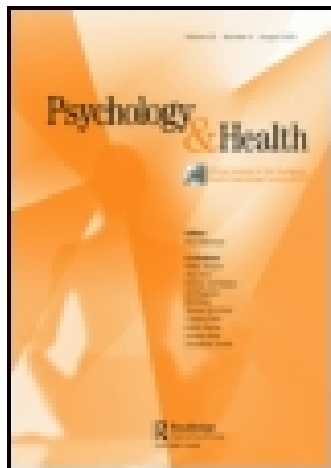


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### Action control bridges the planning-behavior gap: A longitudinal study on physical exercise in young adults

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Accepted Manuscript

## **Action control bridges the planning-behavior gap: A longitudinal study on physical exercise in young adults**

### **Abstract**

**Objectives.** Maintaining physical exercise levels may not only require motivation and planning but also action control which is supposed to mediate between planning and exercise.

**Design.** Behavioral intention, action planning, coping planning, and past behavior were assessed at baseline, and action control and concurrent exercise were measured one month later in 487 young adults.

**Method.** Three nested structural models were specified to examine different mediation mechanisms. One model reflected the intention-planning-behavior chain, the other one focused on the intention-action control-behavior chain, and the third model comprised the full sequence.

**Results.** Indirect effects from intentions on exercise involved either planning or action control as mediating variables. In model 3, all three constructs (action planning, coping planning, and action control) were sequential mediators between intentions and later physical exercise levels. Action and coping planning were not directly, but indirectly related to exercise via action control.

**Conclusions.** Findings support the sequential mediation for planning and action control as antecedents of physical exercise. Action control is needed for exercise because planning in itself is not always sufficient. Maintaining exercise levels may be attributed to effective self-regulatory strategies such as action control in combination with planning.

## **Action control bridges the planning-behavior gap: A longitudinal study on physical exercise in young adults**

Although health benefits of regular physical activity and exercise have been widely acknowledged, many people do not meet the recommended levels (Hallal et al., 2012). Physical activity is recommended for at least half an hour on at least five days a week. It may be of moderate to vigorous intensity, although there are various different recommendations, also depending on age groups (WHO, 2010). Promoting regular physical activity is important for various reasons: physical exercise is beneficial for physical and cognitive health, and it enhances psychological well-being. It increases cardiovascular fitness, positive emotional experiences, improved body self-concept, self-esteem, and quality of life, and it can have mood-brightening effects (Balady et al., 2007; Blair & Morris, 2009; Garber et al., 2011; Hardman & Stensel, 2009; Janssen & LeBlanc, 2010; WHO, 2010).

Knowledge of the determinants of physical activity and exercise is needed to effectively promote an active lifestyle (van Stralen, De Vries, Mudde, Bolman, & Lechner, 2009). Reasons for not attaining the desired levels of activity are manifold. Many people experience competing demands on their time from educational, career, and family obligations, and these demands may have higher priorities in the short run. Resources that could be invested in exercising regularly are depleted due to the necessity to meet other requirements (Presseau, Tait, Johnston, Francis, & Sniehotta, 2013). However, to a large degree, lack of exercise is due to psychological reasons which can be of a motivational or volitional nature (Schwarzer, 2008). People do not form intentions to be sufficiently active because they are not aware of the health risks of a sedentary lifestyle, they may not see the benefits of exercising frequently, or they are not confident in their ability to turn their daily

life into a more active one. Thus, the first step in changing people is to motivate them, which then is reflected by a behavioral intention. When this has been achieved and people have become motivated, the second step is to translate their goals into action (Fleig et al., 2013a). This requires a belief in one's competence as well as self-management skills such as planning, control of temptations, coping with stress, mobilizing social support, setting priorities etc. (Carraro & Gaudreau, 2013). Third, when people have become sufficiently active, they need to protect themselves against relapse. To maintain one's level of exercise, one has to cultivate one's self-efficacy, keep the intention high, and control one's actions by monitoring fluctuations in the activity level (Amireault, Godin, & Vezina-Im, 2013; Fleig, Pomp, Schwarzer, & Lippke, 2013b).

