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Recovery Self-Efficacy and Intention as Predictors of Running or Jogging Behavior: A Cross-Lagged Panel Analysis over a Two-Year Period

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Abstract

The study investigates whether two kinds of self-efficacy and intention predict regular running or jogging behavior over 2 years. Maintenance self-efficacy refers to beliefs about one's ability to maintain a behavior, whereas recovery self-efficacy pertains to beliefs about one's ability to resume a behavior after a setback. Longitudinal data from runners (*N* = 139, 80% men) were collected twice with a time gap of 2 years. Cross-lagged panel analysis revealed that recovery self-efficacy and intention jointly predicted running/jogging behavior 2 years later, whereas running/jogging behavior did not predict recovery self-efficacy and intention. No effects of maintenance self-efficacy were found. The majority of participants (*n* = 120) experienced at least one 2-week period of decline in running or jogging behavior. Among those who experienced lapses, recovery self-efficacy remained the only significant social-cognitive predictor of behavior.

Keywords: vigorous physical activity, past behavior, self-efficacy, intention, cross-lagged analysis

Vigorous physical activity is crucial for a healthy lifestyle and cardiorespiratory fitness. It is associated with a lower risk for diabetes, osteoporosis, colon cancer, coronary heart disease, and hypertension (U.S. Department of Health and Human Services, 1996). Jogging and running behaviors are among the most popular kinds of leisure-type vigorous physical activity. Together with other types of vigorous physical activity, they should be performed as frequently as three or more times per week for twenty minutes (U.S. Department of Health and Human Services, 2000). Runners cover a distance of more than 7 miles per hour, whereas joggers cover 5.5 to 7 miles per hour. Our research investigates whether intentions, maintenance self-efficacy, and recovery self-efficacy precede jogging or running behavior over two years.

Relations between Self-Efficacy, Intentions, and Behavior

In Social Cognitive Theory (SCT), self-efficacy is defined as the general belief about one's ability to perform a behavior, or as the belief to be able to perform a certain behavior in spite of various difficulties that may be encountered during the process of behavior change (Bandura, 1997). SCT suggests that self-efficacy is a proximal predictor of behavior (Bandura, 1997). On the other hand, self-efficacy beliefs may increase continually as an individual gains more and more mastery experiences with certain behaviors (Bandura, 1997).

In adopting a desired behavior, individuals first form a proximal goal (or an intention) and then attempt to execute the action (Abraham & Sheeran, 2003; Ajzen, 2002a; Bandura, 1997). The Theory of Planned Behavior (TPB) suggests that intention is the central component, affecting health behavior (Ajzen, 1991; Sutton, 1998). According to the TPB, intention is the most proximal determinant and the single best predictor of behavior (Sutton, 1998). The strength of a person's intention is determined by cognitions, such as perceived behavioral control (PBC). PBC refers to people's perceptions about their ability to perform a given behavior (Ajzen, 2002a). PBC is similar to Bandura's (1997) construct of self-efficacy; indeed Ajzen (1991) states that the two constructs are synonymous.

According to the TPB, intention is more proximal to behavior than PBC (Sutton, 1998). According to SCT, forming a proximal goal (i.e., intention) is a necessary, but not a sufficient condition of behavior (Bandura, 2000). SCT suggests that self-efficacy influences how high the goals (or intentions) are set.

In a development of the application of the TPB to health behaviors, past behavior is considered to play a role in the formation of intentions and situation-specific cognitions, such as PBC (Sutton, 1994). Ajzen (2002a) suggests that predicting behaviors requires an independent measure of past behavior. However, the processes between past and current behavior should be under the control of social cognitions.

Individuals tend to repeat their responses in a stable situational context. Ouellette and Wood (1998) argue that behaviors that are performed regularly (i.e., weekly) form established behavioral routines. Therefore, past behaviors are good predictors of future behaviors. However, Ajzen (2002b) suggested that even if a behavior has been performed many times in the past, it cannot be assumed that cognitive variables do not influence future behavior. Everyday behavioral routines, such as vigorous physical activity, still remain under volitional control (Ouellette & Wood, 1987) and are determined by intentions (Ajzen, 2002b). Past behaviors also influence intention formation: Individuals are likely to form positive intentions about behaviors that they have frequently performed in the past (Ouellette & Wood, 1998).

Both SCT and the TPB assume that control beliefs (i.e., self-efficacy or behavioral control) influence intentions (cf. Ajzen, 2002a; Sutton, 1998). Intentions, in turn, affect behavior, which affects future control cognitions. It may be expected that intentions predict control beliefs over longer time. Individuals with strong intentions perform a behavior more often, which in turn may strengthen their belief about their ability to perform that behavior or to resume regular performance after a lapse.

Few studies have examined the effects of social cognitions on vigorous physical activity over years. Besides social support and neighborhood environment, self-efficacy was a significant predictor of vigorous physical activity over two years (Sallis, Hovell, Hofstetter, & Barrington, 1992). Low levels of self-efficacy at baseline rarely determine physical activity at follow-ups (Sullum, Clark, & King, 2000).

Past behavior appeared to be a crucial predictor for maintaining vigorous physical activity over years (Boutelle, Jeffery, & French, 2004). Effects of past behavior on follow-up measures of cognitions may be stronger than effects of baseline cognitions on subsequent behavior (Armitage, 2005). A baseline measure of actual attendance at the gymnasium was a significantly better predictor of a follow-up measure of PBC, compared to effects of baseline cognitions on later behavior (Armitage, 2005). Among various predictors of physical activity (including social cognitions), past activity was among the best predictors (Armitage, 2005).

