = lack of motivation; SCR = screen-based sedentary behavior; DEP = depressed mood; PHY = physical health; SCH = school workload; PRE = preconditions; WALK = walking (min per week); MPA = moderate physical activity (min per week); VPA = vigorous physical activity (min per week); MVPA = moderate-to-vigorous physical activity including walking (min per week).

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3

*Results of Item Analysis and Cronbach's Alpha for all Barriers (N = 598)*

| Barriers | *M* (*SD*)[a] | $r_{it}$ | *p* |
|---|---|---|---|
| Leisure Activities (α = .76) | 2.32 (0.82) | | |
| (12) I wanted to do something else on the weekend [Ich wollte am Wochenende etwas anderes machen]. | 2.50 (1.13) | .56 | 50 |
| (17) Other hobbies were more important to me [Mir waren andere Hobbies wichtiger]. | 2.60 (1.05) | .55 | 32 |
| (19) I preferred to meet my friends [Ich habe mich lieber mit Freunden getroffen]. | 1.97 (1.04) | .48 | 53 |
| (35) During leisure time, I rather did something else [Ich habe in meiner Freizeit lieber etwas Anderes gemacht]. | 2.21 (1.07) | .65 | 40 |
| Lack of Motivation (α = .77) | 2.27 (0.88) | | |
| (4) I did not feel like it [Ich hatte keine Lust]. | 2.24 (1.07) | .64 | 41 |
| (10) I was too tired [Ich war zu müde]. | 2.33 (1.04) | .52 | 44 |
| (15) I was too lazy [Ich war zu faul]. | 2.23 (1.07) | .67 | 41 |
| Screen-Based Sedentary Behavior (α = .76) | 1.86 (0.82) | | |
| (8) I preferred surfing the internet [Ich war lieber im Internet]. | 1.96 (0.99) | .62 | 32 |
| (39) I rather watched TV [Ich habe lieber Fernsehen geschaut]. | 1.75 (0.93) | .52 | 25 |
| (43) I rather played computer games/PlayStation [Ich habe lieber vorm Computer oder der Playstation gesessen]. | 1.86 (1.04) | .66 | 29 |
| Depressed Mood (α = .84) | 1.65 (0.74) | | |
| (18) I felt blue [Ich war deprimiert]. | 1.47 (0.86) | .65 | 16 |
| (21) I did a lot of thinking about other things [Ich musste zu viel über andere Dinge nachdenken]. | 1.93 (0.99) | .66 | 31 |
| (22) I was in a bad mood [Ich hatte schlechte Laune]. | 1.72 (0.93) | .73 | 24 |
| (33) I brooded too much [Ich habe zu viel gegrübelt]. | 1.44 (0.77) | .70 | 15 |

Continuation of Table 3

| Barriers | *M* (*SD*)[a] | $r_{it}$ | *p* |
|---|---|---|---|
| Physical Health (α = .67) | 1.53 (0.71) | | |
| (2) I was injured [Ich war verletzt]. | 1.59 (0.95) | .43 | 20 |
| (25) I was ill [Ich war krank]. | 1.57 (0.94) | .47 | 19 |
| (40) My health status did not allow me to be physically active [Mein Gesundheitszustand hat es nicht erlaubt, mich zu bewegen oder Sport zu machen]. | 1.43 (0.86) | .57 | 14 |
| School Workload (α = .83) | 1.82 (0.82) | | |
| (13) I had to do too much for school [Ich musste zu viel für die Schule machen]. | 2.00 (1.04) | .49 | 34 |
| (23) I had to prepare for papers or exams [Ich musste mich auf Referate oder Arbeiten/Klausuren vorbereiten]. | 1.63 (0.90) | .71 | 21 |
| (34) I had too much homework to do [Ich musste zu viele Hausaufgaben machen]. | 1.94 (1.06) | .69 | 31 |
| (37) School was over too late [Ich hatte zu lange Unterricht]. | 1.65 (0.95) | .74 | 22 |
| Preconditions (α = .67) | 1.36 (0.54) | | |
| (5) I had no suitable workout clothes [Ich hatte keine geeigneten Sportsachen]. | 1.33 (0.74) | .49 | 11 |
| (20) Sports clubs, playing fields, indoor swimming pools, or parks were too far away from home [Vereine, Sportplätze, Schwimmhallen oder Parks waren zu weit von Zuhause weg.]. | 1.56 (0.87) | .42 | 19 |
| (32) I did not have enough money to be physically active (tickets, membership fee, or workout clothes) [Ich hatte nicht das Geld, um Sport zu machen (Fahrscheine, Vereinsmitgliedschaft, Gebühren, Sportsachen)]. | 1.28 (0.67) | .42 | 9 |
| (38) I thought I was not capable to be physically active [Ich habe es mir nicht zugetraut, Sport zu machen]. | 1.28 (0.70) | .48 | 9 |

*Note.* $r_{it}$ = item discrimination; *p* = item difficulty.

[a]Scale ranges from 1 (*not at all strong*) to 4 (*very strong*).

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