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Validation of physical activity habit strength with subjective and objective criterion measures

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ABSTRACT

Objectives: A German version of the Self-reported Habit Strength Index (SRHI) for both sports and everyday physical activity (PA) was validated against subjective and objective criterion measures of PA.
Design and method: Data were obtained from 260 participants (21.4% women) in study 1 and 86 participants (58.1% women) in study 2. Both studies assessed habit strength for PA (sports and everyday PA) by the SRHI and PA by the Baecke Questionnaire (Sport, Leisure and Work Index) as subjective criterion measure, as well as by accelerometry (Step Activity Monitor or GTM1 Actigraph) as objective criterion measure. Bivariate correlations as well as path analyses were computed for the associations between the SRHI scores and subjective and objective criterion measures of PA.
Results: Highest associations for subjective criterion measure were found for habit strength for sports and the Sport Index in both studies. The Leisure Index was predicted by habit strength for sports and everyday PA. For objective criterion measures, habit strength for sports was most significantly associated with total PA in study 1 and moderate intense PA in study 2. Habit strength for everyday PA was a significant predictor of moderate intense and total PA in study 1 and low intense PA in study 2.
Conclusion: The present studies replicated high internal consistencies of the SRHI for sports and everyday PA and could partially confirm their validity with subjective and objective criterion measures. The SRHI for sports seems to be more robust than the SRHI for everyday physical activity.

Introduction

Most of our activities in daily life are habitual. Once a behavioral habit is built, it could be good or detrimental to one's health and, from a behavioral perspective, hard to change. Physical activity (PA) is one of the most powerful behaviors to promote good health, to reduce the incidence of many chronic diseases and to increase longevity (Physical Activity Guidelines Advisory Committee Report, 2008; Powell, Paluch, & Blair, 2011). However, interventions that aim to enhance PA often fail in long term behavioral change, and thus presumably in the modification of PA habits (Hillsdon, Foster, & Thorogood, 2005). Habits are psychologically defined as learned dispositions and behavioral tendencies to repeat well-practiced acts in stable circumstances (Ouellette & Wood, 1998; Wood, Quinn, & Kashy, 2002). The behavioral response of habits is triggered automatically by stable cues (Verplanken & Aarts, 1999; Wood et al., 2002). Thus the behavior can be enacted with little awareness and largely unconscious (Verplanken & Orbell, 2003). The automatic features of the habit construct make it quite resistant to modification. Interventions aiming to foster PA and stabilize it in daily life should therefore define a high habit strength of PA as a primary target instead of high PA levels measured in the short run. As a consequence, intervention studies should measure habit strength of PA to predict the potential for change and future stability of PA. One prerequisite is therefore having a valid tool to assess habit strength (Gardner, de Bruijn, & Lally, 2011).

A common measure of habit strength is the Self-Report Habit Index (SRHI) (Gardner et al., 2011; Verplanken & Orbell, 2003). The SRHI consists of 12 items that represent the features of habits: automaticity, history of repetition and self-identity. The SRHI showed high internal consistency and high test–retest-reliability in different behavioral domains (Verplanken & Orbell, 2003). In the context of travel mode choices (including active traveling), the SRHI correlated strongly with past behavioral frequency and the

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response frequency measure of habit. The index discriminated between behaviors varying in frequency, and also between daily versus weekly habits (Verplanken & Orbell, 2003). With respect to PA, Verplanken and Melkevik (2008) showed that habit strength for exercising can be reliably measured, was stable over time and was valid beyond the history of exercise frequency. These findings were confirmed for adolescents by Kremers and Brug (2008) and also supported by a meta-analysis on SRHI studies for diet and PA (Gardner et al., 2011). The strongest correlations among physical activity domains were reported for inactivity and active traveling. Up to now research in the field of PA particularly focused on habits in exercising, active traveling and sedentary behavior (Gardner et al., 2011). Rhodes, de Bruijn, and Matheson (2010) noted that there is a lack of studies focusing on overall PA. From a public health perspective it has been shown that the total amount of PA – including vigorous intense PA, like sports and exercising, as well as moderate intense PA, like everyday physical activity, e.g. domestic activities, gardening or active transportation, seems to be very important (Haskell, Blair, & Hill, 2009). In addition, we are not aware of any studies on PA habits using objectively measured PA as a criterion measure for habit strength (see also Gardner et al., 2011). In addition, we could not identify a published paper validating a German instrument measuring habit strength.

In the current paper we examine whether habit strength, assessed by the SRHI for both sports and everyday PA (excluding sports), was positively correlated with subjective and objective measures of PA as validation criteria. We used data from two different studies. Both studies used the same PA questionnaire as subjective criterion measure and both used accelerometry (Step Activity Monitor or GTM1 Actigraph) as objective criterion measure. We expected that habit strength for sports would correlate most notably with self-reported sports and with vigorous intense PA (vPA) measured by accelerometry. Further we expected that habit strength for everyday PA would show the strongest correlations with self-reported total PA and in leisure time and moderate intense PA (mPA) measured by accelerometry.