Past behavior may be a stronger predictor of intentions than PBC (cf. Rhodes & Courneya, 2003). Compared to other social cognitions, intention appears to be one of the strongest predictors of physical activity measured three to six months later (Bennett, Mayfield, Norman, Lowe, & Morgan, 1999). Relationships between intentions and physical activity are stronger than those between PBC and physical activity (Blanchard, Rogers, Courneya, Daub, & Knapik, 2002; Courneya, Friedenreich, Arthur, & Bobick, 1999). Some studies suggest that intention is a direct predictor of physical activity, whereas self-efficacy is only an indirect predictor (Lippke, Ziegelmann, & Schwarzer, 2004). If the predictive power of intention and PBC are analyzed together, the latter may be a stronger predictor of physical activity (Armitage, 2005). A decline in physical activity results in a decline in self-efficacy over a six-month period (Wallace & Buckworth, 2003). Studies with longer follow-ups (i.e., one year) revealed that PBC may be a stronger predictor of physical activity than intention (Johnston, Johnston, Pollard, & Kinmonth, 2004).

There is no doubt that both self-efficacy and intention contribute significantly to the frequency and intensity of vigorous physical activity (Courneya & McAuley, 1994). These variables are often correlated, which may indicate an overlap between the two constructs. The correlations may also result from an influence of these cognitions on each other. Therefore, it is necessary to explore further the reciprocal relations between social cognitions and behavior.

Using Cross-Lagged Panel to Test Relations among Social Cognitions, and Behavior

Researchers studying relations between self-efficacy and behavior suggest the need to examine whether changes in self-efficacy lead to behavior changes. To support the assumption that beliefs precede behavior, investigators use cross-lagged panel designs. Cross-lagged panel designs examine the correlation between Variable A (Time 1

[T1]) and Variable B (Time 2 [T2]) as compared to the correlation between Variable B (T1) and Variable A (T2; cf. Kenny, 1975). If the cross-lagged coefficients are significant, this may be interpreted as reciprocity of the two variables over time. Autoregressions of the variables on each other over time allow controlling for covariance stability. Autoregression coefficients (stability coefficients) depend on intraindividual changes and interindividual differences. These coefficients inform about a relative change in the population studied, and they are determined by intraindividual stability (cf. Hertzog & Nesselroade, 1987).

Cross-lagged panel designs have been employed relatively seldom to investigate relations between self-efficacy, intention, and physical activity. Evon and Burns (2004) showed that changes in exercise self-efficacy predicted changes in physical activity, but not vice versa. Another study showed that self-efficacy and intentions act as determinants of patients' physical activity (Maddison & Prapavessis, 2004). Using a cross-lagged panel design with a time gap of five weeks, Hagger, Chatzisarantis, Biddle, and Orbell (2001) found that intentions predicted PBC only weakly, whereas the reciprocal relation was not significant. Relations between behavior and intentions were moderate. A cross-lagged panel analysis of adolescents' physical activity over three years revealed that physical activity predicted self-efficacy, whereas self-efficacy did not predict physical activity (Nigg, 2001). Moderate or weak predictive power of self-efficacy may result from the generality of measured beliefs, which do not tap exactly barriers that arise during attempts to maintain the action or recover from lapses.

Cross-lagged panel designs used to investigate physical activity and its predictors employ various time frames. In non-intervention studies, time lags vary from five weeks

(Hagger et al., 2001) to two years (Fukukawa et al., 2004) or even six years (Aartsen, Smits, van Tilburg, Knipscheer, & Deeg, 2002). Long time lags may be particularly suitable to investigate predictors of overcoming lapses.

So far, the majority of studies on social-cognitive predictors of physical activity have dealt with activity of light to moderate intensiveness. It may be expected that more vigorous physical activity requiring large energy expenditure and proper facilities (i.e., safe paths) may be difficult to maintain over years without any lapses or periods of decline. In fact, the majority of individuals who attempt to perform regular vigorous activity are not able to maintain it for several years (cf. Boutelle et al., 2004).

Maintenance Self-Efficacy and Recovery Self-Efficacy

Besides exercise self-beliefs referring to the ability to perform a task, as measured and enhanced in previous studies, self-beliefs may refer specifically to behavioral maintenance or to recovery from relapse (Marlatt, Baer, & Quigley, 1995). Instead of "I can do"-beliefs, they may refer to "I can maintain an action," or "I can resume an action" (cf. Luszczynska & Schwarzer, 2003). *Maintenance self-efficacy* describes optimistic beliefs about one's capability to maintain the behavior, regardless of barriers specific to the maintenance period. Such barriers as lack of immediate positive effects of behavior performance, time investment, and temptations to do something else may be distinguished. *Recovery self-efficacy* pertains to one's beliefs about the ability to resume an action after a lapse. The barriers may refer to lack of performance for a certain period or to a relapse. Recovery self-efficacy helps to gradually return to act upon one's intention. Recovery self-efficacy beliefs are strengthened if individuals are able to regain some control over their behavior after a lapse (cf. Dijkstra & De Vries, 2000).

Two particular studies have dealt with maintenance and recovery self-efficacy as predictors of physical activity: Scholz, Sniehotta, and Schwarzer (2005) found that, among cardiac patients, maintenance self-efficacy predicted physical activity, measured two to eight months later. By contrast, within a subgroup of patients who had experienced lapses, only recovery self-efficacy predicted an increase of physical activity measured over eight months. Effects of recovery and maintenance self-efficacy may be exclusive: among post-MI patients who were able to maintain physical activity as frequently as recommended. For this group of patients, maintenance self-efficacy predicted physical activity six months later, whereas recovery self-efficacy had no effect (Luszczynska & Sutton, in press). By contrast, recovery self-efficacy predicted physical activity six months later among patients who experienced lapses, whereas maintenance self-efficacy had no effect.

