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Predicting Behavioral Intentions and Physical Exercise: A Test of the Health Action Process Approach at the Intrapersonal Level

Urte Scholz, Roger Keller, and Sonja Perren
University of Zurich

Objective: Theories of health behavior are usually tested on the between-person level. Associations between variables on the between- and the within-person level, however, can differ substantially. Thus, in order to better understand intrapersonal processes in the domain of health behavior, studies applying within-person analyses are needed. This study tested the Health Action Process Approach (HAPA) on the within- and between-person level in the context of physical exercise. ***Design:*** Participants were 265 first-year students who completed nine online questionnaires every second week. Data were analyzed by focusing on intrapersonal associations applying multilevel modeling. ***Main Outcome Measures:*** Intentions for physical exercise and self-reported physical exercise served as main outcome measures. ***Results:*** Analyses mainly confirm associations specified by the HAPA at the intrapersonal level: outcome expectancies and self-efficacy, but not risk awareness, were positively associated with intentions for physical exercise. Physical exercise in turn was positively associated with intentions, self-efficacy, action control, but not with action planning. ***Conclusion:*** The HAPA could be confirmed on the within-person level. Future studies should focus on testing other theories of health behavior at the within-person level.

Keywords: health behavior, physical exercise, within-person associations, multilevel modeling

Although there are many health benefits associated with physical exercise (U.S. Department of Health & Human Services, 1996), most individuals lead a sedentary lifestyle (Schoenborn, Adams, Barnes, Vickerie, & Schiller, 2004). Modern theories on health behavior change help us understand why people succeed or fail in changing their physical exercise behavior. So far, studies examining variables and processes specified in those theories usually focus on between-person analyses and results, whereas within-person/intrapersonal processes have been widely neglected. This strong focus on between-person associations, however, does not capture the whole range of processes and individual developments in health behavior change. Especially, as results from between- and within-person analyses can differ substantially (e.g., Nezlek, 2001). Thus, in order to gain a better understanding of intrapersonal processes in the domain of health behavior change, studies focusing on intrapersonal associations are needed. This was the aim of the present study.

The theoretical model we applied is the Health Action Process Approach (HAPA; Schwarzer, 1992; see Figure 1). The HAPA accounts for the empirical finding that intentions often inadequately predict behavior (Sheeran, 2002). Thus, in contrast to common theories of health behavior change, such as the Theory of Planned Behavior (TPB; Ajzen, 1991), and Protection Motivation Theory (PMT; Maddux, & Rogers, 1983) that assume intentions to be the most important predictor of behavior, the HAPA also specifies predictors of behavior that come into play *after* an intention has been formed (e.g., Sniehotta, Scholz, & Schwarzer, 2005).

In the motivational phase of intention formation, the HAPA specifies risk awareness, positive outcome expectancies and self-efficacy (Bandura, 1997) as predictors of intentions (e.g., Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). After intentions have been set, a person enters the volitional phase. The HAPA assumes that intentions and self-efficacy as well as action planning (i.e., exact planning of when, where and how to implement the intended behavior; Gollwitzer, 1999; Leventhal, Singer, & Jones, 1965), plus action control (consisting of three subfacets: awareness of own standards, self-monitoring, and self-regulatory effort; Sniehotta, Nagy, Scholz, & Schwarzer, 2006; Sniehotta et al., 2005) predict behavior.

The HAPA has been shown to be of good predictive validity across a variety of different health behaviors, including nutrition (Schwarzer & Renner, 2000), low-risk single occasion drinking (Murgraff, & McDermott, 2003), interdental hygiene (Schüz, Sniehotta, & Schwarzer, 2007) and physical exercise (e.g., Schwarzer et al., 2008).

Testing Within- and Between-Person Effects

Only a few studies so far have tested the assumptions of the most frequently used theories of health behavior, such as the TPB or PMT, at the intrapersonal level. These studies either tested only some assumptions of a theory, such as the intention-behavior relation, or only bivariate associations instead of more complex

Urte Scholz and Roger Keller, Department of Psychology, University of Zurich, Switzerland; Sonja Perren, Jacobs Center of Productive Youth Development, University of Zurich, Switzerland.