**Motivation to exercise: Behavioral intentions and the intention-behavior gap**

In the process of motivation, intention is regarded by the Health Action Process Approach (HAPA, Schwarzer, 2008) as a kind of "watershed" demarcation between an initial goal setting phase (motivation) and a subsequent goal pursuit phase (volition). The terms motivation and goal setting pertain to the preintentional phase, whereas the terms volition and goal pursuit pertain to the postintentional phase. Although the construct of intention is indispensable in explaining health behavior change, its predictive value is limited (Webb & Sheeran, 2006). Recognized theoretical models that assume intention as the most important proximal predictor of behavior, such as the Theory of Planned Behavior can explain intention better than behavior, with explained variance for behavior of only 19.3% (McEachan, Conner, Taylor, & Lawton, 2011). Meta-analyses have found that 46% of intenders were not successful at following through with their physical activity (Rhodes & de Bruijn, 2013). Population effect sizes between intention and behavior of  $r = .51$  were also identified (Rhodes & Dickau, 2012). As can be seen, motivation alone does not suffice

to change behavior, because, when trying to translate intentions into behavior, individuals are faced with various obstacles, such as distractions, forgetting, or conflicting bad habits. To overcome this intention-behavior gap (Sheeran, 2002), further variables are required that operate after people have become motivated.

### **Translating intentions into exercise by action planning and coping planning**

By forming an intention, a person develops an inclination towards a particular health behavior, but this has to be transformed into detailed instructions on how to perform the desired action (Schwarzer, 2008). Planning has been proposed as a variable to bridge the intention-behavior gap (Sniehotta, Scholz, & Schwarzer, 2005a). Planning can be conceptualized as *action planning* when concrete plans are elaborated about where, when, how often and how a specific behavior is expected to be performed. It can be classified as *coping planning* when difficulties to perform the behavior are anticipated and coping strategies are elaborated (Carraro & Gaudreau, 2013; Kwasnicka, Penseau, White, & Sniehotta, 2013; Sniehotta et al., 2005a). Both kinds of planning involve mental simulation where situational cues are related to behavioral responses (Sniehotta, Schwarzer, Scholz, & Schüz, 2005b). Coping planning is expected to take place on top of action planning, because it implies the provision of already elaborated action plans. Action planning alone does not produce a lasting behavior but rather helps to initiate action (Caudroit, Boiche, & Stephan, 2014). To maintain behaviors in the long run, coping planning is a promising strategy. So far, a large body of evidence has been accumulated that confirms the mediating role of both kinds of planning for a variety of health behaviors (for an overview see Hagger & Luszczynska, 2014). Thus, planning can be considered a straightforward way to help bridge the intention-behavior gap. However, for the maintenance of exercise more proximal and on-going strategies are needed that help to prevent a relapse to sedentary behaviors,

resuming previous habits (Conroy, Maher, Elavsky, Hyde, & Doerksen, 2013).

Nevertheless, some caution is advisable when judging the contribution of planning to bridge the intention-behavior gap. Higher levels of planning and planning interventions are not always associated to higher levels of behavior (Parschau et al., 2014; Scholz, Ochsner, & Luszczynska, 2013). As pointed out by Hagger and Luszczynska (2014) and by Scholz et al. (2013) this might be explained by putative moderators between intention and planning as well as between planning and behavior such as intention strength, habit strength, self-efficacy, executive function. Moreover, intervention engagement, adherence to the study protocol, intervention settings, and specific planning content might also act as moderators.

#### **Maintaining levels of exercise by action control**

Once an action has been initiated, it is important to keep going (Rothman, Baldwin, & Hertel, 2004). Maintaining the target health behavior might fail if individuals are not constantly aware of their goals and behavioral standards, do not monitor their actions, and do not make an effort to reduce the discrepancy between their current behaviors and their self-imposed standards. Then, a gap between planning and behavior arises, particularly when behavior requires continuous self-regulatory efforts. Within the theoretical framework of HAPA (Schwarzer, 2008), action control is a self-regulatory strategy, which involves *awareness of standards, self-monitoring* and *effort* (Sniehotta et al., 2005a). It is a more proximal predictor of behavior, and may help translating intentions and plans into behavior change. Action control is related to the concept of feedback loops as spelled out by Carver and Scheier (1998) and to the theory of Kuhl and Beckmann (1985). Action control is supposed to mediate not only the effects of intentions on behavior, but also the effects of planning on behavior. Recent evidence emphasizes the relevance of action



control for health behavior change in various domains (Godinho, Alvarez, Lima, & Schwarzer, 2014; Parschau et al., 2013; Reyes Fernández, Montenegro-Montenegro, Knoll, & Schwarzer, 2014; Schwarzer, Antoniuk, & Gholami, 2014).