Aims

The present research investigated whether maintenance self-efficacy, recovery self-efficacy, and intentions predict jogging or running behavior two years later. It was hypothesized that (1) individuals with strong intentions and maintenance or recovery self-efficacy beliefs would run (or jog) more frequently two years later. In line with SCT, it was hypothesized that (2) in the cross-lagged panel design, social cognitions would precede behavior (measured two years later). Further, searching for the most proximal social-cognitive predictor of behavior, it was hypothesized that (3) compared to running or jogging behavior at T1, social cognitions would be the stronger predictors of jogging or running behavior at T2. Finally, it was hypothesized that (4) among individuals who declined in jogging or running behavior, recovery self-efficacy would be a stronger predictor of jogging or running behavior (T2) than maintenance self-efficacy (T1) and intentions (T1).

Method

Sample and Procedure

The final longitudinal sample consisted of 139 individuals (80% men), aged from 15 to 60 years (M = 29.5, SD = 9.4), with 81% of the participants being 35 years or younger. Most of them had completed tertiary education (59.7%), 7.2% were students, 27.4% completed secondary education, and 5.8% primary education.

Longitudinal data were collected on-line, with a time lag of two years between waves. At T1, the study was advertised on a noncommercial website for leisure-time running that contained various professional advice regarding running and physical activity and reports written by professional and nonprofessional runners (i.e., reports from participation in various running events, marathons, etc.). After clicking on the advertisement, the Internet users were linked to an invitation to take part in the study. The invitation informed about the aim of the study, and participants were assured confidentiality. Participants were informed that the study deals with their physical activity and its predictors. After reading the invitation, those who agreed to participate in the study were referred to a website that included questionnaire instructions. After reading the instructions, they followed a link to a self-administered questionnaire. Provision of an e-mail address was not a prerequisite for taking part in the study, but participants were invited to leave their e-mail address if they would like to participate in T2 data collection.

One month after T1, participants were asked about their running/jogging frequency within the last month. This additional measurement point was used to identify a subgroup of participants who declined in regular running/jogging behavior. Two years after T1, the participants of the first wave received an e-mail message with an invitation to take part in the second wave.

Overall, 412 individuals filled out the questionnaires at T1; 302 left a valid e-mail address and agreed to participate in further data collection. Two years later, 139 participants responded to the posted questionnaires. Attrition was partially related to the invalid correspondence address (22%).

Measures

At T1 and T2, *running/jogging behavior* was measured with one item. Definitions of running or jogging behavior were introduced to the participants ("Running refers to making a distance of more than 7 miles per hour, jogging refers to making a distance of 5.5 to 7 miles per hour") and followed with a question, "Within the last 2 weeks, how often did you run or jog (for at least 20 minutes)". Responses were made on a six-point scale rated from 1 to 6 (*never*, *less than* o*nce per two weeks*, *once per week*, *twice per week*, *three times per week*, *four times per week, or more*). On average, participants declared that they had run three times per week, $M = 4.89$, $SD = 1.38$, and twice per week at T2, $M = 3.83$, $SD = 1.90$. At one month after T1, participants were asked, "Within the last month, how often did you run or jog (for at least 20 minutes)?" The responses were made on a scale from 1 to 6 (*never* to *four times per week or more)*. They indicated that they went running/jogging three times per week, $M = 4.70$, $SD = 1.51$.

At T1 and T2, the *intention to maintain regular running/jogging behavior* was measured with three items: "Within the next month, I intend to (a) run/jog on a regular basis, (b) run for at least 30 minutes twice per week or more often, (c) run a distance of at least 10 kilometers each week." The responses were given on a scale from 1 (*no*) to 4 (*yes*), and ranged from 4 to 12 at both times. On average, participants said that they intended to run/jog regularly, T1: M = 11.09, SD = 1.79; T2: M = 10.78, SD = 2.14. Cronbach's alpha for the scale was .73 at T1 and .84 at T2.

At T1 and T2, *maintenance self-efficacy* was measured with four items. Participants were instructed: "Think about the maintenance of regular performance of jogging/running. Do you believe that you are able to perform it regularly?". They were then presented with the following statements: "I am confident that I am able to go running/jogging regularly, even if (a) my family and friends do not run/jog, (b) I feel weak, (c) some situations remind me about times when I didn't exercise at all, and (d) I receive no support for my efforts." The responses were given on a four-point scale ranging from *definitely not* (1) to *exactly true* (4). At T1 and T2, the responses ranged from 6 to 16, T1: M = 13.13, SD = 2.50; T2: M = 12.93, SD = 2.44. Cronbach's alpha for the scale was .64 at T1 and .65 at T2.

At T1 and T2, *recovery self-efficacy* was measured with four items. Participants were instructed: "It may happen that you give up running/jogging for some time. Do you believe that you are able to resume regular running?" They were then presented with the following statements: "I am confident that I am able to start regular running/jogging again, even if (a) I did not run for some time because I felt weak, (b) I did not run for some time because I had no time for doing it on a regular basis, (c) I would have to reschedule my running, (d) I had a break from running due to vacation." The responses were given on a four-point scale ranging from *definitely not* (1) to *exactly true* (4). At T1 and T2, the responses ranged from 4 to 16, T1: $M = 11.56$, $SD = 3.13$; T2: $M = 11.64$, $SD = 2.93$. Cronbach's alpha for the scale was .72 for T1 and for T2 as well.

Results

Preliminary Analyses: Attrition Checks and Correlations between Variables

Across variables under study, individuals who participated in both waves and those who participated only in Wave 1 differed neither in gender, $\chi^2[1] = 0.17$ nor in age, $F(1, 420) = 2.35$, *ns*. No between-group differences were found for baseline behavior, $F(1, 419) = 1.06$, ns, intention, $F(1, 417) = 1.15$, *ns*, recovery self-efficacy, $F(1, 414) = 2.06$, *ns,* or maintenance self-efficacy, $F(1, 411) = 3.08$, *ns*.

The correlations between the variables under study are displayed in Table 1. Behavior at T1 was related to social-cognitive variables measured at the same time and to behavior measured two years later. Social-cognitive variables were related within and across measurement points of time, except for the relation between maintenance self-efficacy (T1) and intention at both measurement points. Overall, the associations were weak to moderate.