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Correspondence concerning this article should be addressed to Urte Scholz, University of Zurich, Department of Psychology, Social and Health Psychology, Binzmuehlestr. 14/Box 14, CH-8050 Zürich, Switzerland. E-mail: urte.scholz@psychologie.uzh.ch

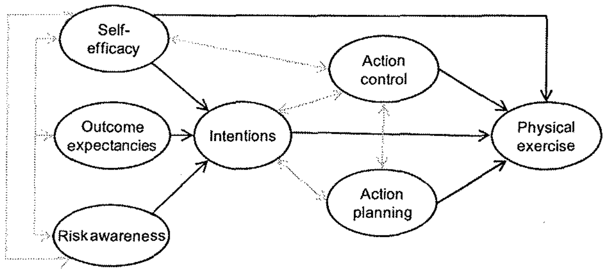

Figure 1. Conceptual figure of the Health Action Process Approach (Schwarzer, 1992).

models (e.g., Norman, Sheeran, & Orbell, 2003). Thus, in the domain of health behavior, no study has so far tested a whole theory's assumptions at the within-person level. Other studies assessed numerous different behaviors and their predictors per person cross-sectionally, which were then related to each other at the within-person level (e.g., Hagger & Chatzisarantis, 2006; Norman et al., 2003). However, as any one theory might predict different behaviors differently and as cross-sectional studies do not capture intraindivdual developments, it is important to test a theory's assumption at the intrapersonal level for a single behavior only by applying a longitudinal design.

Only one study so far has tested for intrapersonal associations of the HAPA constructs with intention formation and behavior, and this was only on the basis of bivariate associations. It therefore did not provide a strict test of the model's assumptions at the intrapersonal level (Scholz, Nagy, Schüz, & Ziegelmann, 2008). However, as Nezlek (2001), and Vancouver and colleagues (Vancouver, Thompson, Tischner, & Putka, 2002) point out, associations at the between-person level do not necessarily correspond with associations at the within-person level. On the contrary, it is possible that a positive association at the between-person level is accompanied by a positive, null, or even negative association at the within-person level (see Nezlek, 2001; Vancouver et al., 2002 for examples).

Thus, in order to gain a better understanding of intrapersonal processes, studies that test health behavior theories at the within-person level are urgently needed. Therefore, studies assessing more than only two or three points of measurement are required. These studies then apply multilevel modeling because the data structure is hierarchical, as points of measurement are nested within persons. The advantage of multilevel modeling is that it allows associations at both levels of analyses, the between- and the within-levels, to be tested (Affleck, Zautra, Tennen, & Armeli, 1999). There is a growing body of research on intrapersonal associations; for example, associations between daily stresses and eating behavior (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008) or between affect and alcohol consumption (Rankin & Maggs, 2006). However, so far no study has tested a health behavior theory as a whole for its validity at the intrapersonal level.

Thus, the aim of the present study was to test whether the assumptions of the HAPA that are well-confirmed at the between-person level also hold at the intrapersonal level.

Method

Procedure and Sample

Participants were first-year students of the University of Zurich, Switzerland, studying different subjects. They were invited by email to participate in the study 6 weeks before the start of their first year. The first point of measurement was 4 weeks before beginning of the semester. After giving informed consent, participants filled in an online questionnaire every 2 weeks throughout their first semester, resulting in 9 points of measurement altogether. Of the 2,230 students initially invited, 294 (13.2%) volunteered to participate. Of these, 265 (90.1%) students completed at least 5 of the 9 points of measurement and were included in the current analyses. Missing values were accounted for by means of Multiple Imputation (see below). Participants received a voucher for books worth 60 Swiss Franks (ca. 60 USD) together with feedback on the study results.

The final sample comprised N = 265 individuals (n = 195 women, 73.6%), with a mean age of 21.3 years (SD = 5.1) and an age range between 18 and 55 years. About half of the sample were in an intimate relationship (n = 124, 46.8%), the others were single; 4 persons (1.5%) did not report their relationship status. Drop-out analyses revealed no systematic differences between participants who completed all 9 questionnaires and those who completed fewer.