Methods

Participants and procedure

Study 1

Data were collected as part of a larger study on health promotion within the research project GemNet (www.gemnet.de). Overall, 260 employees volunteered and completed a computer-based questionnaire (total sample). All participants were asked to take part in an objective monitoring of PA for seven consecutive days. Interested participants gave their consent by providing their mail address. We contacted all eligible people by email and invited them for a personal briefing on how to use the accelerometer, including a PA diary where participants were asked to report time when putting on and off the device (e.g. for showering, swimming, sleeping). 35 participants with complete objectively monitored data were available for analyses (Actigraph sample; Table 1). No significant ($p < .10$) differences in age and sex (Pearson Chi^2-Test) as well as habit strength and PA (Student's *t*-tests) between participants of the total sample and the Actigraph sample could be found. Therefore no selection effects are supposed.

Study 2

We recruited a convenience sample of 86 participants. Participants completed a questionnaire on PA and habit strength and were monitored for seven consecutive days using a microprocessor-based step-activity-monitor (SAM; StepWatch, Orthocare Innovations, Washington, D. C., USA). Prior to participation, the participants were instructed, familiarized to the SAM and gave written informed consent. 16 participants had to be excluded due to incompletion of at least one measure, thus the data of 74 participants (86%) were available for analysis.

Measurement

Habit strength

We assessed habit strength in both studies by a German version of the 12-item Self-Report Habit Index (SRHI) (Verplanken & Orbell, 2003) after translation into German and back-translation. The SRHI comprises 12 responses to the initial stem 'Doing sports is something …' for the sports scale and 'Physical activity (except from sports) is something …' for the everyday PA scale, comprising the dimensions automaticity (e.g. '… I do without thinking'), frequency (e.g. '… that belongs to my weekly routine') and self-identity (e.g. '… that is typically 'me' '). Each item was scored on a 5-point Likert scale (agree–disagree). Habit strength was calculated as the mean of all items on the condition that at least 9 (75%) items were answered. High scores indicate high habit strength. The SRHI showed high internal consistency and high retest-reliability in terms of PA and other behaviors (Gardner et al., 2011). Own pilot studies with the German SRHI for PA attested good reliability ($\alpha = .96$ for everyday PA and $\alpha = .95$ for sports) and reasonable retest-reliability ($r = .55$ for everyday PA, $r = .92$ for sports). For the current samples Cronbach's alphas for the SRHI were $\alpha = .96$ for everyday PA and also for sports in study 1 and $\alpha = .89$ for everyday PA and $\alpha = .96$ for sports in study 2, respectively.

Subjective PA criterion measure

Self-reported PA in both studies was assessed by the German version of the *Questionnaire for the Measurement of Habitual Physical Activity in Epidemiological Studies* (Baecke, Burema, & Frijters, 1982; Wagner & Singer, 2003). Baecke's questionnaire quantifies indices of PA in three domains: PA at work (Work Index), sports and exercising (Sport Index), and PA during leisure time excluding sports (especially active travel) (Leisure Index). Participants responded on a 5-point scale (never–always). Indices for each domain were calculated ranging from 1 (low) to 5 (high). The indices are calculated as the mean of each dimensions' items. In the German Version (Wagner & Singer, 2003) the number of items is reduced from 8 to 6 items for the Work Index and from 4 to 3 items for the Leisure Index. A number of studies (including one German study) suggested that the Baecke questionnaire is reliable and valid (Baecke et al., 1982; Florindo & Latorre, 2003; Richardson, Ainsworth, Wu, Jacobs, & Leon, 1995; Wagner & Singer, 2003).

Objective PA criterion measures

In study 1 the Actigraph GT1M was used. The GT1M is an unidirectional accelerometer. The device was used to provide a measure of overall PA. Participants wore the accelerometer on the right hip for seven consecutive days. It measures acceleration in the vertical axis with 0.25–2.5 Hz. This monitor is a valid and reliable device (Butte, Ekelund, & Westerterp, 2012). PA is quantified in 'counts' but the GT1M also provides steps per given time interval as an optional measurement unit. An epoch time of one minute was chosen. Accelerometer data were downloaded using standard software 'ActiLife', analyzed with the software 'MeterPlus' (SANTECH), and exported to IBM SPSS (version 21). Accelerometer data were included in the analysis if the minimal number of wearing days was 4, with a minimum of 10 h recording time each day, and excluding periods of 30 min or more with continuous zero activity counts (Matthews, Hagstromer, Pober, & Bowles, 2012). Output was time-stamped activity counts/minute, and accelerometer-determined step data. Low intense PA (lPA), moderate intense PA