Jogging and Running Behavior among Individuals with Weak and Strong Intentions or Weak and Strong Self-Efficacy

According to the first hypothesis, individuals with high baseline levels of social-cognitive variables were expected to run/jog more frequently two years later. For the analysis of intention effects, participants with standardized intention scores above zero, $n = 87$, were assigned to the group with strong intentions, whereas those with values of zero or below, $n = 45$, were assigned to the group with weak intentions at T1. Using the same procedure, participants were divided into subgroups with strong, $n = 72$, and weak, $n = 66$, maintenance self-efficacy and into subgroups with strong, $n = 72$, and weak, $n = 61$, recovery self-efficacy. Means for number of jogging or running sessions for groups with high and low levels of social-cognitive variables are displayed in Figure 1.

Regarding the participants with weak and strong intentions at T1, repeated measures analysis of variance revealed that there was a time effect, $F(1, 130) = 34.55$, $p < .001$, $\eta^2 = .11$, but there was no Time x Group interaction, $F(1, 130) = 0.01$, *ns*, $\eta^2 < .001$ (cf. Figure 1). Both groups differed at T1, $F(1, 131) = 24.31$, $p <.001$, $\eta^2 = .16$, $d = 0.84$, as well as at T2, $F(1, 131) = 12.24$, $p <.001$, $\eta^2 = .09$, $d = 0.65$. Participants reduced the number of running or jogging sessions over two years, regardless of their strong, $d = 0.70$, or weak, $d = 0.62$, intentions at T1.

For participants with weak and strong maintenance self-efficacy at T1, repeated measures analysis of variance revealed a time effect, $F(1, 136) = 42.12$, $p < .001$, $\eta^2 = .24$, but no Time x Group interaction, $F(1, 136) = 0.21$, *ns*, $\eta^2 = .002$ (cf. Figure 1). Both groups differed at T1, $F(1, 137) = 4.66$, $p <.05$, $\eta^2 = .03$, $d = 0.37$, but not at T2, $F(1, 137) = 1.16$, *ns*, $\eta^2 = .01$, $d = 0.18$. Similarly to the findings for groups with weak and strong intentions, participants declined in frequency of running/jogging over the two years, regardless of their strong, $d = 0.71$, or weak, $d = 0.59$, baseline maintenance self-efficacy.

Finally, for participants with weak and strong recovery self-efficacy at T1, repeated measures analysis of variance revealed a time effect, $F(1, 131) = 43.43$, $p < .001$, $\eta^2 = .25$. In contrast to previous findings, there was a Time x Group interaction, $F(1, 131) = 3.70$, $p = .05$, $\eta^2 = .03$. Overall, participants reduced the number of jogging or running sessions over two years regardless of their strong, $d = 0.35$, or weak, $d = 0.80$, recovery self-efficacy at T1. Both groups did not differ in jogging/running behavior at T1, $F(1, 132) = 0.48$, *ns*, $\eta^2 = .01$, $d = 0.12$. However, participants with strong recovery self-efficacy (T1) ran/jogged more often at T2 than those who had weak recovery self-efficacy at T1, $F(1, 131) = 6.12$, $p < .05$, $\eta^2 = .05$, $d = 0.54$).

Insert Table 1 and Figures 1 and 2 about here

Results of Path Analysis: Intention, Maintenance Self-Efficacy, and Recovery Self-Efficacy as Predictors of Running/Jogging Behavior Two Years Later

In order to investigate whether both types of self-efficacy and intentions precede jogging or running behavior, a cross-lagged panel design (Arbuckle & Wothke, 1999) was used. A full two-wave cross-lagged panel design with a two-year time lag, taking stabilities of the variables into account, was tested by means of path analysis with observed variables. The hypothesized model consisted of eight observed variables (cf. Figure 2). Intention, two types of self-efficacy, and jogging/running behavior measured at T1 predicted intention, and two types of self-efficacy and jogging/running behavior measured at T2. The variables assessed at the same point in time were specified to be intercorrelated. All variables were measured with the respective indicators mentioned in the Method section.

Evaluation of model-data fit was based on the most recommended indices, such as CFI, TLI, and RMSEA. For TLI and CFI, values ranged from .90 to 1, indicating a good fit of the model. The RMSEA value of .05 or less indicates a close fit of the model. To account for missing data, the full information maximum likelihood procedure was used.

The model fit the data well, $\chi^2 = 1.38$, $df = 1$, $p = .24$, CFI = .99, TLI = .99, RMSEA = .03. The standardized solution (with significant paths displayed) is shown in Figure 2. Regarding behavior at T1 as the predictor of variables at T2, only the path to behavior measured two years later was significant, $p \leq .05$. Intention at T1 predicted intention, $p < .01$, recovery self-efficacy, $p < .01$, and jogging/running behavior, $p < .01$, measured two years later. Recovery self-efficacy at T1 predicted recovery self-efficacy, $p < .05$, maintenance self-efficacy, $p \leq .05$, and jogging or running behavior, $p < .05$, assessed two years later. Overall, social-cognitive variables predicted behavior, whereas behavior did not predict social-cognitive variables. The variables at T1 explained 17% of the variance in jogging or running behavior two years later, whereas 10% of intention and recovery self-efficacy and 6% of maintenance self-efficacy was explained.

The next research question referred to the strength of effects of social cognitions on behavior. In particular, it was asked whether intention or self-efficacy is a stronger predictor of behavior. Because no significant effects of maintenance self-efficacy were found in the hypothesized model, the analyses were performed to compare effects of intentions and recovery self-efficacy. To test whether the paths from particular social cognitions to behavior are different, a nested model was designed. The nested model differed from a hypothesized model in one respect: Paths representing the relations between intention and behavior as well as between recovery self-efficacy and behavior were constrained to be equal. Then, the fit indices of the hypothesized model and a nested model were compared. The lack of significant differences between the hypothesized and the nested model means that the nested model can be accepted.