Measures

All variables were assessed at all nine points of measurement. Unless otherwise indicated, all items are from Sniehotta et al. (2005) and were administered with a response scale from 1 (*not at all true*) to 7 (*completely true*). Item examples are translations from German. Table 1 displays means, standard deviations, range and Cronbach's alphas for all variables in the study.

Risk awareness was measured by three items adapted from Harris and Napper (2005). An example of an item is "How likely

Table 1
Means, Standard Deviations, Range, Cronbach's Alphas, and Intraclass Correlations (ICC) of Main Level 1 Variables

	M	SD	Range	Range of Cronbach's alphas	ICC
Risk awareness	2.65	1.21	1–7	.70–.82	0.81
Positive outcome expectancies	5.35	1.50	1–7	—[a]	0.66
Self-efficacy	4.36	1.41	1–7	.89–.92	0.76
Intention	4.28	1.99	1–7	.86–.91	0.60
Action planning	4.91	2.24	1–7	.90–.94	0.45
Action control	3.61	2.23	1–7	.95–.97	0.45
Physical exercise	111.56	168.37	0–1006	—	0.53
Physical exercise (log transformed)	2.75	2.55	0–6.92	—	0.47

Note. Number of observations = 2,385.
The ICC stands for the amount of between-person variance in relation to total variance (Kreft & DeLeuw, 1998). The log transformed physical exercise measure was used as the outcome variable in the analyses. The raw scores of physical exercise are only displayed for information.
[a] As this was a single item, no Cronbach's alpha could be computed.

do you think you will be to experience cardiovascular problems, such as heart attack or stroke, at some stage in the future?" for assessing perceived vulnerability to health problems.

Positive outcome expectancies for physical exercise were assessed by a single item: "If I exercise, then my mood improves."

Self-efficacy for physical exercise was assessed by six items. The item stem "I am confident I will engage in regular physical activity . . ." was followed by six items concerning typical barriers that may hinder the behavior, such as, ". . . even if I cannot see any positive changes immediately".

Behavioral intentions for physical exercise were measured by five items. All items followed the stem: "In the next 14 days, I intend to . . .", for example ". . . be physically active at least once a week so that I start sweating and get out of breath."

Action planning was assessed by four items. The item stem, "I have made a detailed plan for . . ." was followed by the items (a) ". . . when to exercise," (b) ". . . where to exercise," (c) ". . . how to exercise," and (d) ". . . how often to exercise."

Action control was assessed by a nine-item scale. Three items each addressed self-monitoring, awareness of standards, and self-regulatory effort. The items were introduced by the stem, "During the last seven days, I have . . ." (a) ". . . constantly monitored whether I exercise frequently enough," (b) ". . . always been aware of my intended training program," and (c) ". . . tried my best to act in accordance to my intentions."

Vigorous physical exercise was assessed by using one item of the International Physical Activity Questionnaire (IPAQ; Booth, 2000). Participants were asked to indicate how often during the past 7 days they had engaged in vigorous physical activities such as jogging, swimming, cycling, power walking, and so forth. They were also asked how much time they had usually spent performing these activities per training session. Frequency and average duration per session were multiplied, resulting in average total minutes of physical exercise per week. The distributions of physical exercise at all nine points of measurement were skewed, as 10.2% of the respondents were inactive (i.e., reported 0 minutes physical exercise across all nine points of measurement). Overall, 78.2% of the participants reported exercising on average 270 minutes across the nine time points, that is, about 30 minutes per week. About 11.6% of the whole sample exercised on average more than 270 minutes across the nine points of measurement. To smooth the distributions and approximate a normal curve, a logarithmic transformation was applied (Tabachnick & Fidell, 2001) and this log transformed variable was used as outcome variable in the analyses.

Statistical Analyses

The data structure of the present study was hierarchical because observations were nested within persons. Therefore, we used multilevel modeling (Raudenbush & Bryk, 2002), applying the program HLM 6.06 (Raudenbush & Bryk, 2002). Multilevel modeling allows associations between constructs at both the within-person (Level 1) and the between-person level (Level 2) to be investigated. As the aim of the present study was to test whether the HAPA model holds at the within-person level, we specified all associations of the HAPA at the within-person level.