### **The proposed mechanism: Bridging the planning-behavior gap**

Looking at the self-regulatory process that takes place after a behavioral intention has been formed, one can expect that action planning constitutes the next step, followed by coping planning when individuals contemplate possible barriers confronting their plans. With the onset of the intended behavior, such as increased frequency of exercise, people may monitor their actions and evaluate them. Thus, action control constitutes the last step in the chain, occurring parallel to behavioral attempts. In this way, a sequence emerges that leads from intentions to action planning, from there to coping planning, and finally to action control as the most proximal effort to maintain an on-going exercise behavior. This hypothetical sequence is in line with the volitional phase of the Health Action Process Approach (HAPA, Schwarzer, 2008).

### **Aims**

The purpose of this study is to identify factors that help to maintain the level of physical exercise in young adults and order of sequence of these factors. Here, the focus is on post-intentional psychological constructs. Based on the HAPA, it is assumed that there is a sequence that starts with the intention level, leads to action planning and coping planning, and affects exercise maintenance via action control. There are three sequential mediators: action planning, coping planning, and action control. It is also explored whether less than three mediators are sufficient for this mediation process, and if so, which ones will

be the most promising candidates for a more parsimonious mediation chain. In order to test these assumptions, a set of hypotheses was proposed.

1. Action planning, coping planning and action control mediate between intentions and physical exercise in this sequential order.
2. Indirect effects of intentions on exercise via action control are stronger than indirect effects via planning only.
3. The indirect effects of intention via action planning or coping planning on physical exercise are fully mediated by action control.

## Method

### Participants

A total of 697 university students completed questionnaires at Time 1 (T1), and 497 of them completed questionnaires one month later at Time 2 (T2), forming the longitudinal sample to be analyzed. Their mean age was 18.74 years (SD = 2.8, range 16-48 years). A subsample of  $n = 263$  of them were women (52.9%).

### Procedure

Participants were recruited from a Costa Rican university. They were invited to voluntarily participate. Informed consent was given before completion of study materials, all other procedures required by the ethics committee of the university were fulfilled. The students received the questionnaires in their classrooms just after their lessons.

Approximately one month after the first assessment, students answered the second questionnaire (Time 2).

### Measures

Social-cognitive measures were adapted from Sniehotta et al. (2005a). Responses were made on a four-point Likert scale ranging from 1 (*not at all true*) to 4 (*exactly true*).

*Intention.* Intention was measured at Time 1 by three items, such as ‘*I intend to practice physical exercise on a regular basis.*’ (Cronbach’s  $\alpha = .87$ ). There was an introductory question for these items asking “What intentions do you have for the following weeks?”

*Action Planning.* Three items were used to measure action planning at Time 1 (Cronbach’s  $\alpha = .87$ ). The items started with the stem ‘*I have already planned*’ and were correspondingly followed by ‘*on which days I will do exercise*’, ‘*where to practice exercise*’ and ‘*how to practice exercise*’, respectively.

*Coping planning.* At Time 2 to assess coping planning, the stem ‘*I have already planned what to do*’ was followed by three items (Cronbach’s  $\alpha = .96$ ) such as: ‘*in difficult situations to stick to my intentions*’.

*Action control.* Action control at Time 2 was measured by four items (Cronbach’s  $\alpha = .86$ ), introduced with the stem “In the past weeks...” and followed by items such as ‘*I have constantly monitored if I do enough exercise*’.

*Physical exercise.* The physical exercise measure was taken from Warner, Ziegelmann, Schüz, Wurm, and Schwarzer (2011). After receiving instructions on how to define exercise and how to complete the questionnaire, students responded to two items, one for frequency of exercise sessions per week and the other one for minutes per bout at baseline and at T2. The items were: (1) ‘*how many days during the week do you practice physical exercise?*’, response options ranged from 1 to 7 days per week, and (2) ‘*how many minutes per occasion do you practice exercise?*’, with an open answer format. For the analyses, the product of these items was used to define the amount of weekly minutes dedicated to exercise.

## **Data Analysis**

Structural equation modeling was conducted using AMOS 18. It provides fit indices to evaluate complex models, estimate their parameters, and control for measurement error. Missing values (missings < 1.7%), were imputed with the EM algorithm in SPSS 22.

To explore the contribution of action planning, coping planning, and action control to the indirect effect of intention on exercise, three nested models were specified. In a first model, action planning and coping planning were specified as serial mediators between intention and exercise, but there was no effect specified from action control on exercise, in order to filter out all possible effects of planning and intention on exercise via action control. In other words, the aim was to estimate indirect effects of intention on exercise merely due to planning. In a second model, action control was specified as the only variable to bridge the intention-behavior gap. All possible effects that intention could exert on exercise via planning were partialled out. Finally, in a third model, action planning, coping planning, and action control were specified as serial mediators between intention and exercise. This last one is the full model under the nested models perspective. All the paths not used in Models 1 and 2 were constrained to zero. In Model 3, all parameters were freely estimated. For each model, parameter estimates and confidence intervals were generated by bootstrapping with 5,000 resamples. Bootstrapping is a non-parametric re-sampling procedure that allows generating confidence intervals for statistical inference where normality assumptions about the sample distribution are not required. It is recommended for mediation analyses, including serial mediation models (Hayes, 2009; Hayes, 2013).