The comparison between the hypothesized model (with paths from social cognitions to behavior not constrained to be equal) and the nested model (with respective paths constrained to be equal) revealed that the two models did not differ significantly from each other, $\chi^2 = 1.15$, $df = 1$, $p = .28$, Δ TLI = -.001. Therefore, the model with equal effects of intentions and recovery self-efficacy on jogging or running behaviour has to be accepted.

Additionally, it was tested whether effects of intention on recovery self-efficacy differ from effects of recovery self-efficacy on intention. The same procedure, employing nested models comparison was used. The analyses revealed that the nested model (with paths between social cognitions constrained to be equal) did not differ significantly from the hypothesized model, $\chi^2 = 2.52$, $df = 1$, $p = .11$, Δ TLI = .006. Therefore, the model with equal paths from intention to recovery self-efficacy and from recovery self-efficacy to intention has to be accepted.

Social Cognitions as Predictors of Physical Activity among Individuals who Experienced Lapses in Frequency of Jogging or Running Behavior

In order to answer the question whether among those individuals who declined in frequency of jogging or running behavior, recovery self-efficacy would be a stronger predictor of behavior (T2) than maintenance self-efficacy (T1) and intentions (T1), cross-lagged panel analyses with the hypothesized model were performed for a subsample of participants who experienced lapses in running or jogging. A lapse was defined as a period of exercising less than twice per week for at least two weeks.

For these analyses, participants who experienced at least one two-week lapse in running/jogging behavior have been selected. These were participants who either (a) decreased in behavior frequency from T1 to T2, $n = 67$, or (b) reported a decrease in frequency of running/jogging behaviour at one month after T1, as compared to behavior at T1, $n = 62$. Overall, 120 out of 139 participants reported a decline in running/jogging behavior. On average, they declared less than two running sessions per week at T2, $M = 3.60$, $SD = 1.92$.

For participants who experienced lapses, the hypothesized model fit the data reasonably well, $\chi^2 = 1.46$, $df = 1$, $p = .23$, CFI = .99, TLI = .99, RMSEA = .06. Only a few paths in the model were significant: Past behavior predicted behavior at T2, $\beta = .46$, $p < .001$, recovery self-efficacy (T1) predicted behavior at T2, $\beta = .19$, $p \leq .05$, intention (T1) predicted recovery self-efficacy at T2, $\beta = .24$, $p < .05$, intention (T1) predicted intention at T2, $\beta = .22$, $p \leq .05$, and recovery self-efficacy (T1) tended to predict intention at T2, $\beta = .18$, $p = .056$. Paths for participants who experienced lapses are marked in bold in Figure 2. Among participants who experienced a lapse in jogging or running behavior, past behavior and recovery self-efficacy accounted for 30% of the variance of behavior measured two years later.

Discussion

The results of the present study suggest that social cognitions precede and explain behavior two years later. Cross-lagged panel analyses revealed that intention and recovery self-efficacy precede behavior. The effects of recovery self-efficacy and intentions were equally strong for the total sample. Among individuals who experienced a period of decline in their jogging or running behavior over two years, only recovery self-efficacy predicted behavior measured two years later.

Across analyses, only recovery self-efficacy had a consecutive effect on behavior measured two years later. Although participants with high and low levels of intention at baseline did not differ at T2, for the total group of participants, intention predicted behavior in a cross-lagged panel analysis. The relation became negligible for participants who experienced lapses in running/jogging behavior. No effects of maintenance self-efficacy were found.

The strength of the effect of recovery self-efficacy may result from the fact that the sample consisted mostly of individuals who experienced some lapses in their running/jogging behavior over the two-year period. Maintenance self-efficacy, that is beliefs about one's ability to maintain certain behaviors, is expected to predict behavior mainly among individuals who continue to maintain their behavior as expected (cf. Luszczynska & Sutton, in press). Therefore, its effects may be negligible among those persons who experience lapses or decline in their performance.

It may also be assumed that effects of maintenance self-efficacy would be salient if shorter time gaps between waves are considered. The shorter the period between waves, the lower the probability of experiencing lapses or declining in performance of regular behaviors, such as jogging or running. The more lapses or decline periods occur, the more likely is it that only beliefs about one's ability to regain control and recover from lapses predict subsequent behavior. This assumption requires further investigation.

For the total sample of participants, the effects of intention were as strong as the effects of recovery self-efficacy. The TPB favors intentions as the most proximal predictors of behavior (Ajzen, 1991; Sutton, 1998), whereas SCT suggests that self-efficacy is the most proximal predictor (Bandura, 1997, 2000). The results of the present study suggest that the effects of both cognitions are equal when it comes to running/jogging behavior performed regularly. These cognitions exert similar effects upon behavior and upon each other. This conclusion refers, however, only to recovery self-efficacy. For maintenance self-efficacy, in contrast, intention was a stronger predictor than self-efficacy among those who (predominantly) did not maintain equally frequent jogging or running behavior within two years.

Previous research suggested that intention is a stronger predictor of behavior than self-efficacy or perceived behavioral control (Armitage, 2005; Blanchard et al., 2002; Courneya et al., 1999). However, these results were obtained for self-efficacy measured as relatively general beliefs about the ability to perform some kind of physical activity. It may be assumed that the difference in the strength of effects of intention and self-efficacy on behavior may depend on the particular type of self-efficacy. Among individuals who experienced lapses or who decline in their performance, recovery self-efficacy may be a stronger predictor of physical activity than just beliefs about the ability to be physically active (or beliefs about the ability to maintain behavior) because these beliefs themselves are measured in a way more proximal to actual behavior.