To give an example, the Level 1 equation for intention formation reads as follows:

$$y(\text{intention})ij = \beta 0j + \beta 1j\,(\text{risk awareness}) + \beta 2j\,(\text{positive outcome expectancies}) + \beta 3j\,(\text{self-efficacy}) + \beta 4j\,(\text{time}) + \beta 5j\,(\text{time squared}) + rij$$

with yij being the individual j's intention across i points of measurement. β0j is individual j's intercept representing a person's initial level of intentions. β1j, β2j, and β3j are the slopes representing the within-person association between intention and risk awareness, positive outcome expectancies, and self-efficacy. β4j and β5j are the slopes of individual j for linear and quadratic time trends, and rij is the residual variance. The inclusion of the time trends served to control for whether the associations between predictors and criterion on the within-person level are due to shared time trends (i.e., methodological artifacts) rather than representing real effects. All Level 1 predictors except for the two time trends were group mean centered, that is, person-specific means were subtracted from variables. The two time trends were centered at the first occasion. Group means were then reintroduced as predictors of the intercept on Level 2 and grand-mean centered (Kreft & DeLeeuw, 1998). By doing so, it is possible to distinguish effects on the within-person level, in this case fluctuations around the individual mean across points of measurement, from effects of interindividual differences, in this case mean levels across points of measurement, on the criterion.

The Level 2 equations for intention formation are as follows:

$$\beta 0j = \gamma 00 + \gamma 01\,(\text{group mean of risk awareness}) + \gamma 02\,(\text{group mean of positive outcome expectancies}) + \gamma 03\,(\text{group mean of self-efficacy}) + u0j$$

$$\beta 1j = \gamma 10 + u1j;$$

$$\beta 2j = \gamma 20 + u2j;$$

$$\beta 3j = \gamma 30 + u3j;$$

$$\beta 4j = \gamma 40 + u4j;$$

$$\beta 5j = \gamma 50 + u5j$$

with γ00 being the sample mean of intentions, and γ01, γ02, and γ03 the between-person association between intentions and risk awareness, positive outcome expectancies, and self-efficacy. u0j is the random error, that is, the interindividual variation in β0j. γ10, γ20, γ30, γ40, and γ50 are the average within-person effects of risk awareness, positive outcome expectancies, self-efficacy, and linear and quadratic time trends, on intentions. All predictors were modeled as random (error terms: u1j, u2j, u3j, u4j, and u5j), indicating potential interindividual differences in these mean effects.

For the prediction of (log transformed) physical exercise, intentions, self-efficacy, action planning, and action control served as group-mean centered Level 1 predictors, together with the centered linear and quadratic time trends. Here again, grand-mean centered individual (i.e., group) means were reintroduced into Level 2 as predictors of the intercept (Kreft & DeLeeuw, 1998).

As an indicator of effect size, we report a Pseudo R^2 statistic that results from the difference in residual within-person variance between the model with all predictor variables included, and a model with all but the predictor of interest included (Kreft & DeLeeuw, 1998; Singer & Willet, 2003). However, this is only an approximation to the R^2 known from the usual regression models, because R^2 cannot be uniquely defined in models with random intercept and random slopes (Kreft & DeLeeuw, 1998; Singer & Willet, 2003). This might sometimes also result in failures to compute a Pseudo R^2 for predictors. Thus, the Pseudo R^2s reported should be interpreted with caution.

Treatment of Missing Values

The problem of missing data occurs in most longitudinal studies. Although dropout analyses of the present study have shown that the patterns of missing values for the main variables in the study are not systematic, about 25% of participants completed less than the nine (but at least five) questionnaires. Together with occasional missing data points caused by item nonresponse, some variables had up to 27% missings. Therefore, missing values were estimated using the Multiple Imputation (MI) method (Schafer & Graham, 2002) employing NORM 2.03 (Schafer, 1999). MI is a Monte Carlo technique that takes the missing data uncertainty into account by generating multiple values for one missing observation in the form of generated multiple datasets. Unlike alternative single imputation methods, MI has the advantage of reflecting the uncertainty of missing data by the between-imputation variance (Schafer & Graham, 2002). After having generated the imputed data sets, each of the generated data sets is analyzed separately by HLM 6.06. Results are then integrated following a method suggested by Rubin (1987) to obtain overall estimates and correct standard errors. This is automatically done in HLM 6.06. For the present study, five datasets were generated. All analyses were conducted using all five imputed data files.