Besides the overall fit estimate chi square ( $\chi^2$ ), other fit indices were the comparative fit index (CFI), Tucker-Lewis index (TLI), Akaike Information Criterion (AIC), and the root mean square error of approximation (RMSEA). CFI and TLI values close to 0.95 and RMSEA values close to 0.06 (Hu & Bentler, 1999) indicate an adequate model fit. The

three nested models were compared by means of the Akaike Information Criterion (AIC), with lower values being indicative of a better and more parsimonious fit, and by means of the chi-square difference tests (Kline, 2005).

## Results

### Dropout analysis

There was a drop-out rate of 28.7% (completers,  $n = 467$ ; non-completers,  $n = 200$ ). To examine whether there were any differences at baseline between those who completed both measurement points in time and those who did not, a dropout analysis was conducted. No significant differences regarding baseline exercise, intention and action planning were found by means of a multivariate analysis of variance (MANOVA). No sex differences were found either. However, analysis of variance (ANOVA) revealed an age difference: those who completed the study were slightly younger than those who did not ( $M_{\text{completers}} = 18.74$ ,  $SD_{\text{completers}} = 2.80$ ;  $M_{\text{non-completers}} = 19.28$ ,  $SD_{\text{non-completers}} = 3.19$ ),  $p < .05$ ,  $\eta^2 = .07$ .

### Descriptive statistics

The means, standard deviations, and inter-correlations between all the variables included in the model are shown in Table 1. All variables showed significant associations with each other, and the effect size of these correlations were moderate to strong, in accordance with Cohen's (1988) guidelines. Minutes of weekly exercise at T1 were closely associated with minutes of weekly exercise at T2 ( $r = .77$ ), reflecting rank-order stability of this behavior across the two measurement points in time.

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Insert Table 1 over here

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### Evaluating the measurement model: Confirmatory factor analysis

To evaluate the fit of the measurement model to the correlational structure of the observed variables, a confirmatory factor analysis (CFA) was performed, with four factors (i. e., intention, action planning, coping planning, and action control) allowed to freely inter-correlate. All factors were standardized by fixing their variances to 1.00. The measurement model yielded a good fit:  $\chi^2(59) = 150.40$ ,  $p < .001$ ,  $\chi^2/df = 2.55$ , CFI = .98, TLI = .97, RMSEA = .056, 90% CI [.045; .067], indicating that the items measured the four distinct constructs. Table 2 presents the factor loadings for this CFA.

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Insert Table 2 over here

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### Planning as a mediator between intention and exercise

Coefficient estimates of Model 1 are presented in Figure 1. There was an indirect effect of intention (T1) on exercise (T2) via action and coping planning (T1 and T2, respectively) working as serial mediators,  $\beta = .09$  (CI 95%, [.03, .16]), although there was no direct effect from action planning on exercise. The model fit was good, but the absolute fit (RMSEA) was less satisfactory:  $\chi^2(81) = 317.69$ ,  $\chi^2/df = 3.92$ , CFI = .96, TLI = .95, RMSEA = .077,  $p$  (RMSEA) < .001, AIC = 395.69.

### Action control as a mediator between intention and exercise

In the second model (Model 2; Figure 1), the indirect effect from intention (T1) to exercise (T2) via action control (T2) was  $\beta = .31$  (CI 95%, [.23, .39]). The model fit was again good, but the absolute fit was less satisfactory:  $\chi^2(84) = 350.69$ ,  $\chi^2/df = 4.17$ , CFI = .95, TLI = .94, RMSEA = .08,  $p$  (RMSEA) < .001, AIC = 422.69. Model 2 coefficients also indicated a significant albeit small negative direct relationship between intention at T1 and

exercise at T2. Comparing this small negative partial direct effect with the significant positive zero-order correlation between the two manifest indicators ( $r = .46$ ; see Table 1), suppression may have occurred.