Intentions and recovery self-efficacy remained stable over two years. As they were measured as specific cognitions, they were likely to change. It may be assumed that the influence of those cognitions on each other may contribute to their consistency over longer time periods. Stability of cognitions may be one of the crucial predictors of behaviors. Research revealed that the temporal stability of intentions may affect relations between past behavior, intention, and control beliefs (cf. Sheeran & Abraham, 2003).

The health behavior change process can be subdivided into initiation, maintenance, and recovery after lapses. Self-efficacy beliefs matching the corresponding phase of the health behavior change process may allow for a better prediction of behavior than just beliefs that are specific for a certain behavior. Previous research has shown that recovery self-efficacy is a substantial predictor among individuals who experience lapses or who decline in their target behavior (Luszczynska & Sutton, in press; Scholz et al., 2005). The present study further corroborates the distinction between maintenance self-efficacy and recovery self-efficacy. Exclusive relations were found for recovery self-efficacy and behavior among those who experienced lapses in their performance.

The study has limitations. The sample size was small. Behavior was self-reported. Although objective measures of running or jogging would be preferable, they were difficult to collect in this context. In addition, data on participants' running/jogging behavior history (before the baseline measurement) was not available. Therefore, participants' behavior patterns and degree of maintenance prior to the study was not controlled for. The present study relies on self-report measures capturing behavior for the previous two weeks only, which is a brief period of activity. However, retrospective self-reports dealing with longer periods of time can be biased due to memory distortion (Stone & Shiffman, 2002). Including several measurement points would allow for a more precise test for maintenance and relapse patterns. The present study focused on one type of vigorous physical activity. It is possible that, over time, individuals may switch from one form of vigorous physical activity to another (e.g., substitute running with aerobic exercises), which may explain an overall decline in running/jogging behavior in the present study. As other forms of vigorous physical activity were not controlled for, the results cannot be generalized to an overall decline in vigorous physical activity. Consequently, replication is warranted.

Although further experimental evidence is needed, the results of the present research are of particular importance for psychological practice. Interventions designed to increase confidence in one's ability to perform a healthy behavior should enhance specific recovery beliefs if the treatment targets individuals who are at risk for lapses. The strength of relations between particular social cognitions and behavior may depend on the particular phase of behavior change. Therefore, the proximity of specific cognitions and behavior may depend on the health behavior change process. Cognitions proximal in one phase may be unrelated in a different phase. Targeting specific cognitions may be either irrelevant or crucial for a healthy behavior, depending on the actual phase of behavior change process. For example, among individuals who struggle with lapses, recovery self-efficacy may help to regain control and to act upon their intentions.

References

Aartsen, M. J., Smits, C. H., van Tilburg, T., Knipscheer, K. C., & Deeg, D. J. (2002) Activity in older adults: Cause or consequence of cognitive functioning? A longitudinal study on everyday activities and cognitive performance in older adults. *Journal of Gerontology Series B: Psychological Sciences and Social Sciences*, *57*, 153-162.

Abraham, C., & Sheeran, P. (2003). Implications of goal theories for the Theories of Reasoned Action and Planned Behaviour. *Current Psychology*, *22*, 264-280.

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behavior and Human Decision Processes*, *50*, 179–211.

Ajzen, I. (2002a). Perceived behavioural control, self-efficacy, locus of control, and the Theory of Planned Behavior. *Journal of Applied Social Psychology*, *32*, 1–20.

Ajzen, I. (2002b). Residual effects of past on later behaviour: Habituation and Reasoned Action perspectives. *Personality and Social Psychology Review, 6*, 107-122.

Arbuckle, J. L., & Wothke, W. (1999). *Amos 4.0 user guide*. Chicago: Small Waters.

Armitage, C. J. (2005). Can the Theory of Planned Behavior predict maintenance of physical activity? *Health Psychology*, *24*, 235–245.

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

Bandura, A. (2000). Cultivate self-efficacy for personal and organizational effectiveness. In E. A. Locke (Ed.), *The Blackwell handbook of principles of organizational behavior* (pp. 120–136). Oxford, England: Blackwell.

Bennett, P., Mayfield, T., Norman, P., Lowe, R., & Morgan M. (1999). Affective and social cognitive predictors of behavioral change following first myocardial infraction. *British Journal of Health Psychology*, *4*, 247–256.

Blanchard, C. M., Rodgers, W.M., Courneya, K. S., Daub, B., & Knapik, G. (2002). Determinants of exercise intention and behavior during and after phase 2 cardiac rehabilitation: An application of the Theory of Planned Behavior. *Rehabilitation Psychology*, *47*, 308–323.

Boutelle, K. N., Jeffery, R. W., & French, S. A. (2004). Predictors of vigorous exercise adoption and maintenance over four years in a community sample. *International Journal of Behavioral Nutrition and Physical Activity*, *1,* 13.

Courneya, K. S., & McAuley, E. (1994). Are there different determinants of the frequency, intensity and duration of physical activity? *Behavioral Medicine*, *20*, 84–90.

Courneya, K. S., Friedenreich, C. M., Arthur, K., & Bobick, T. M. (1999). Understanding exercise motivation in colorectal cancer patients: A prospective study using the Theory of Planned Behavior. *Rehabilitation Psychology*, *44*, 68–84.

Dijkstra, A., & De Vries, H. (2000). Self-efficacy expectations with regard to different tasks in smoking cessation. *Psychology and Health*, *15*, 501–511.

Evon, D. M., & Burns, J. W. (2004), Process and outcome in cardiac rehabilitation: An examination of cross-lagged panel. *Journal of Consulting and Clinical Psychology*, *72*, 605–616.

Fukukawa, Y. Nakashimura, C., Tsuboi, S., Kozakai, R., Doyo, W., Niino, N., Ando, F., & Shimokata, H. (2004). Age difference in the effect of physical activity on depressive symptoms. *Psychology and Aging*, *19*, 346-351.

Hagger, M, S., Chatzisarantis, N. L. D., Biddle, S. J. H., & Orbell, S. (2001). Antecedents of children's physical activity intentions and behaviour: predictive validity and longitudinal effects. *Psychology and Health*, *16*, 391–407.