Results

The intraclass correlation (see Table 1) stands for the amount of between-person variance in relation to total variance (Kreft & DeLeuw, 1998). Except for the ICC of risk awareness, self-efficacy, and positive outcome expectancies, ICCs varied around .5, indicating more or less equal amounts of between- and within-person variance for most of the constructs.

Prediction of Intentions

In the model specifying the prediction of intentions, the random effects of the intercept of intentions and of the slopes of positive outcome expectancies, self-efficacy, linear and quadratic time trends, but not of risk awareness, were significantly different from zero. These random effects indicated interindividual differences in initial levels of intentions and in the within-person associations between intentions and all predictors except for risk awareness.

The model resulted in significant effects of positive outcome expectancies ($b = 0.15, p = .001$; Pseudo $R^2 = .04$), self-efficacy ($b = 0.40, p = .001$, Pseudo $R^2 = .05$), linear time trend ($b = -.20, p = .001$, Pseudo $R^2 = .14$), a marginally significant effect of the quadratic time trend ($b = .01, p = .08$, Pseudo $R^2 = .14$), but no effect of risk awareness ($b = -0.04, p = .48$, Pseudo R^2 could not be computed) on intentions at the within-person level (see Figure 2). These results indicate that weeks with higher positive outcome expectancies and higher self-efficacy were related to weeks with higher intentions within individuals, and this finding was robust after controlling for slight decreases in intentions over the nine points of measurement. In terms of interindividual differences, all three predictors resulted in significant effects on the intercept of intentions ($b = 0.16, p = .001$, Pseudo $R^2 = .04$ for risk awareness; $b = 0.47, p = .001$, Pseudo $R^2 = .24$ for positive outcome expectancies; $b = 0.51, p = .001$, Pseudo $R^2 = .08$ for self-efficacy), indicating that interindividual differences in mean level of the three predictors were all associated positively with mean initial levels of intentions.

Prediction of Physical Exercise

In the model specifying the prediction of log transformed physical exercise, the random error variance of the intercept of physical exercise and of the slopes of intentions, of action control, and of the two time trends, but not of action planning and self-efficacy, were significantly different from zero. These random effects indicated interindividual differences in initial levels of physical exercise and in the within-person associations between log transformed physical exercise and all predictors except for action planning and self-efficacy.

The model predicting log transformed physical exercise resulted in significant positive effects of intentions ($b = 0.25, p = .001$, Pseudo $R^2 = .07$), self-efficacy ($b = 0.15, p = .04$, Pseudo R^2 could not be computed), and action control ($b = 0.15, p = .001$, Pseudo $R^2 = .08$) on the within-person level. Action planning ($b = 0.03, p = .33$, Pseudo R^2 could not be computed) as well as both time trends ($b = -.02, p = .71$, Pseudo $R^2 = .05$ for linear, $b = -.001, p = .91$, Pseudo $R^2 = .03$ for quadratic) did not display a significant within-person association with physical exercise (see

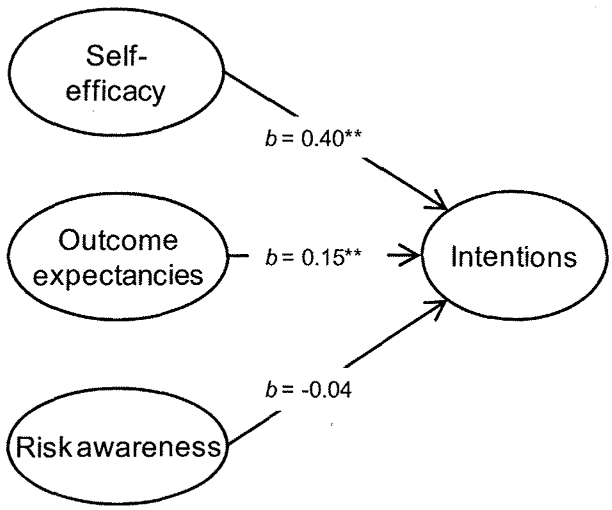

Figure 2. Prediction of intentions: Results of the within-person level. Note. $^{**}p < .001$, $^{*}p < .05$; controlled for linear and quadratic time trend.