Hertzog, C., & Nesselroade, J. R. (1987). Beyond autoregressive models: Some implications of the trait-state distinction for the structural modeling of developmental change. *Child Development*, *58*, 93-109.

Johnston, D. W., Johnston, M., Pollard, B., & Kinmonth, A. L. (2004). Motivation is not enough: Prediction of risk behavior following diagnosis of coronary heart disease from the Theory of Planned Behavior. *Health Psychology*, *23*, 533–538.

Kenny, D. A. (1975). Cross-lagged panel correlation: A test for its spuriousness. *Psychological Bulletin*, *82*, 225–233.

Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2004). Behavioral intentions and action plans promote physical exercise: A longitudinal study with orthopedic rehabilitation patients. *Journal of Sport and Exercise Psychology*, *26*, 470–483.

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.

Luszczynska, A., & Sutton, S. (in press). Physical activity after cardiac rehabilitation: The evidence that different types of self-efficacy are important in maintainers and relapsers. *Rehabilitation Psychology*.

Marlatt, G. A., Baer, J. S., & Quigley, L. A. (1995). Self-efficacy and addictive behavior. In A. Bandura (Ed.), *Self-efficacy in changing societies* (pp. 289–315). New York: Cambridge University Press.

Maddison, R., & Prapavessis, H. (2004). Using self-efficacy and intention to predict exercise compliance among patients with ischemic heart disease. *Journal of Sport and Exercise Psychology*, *26*, 511–524.

Nigg, C. R. (2001). Explaining adolescent exercise behaviour change: A longitudinal application of the Transtheoretical Model. *Annals of Behavioral Medicine*, *23*, 11–20.

Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behaviour predicts future behaviour. *Psychological Bulletin*, *124*, 54-74.

Rhodes, R. E., & Courneya, K. S. (2003). Modelling the theory of planned behavior and past behavior. *Psychology, Health and Medicine*, *8*, 57–67.

Sallis, J. F., Hovell, M. F., Hofstetter, C. R., & Barrington, E. (1992). Explanation of vigorous physical activity during two years using social learning variables. *Social Science and Medicine*, *34*, 25–32.

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

Sheeran, P., & Abraham, C. (2003). Mediator of moderators: temporal stability of intention and the intention-behavior relation. *Personality and Social Psychology Bulletin*, *29*, 205-215.

Stone, A. A., & Shiffman, S. (2002). Capturing momentary, self-report data: A proposal for reporting guidelines. *Annals of Behavioral Medicine*, *24*, 236-143.

Sullum, J., Clark, M. M., & King, T. K. (2000). Predictors of exercise relapse in a college population. *Journal of American College Health*, *48*, 175–180.

Sutton, S. (1994). The past predicts the future: Interpreting behaviour-behaviour relationships in social psychological models of health behaviour. In D. Rutter & L. Quine (Eds.), *Social psychology and health: European perspectives* (pp. 71-88). Brookfield, VT: Avebury.

Sutton, S. (1998). Predicting and explaining intentions and behavior: How well are we doing? *Journal of Applied Social Psychology*, *28*, 1317–1338.

U.S. Department of Health and Human Services (1996). *Physical activity and health: A report of the surgeon general.* Atlanta, GA: Centers of Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

U.S. Department of Health and Human Services (2000*). Healthy People 2010: Understanding and improving health* (2nd ed.). Washington, DC: Government Printing Office.

Wallace, L. S., & Buckworth, J. (2003). Longitudinal shifts in exercise stages of change in college students. *The Journal of Sports Medicine and Physical Fitness*, *43*, 209–212.

Table 1.

Correlations Among Social-Cognitive Variables and Running /Jogging Behavior at Time 1 (T1) and Time 2 (T2) (Two Years Later).

Variable	Behavior (T2)	Intention (T1)	Intention (T2)	Maintenance self-efficacy (T1)	Maintenance self-efficacy (T2)	Recovery self-efficacy (T1)	Recovery self-efficacy (T2)
Behavior (T1)	.33***	.52***	.13	.20*	.06	.23**	.17†
Behavior (T2)		.32***	.35***	.15†	.25**	.25**	.32***
Intention (T1)			.30**	.10	.10	.14	.25**
Intention (T2)				.02	.23**	.16†	.39***
Maintenance self-efficacy (T1)					.18*	.59***	.06
Maintenance self-efficacy (T2)						.24**	.45***
Recovery self-efficacy (T1)							.22**