Figure 3). After controlling for time-related trends, behavior was thus higher on weeks with greater intentions, self-efficacy, and action control within persons, whereas no such intraindividual association was found for action planning. Interindividual differences in the means of intentions and self-efficacy were significantly positively associated with mean initial levels in physical exercise (b = 0.67, p = .001, Pseudo R^2 = .23 for intentions; b = 0.29, p = .001, Pseudo R^2 = .04 for self-efficacy). Interindividual mean levels of action planning were associated with mean initial levels in physical exercise on the 10% level (b = 0.13, p = .07, Pseudo R^2 could not be computed), whereas interindividual differences in action control did not display a significant effect (b = −0.02, p = .75, Pseudo R^2 could not be computed).

Discussion

This study is the first that tested associations between motivational predictors and intentions as well as between volitional predictors and behavior, as specified in the HAPA (Schwarzer, 1992), at both the between- and the within-person level. The within-person analyses largely confirm the assumptions of the HAPA and are in line with results from studies that focused on the between-person level only (e.g., Schwarzer et al., 2008). This is an important step toward a better understanding of intrapersonal processes in the domain of health behavior change.

The intrapersonal results are mainly as expected according to the assumptions of the HAPA. Only the nonsignificant effect of risk awareness on intentions at the within-person level was not in line with our hypotheses. A possible explanation for this nonassociation might be that risk awareness seems to be rather low and stable across all points of measurement. This might be because illnesses like cardiovascular disease could be rather abstract for 21-year-olds. Another explanation is that risk awareness as measured in the present study violates the correspondence principle

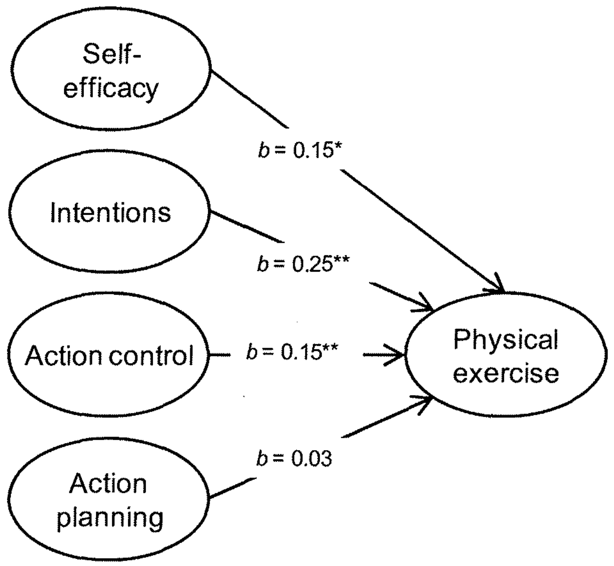

Figure 3. Prediction of physical exercise: Results of the within-person level. Note. $^{**}p < .001$, $^{*}p < .05$; controlled for linear and quadratic time trend.

(Ajzen, 1991). This means that the items of risk awareness are more generally formulated than our items for intentions to engage in physical exercise, and that therefore predictive power is limited. In the light of the results at the between-person level, however, this explanation is unlikely, because interindividual differences in mean risk awareness were predictive for the mean initial level of intentions. This is in line with studies on the HAPA that focus on the between-person level, although risk awareness is not always a significant predictor and is usually the weakest in comparison with outcome expectancies and self-efficacy (e.g., Schwarzer et al., 2008).

A rather unexpected result was the nonsignificant association between action planning and physical exercise at the within-person level. Studies that focus on between-person analyses have repeatedly shown that action planning is one of the most important predictors of behavior (e.g., Schwarzer et al., 2008; Sniehotta et al., 2005). Investigating bivariate associations between action planning and physical exercise at the within-person level revealed a significant positive association (b = 0.11, p = .001). This association held when controlling for linear and quadratic time trends at the within-person level. Thus, for the present sample, action control, intentions, and self-efficacy seemed to be more powerful predictors of physical exercise than action planning on the within-person level. Further studies focusing on intrapersonal associations in different samples and with different behaviors are needed in order to replicate these results and to provide insights into the sample and/ or behavior-specific importance of action planning for behavioral change compared to the other volitional predictors at the within-person level.

Although not entirely comparable to the usual between-person effects, as interindividual differences in the present study were interindividual differences in mean levels over time, the between-person effects mostly replicate findings from studies focusing exclusively on the between-person level (e.g., Schwarzer et al., 2008). An exception here is the nonsignificant effect of the mean level of action control on mean initial level of physical exercise. In several studies action control, and especially the subfacet self-monitoring, has been found to be an important predictor of behavior (e.g., Baumeister, Heatherton, & Tice, 1994). In the present study, however, this association could be confirmed at the within- but not at the between-person level. A possible explanation for this unexpected result is that participating in a study like this can also be regarded as an action control intervention. As Godin, Sheeran, Conner, and Germain (2008) pointed out, even completing only one questionnaire can produce intervention effects. Thus, completing questionnaires every second week relating to one's physical exercise behavior might foster a higher awareness of one's standards, a higher degree of self-monitoring, and eventually also a higher investment of self-regulatory effort when a discrepancy between one's standards and one's actual behavior is acknowledged. This potential intervention effect, however, could differ in strength according to participants' initial level of action control. A mean level across all points of measurement could thus be equally high for individuals starting with a rather high level of action control and staying stable over time, as for individuals starting off with a lower level of action control and experiencing a steep increase in action control over time. This might explain why there was no significant association between action control and physical exercise at the between-person level.

This study has some limitations that have to be acknowledged. First, the sample was not representative of the general population, nor is it likely that the sample was a representative sample of all first-year students of the University of Zurich, Switzerland, considering the rather low response rate among invited students. Thus, findings need to be replicated with different samples of different educational background, different ages, and so forth. Second, our measure of physical exercise was based on self-report. Self-report measures of behavior are usually affected by social desirability or recall bias (e.g., Sallis, & Saelens, 2000). Some studies, however, indicate that self-report measures of physical exercise are valid. As Sallis and Saelens (2000) point out, it is rather difficult to give a valid assessment of the absolute amount of physical activity by self-report. As we were not interested in absolute amounts, but in associations between predictor variables and physical exercise, potential bias should be limited. A third limitation was that the design of the study might potentially have resulted in an intervention effect on participants in some of our variables (Godin et al., 2008). In order to control for this, a control group, completing only the first and last points of measurement, would be needed. However, as the aim of the present study was to test for associations between HAPA variables at the within-person level, no such control group would have been possible. Thus, these effects seem inevitable in studies investigating within-person associations. As we controlled for time trends, however, and did not find differences in associations between our main study variables, bias due to potential intervention effects seems manageable. Moreover, being able to assess nine points of measurement per person can be considered a strength of the study.

There are several implications for further research. This was to our knowledge the first study to apply a strict test of the validity of a model of health behavior change at both, the between- and within-person level applying a longitudinal design with one target behavior. This differs from studies on the TPB (e.g., Hagger & Chatzisarantis, 2006; Norman et al., 2003), who tested the theory's assumptions using a cross-sectional design with numerous behaviors and predictors being assessed per person. Thus, further studies are needed not only to replicate the present findings for the HAPA, but also to test whether this applies to other health behaviors or populations as well. Moreover, as intraindividual associations can be quite opposite to between-person associations, more studies are needed to test whether common theories of health behavior, such as the TPB (Ajzen, 1991) or PMT (Maddux, & Rogers, 1983) produce the same well-established findings we know from between-person levels at the within-person level. This will augment our knowledge on processes and individual developments in health behavior change substantially.

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