Note. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

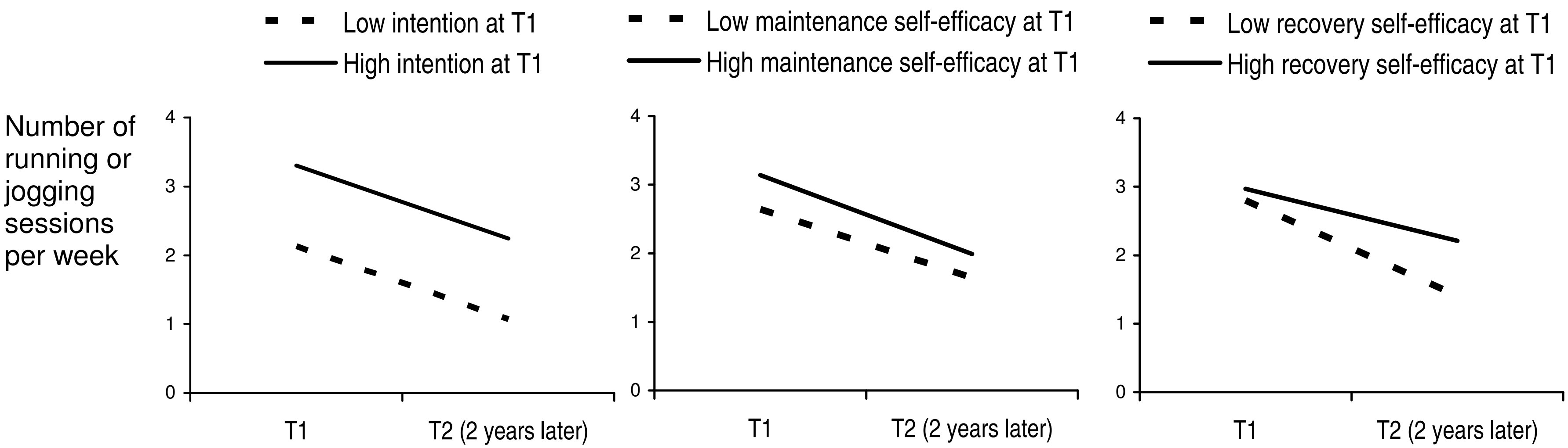
Figure Captions

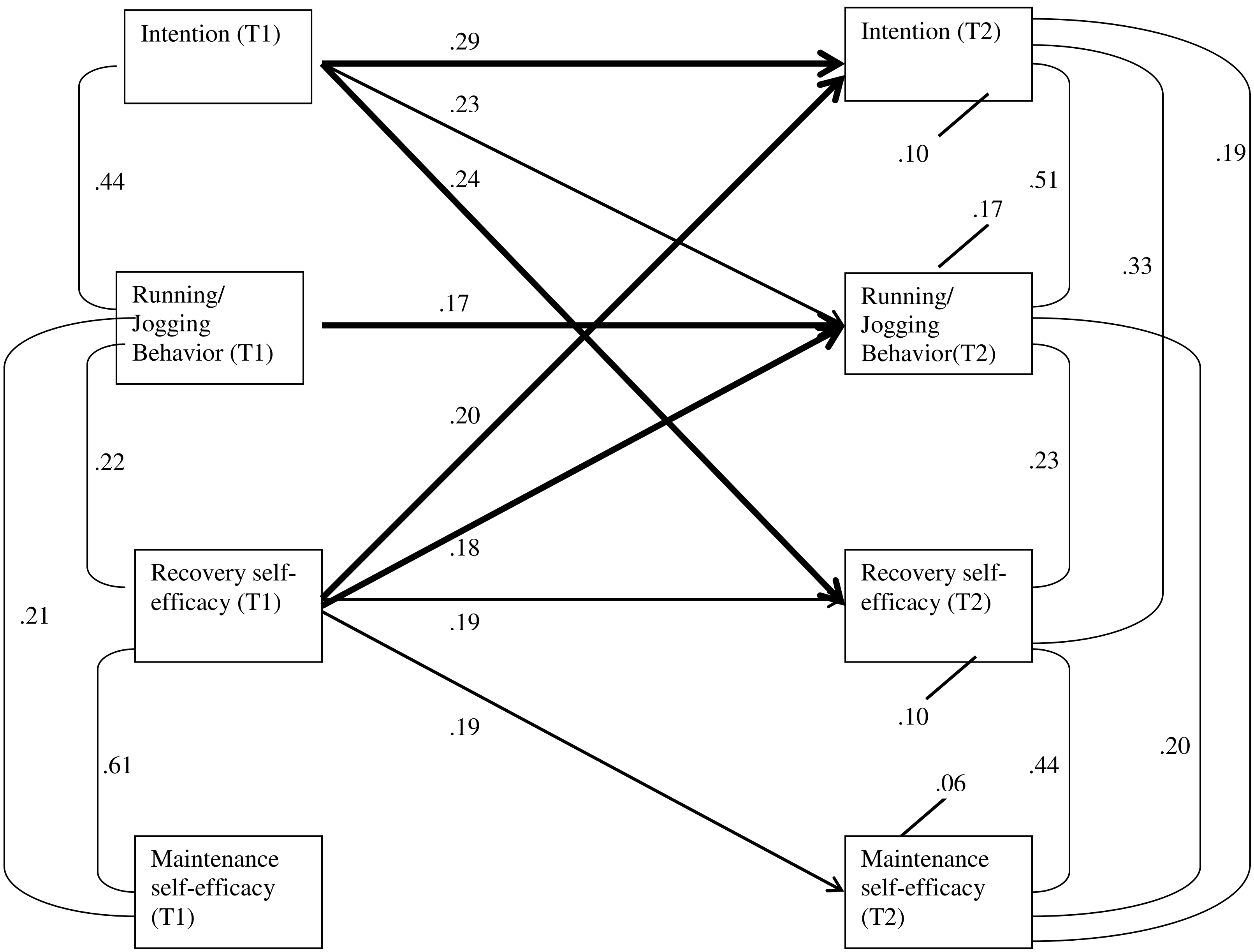
Figure 1. Changes in vigorous running or jogging behavior over 2 years: differences between individuals with high and low levels of social cognitions at T1.

Note: Y-axis refers to a number of running or jogging sessions per week.

Figure 2. Relations between intention, maintenance self-efficacy, recovery self-efficacy, and frequency of running / jogging behavior over 2 years: Cross-lagged panel analysis.

Note: All displayed path coefficients are significant at $p < .05$. Nonsignificant paths are omitted. All paths significant for a subgroup of individuals who experienced lapses ($n = 120$) are in bold.


Low intention at T1
High intention at T1
Low maintenance self-efficacy at T1
High maintenance self-efficacy at T1
Low recovery self-efficacy at T1
High recovery self-efficacy at T1
Number of running or jogging sessions per week
0
1
2
3
4
T1
T2 (2 years later)


Intention (T1)
Running/ Jogging Behavior (T1)
Recovery self-efficacy (T1)
Maintenance self-efficacy (T1)
Intention (T2)
Running/ Jogging Behavior(T2)
Recovery self-efficacy (T2)
Maintenance self-efficacy (T2)
.29
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.24
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