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Insert Figure 1 over here

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### **Action control mediating the effects of intention and planning on exercise**

Finally, in the full model (Model 3; Figure 2), an indirect effect from intention (T1) on exercise emerged with action planning (T1), coping planning (T2) and action control (T2) as sequential mediators  $\beta = .27$ , (CI 95%, [.19, .36]). There were no direct effects of action planning, coping planning, or intention on exercise. Only action control had a direct effect on exercise,  $\beta = .42$  (CI 95%, [.31, .53]). Effects of intention and planning on exercise were fully mediated by action control. The model fit was good, and absolute fit was acceptable:  $\chi^2(80) = 246.36$ ,  $\chi^2/df = 3.07$ , CFI = .97, TLI = .96, RMSEA = .065,  $p$  (RMSEA) = .004, AIC= 326.36.

Based on the AIC score, the full model appeared as the best one. When contrasting this third model with the other two models, it had a better fit than the first one ( $\Delta \chi^2(1) = 71.32$ ,  $p < .001$ ), and a better fit than the second one ( $\Delta \chi^2(3) = 104.33$ ,  $p < .001$ ).

Regarding the different mediator sequences explored to understand indirect effects of intention on exercise, similar indirect effect sizes were found for the indirect effect of intention on exercise via action control alone (Model 2,  $\beta = .31$ , bootstrapped CI 95% [.23, .39]) and for the size of the effect via the sequence action planning, coping planning and action control (Model 3,  $\beta = .27$ , bootstrapped CI 95% [.19, 36]). However, the mere effect

via action and coping planning (Model 1) was lower,  $\beta = .09$ , bootstrapped CI 95% [.03, .16]<sup>1</sup>.

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Insert Figure 2 over here

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## **Discussion**

This was an observational longitudinal study with young adults, and therefore, no increases in levels of physical exercise were expected. Instead, a minor decline was observed which may have various reasons such as changes in school workload, weather, or other circumstances. When raising the question of correlates for behavioral maintenance, we focused on social-cognitive variables. Individual differences in intention, action planning, coping planning, and action control were related to exercise maintenance. According to the HAPA (Schwarzer, 2008) which served as a theoretical framework, intention was specified as the most distal factor whereas action control was specified as the most proximal factor to Time 2 exercise levels, and the two planning constructs were supposed to operate as mediators between them. Following a nested design, three structural equation models were designed to examine the sequence among this set of proposed predictors and mediators. Findings indicated that action planning, coping planning, and action control mediated between intentions and physical exercise in this sequential order which was reflected by the final Model 3 (Hypothesis 1 confirmed). The other two models were less convincing. In Model 1, the putative direct path of action control on exercise was eliminated. This confirmed the mediating role of planning between intention and behavior,

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<sup>1</sup> In a manifest model 3, using macro Process by Hayes (2012), concurrent results are found and the pairwise comparison show that indirect effects via action control are higher than indirect effects via action and coping planning. The differences fall within bootstrapped confidence intervals, 5,000 resamples, 95% confidence.



because an indirect effect emerged. The vast amount of literature on planning bridging the intention-behavior gap (Hagger & Luszczynska, 2014) was further supported. Model 2, instead, tested the mediation via action control, ignoring the role of planning. Evaluation of models was not only done in terms of technical fit indices but also in terms of indirect effect sizes. When comparing Models 1 and 2, indirect effects of intentions on exercise via action control were higher than indirect effects via planning only (Hypothesis 2 confirmed). Eventually, Model 3 including the full sequence of all three mediators, turned out to be the superior one: The indirect effects of intention via action planning and coping planning on physical exercise were fully mediated by action control (Hypothesis 3 confirmed). In other words, although planning remained a useful volitional variable, a planning-behavior gap may be bridged by action control as the most proximal determinant of physical exercise. This is theoretically meaningful, as action control can only take place after a behavior has been initiated.

Limitations of this study need to be addressed. All variables were measured by means of self-report. Therefore, information might be biased, because participants may not have been capable of exactly recalling the amount of exercise performed or they may have tried to make a better impression by over-reporting their exercise levels. However, there was a high stability between the levels of exercise reported at the two points in time which suggests credibility. Unfortunately an experimental design was not employed and, thus, causal inferences cannot be made. Moreover, there were only two measurement points in time, and therefore, the existence of the proposed sequence cannot be proved. The serial model used as statistical strategy for the analysis would have provided a better ground for our study if there were five points in time. However, the assumed logical and temporal

order is plausible when considering theory and evidence from other studies (Schwarzer, 2008; Sniehotta et al., 2005a).

Overall, the present paper adds to the cumulative evidence on the mediating role of planning between intention and exercise (Amireault et al., 2013; Carraro & Gaudreau, 2013; Hagger & Luszczynska, 2014; Kwasnicka et al., 2013). Moreover, the focus has now been advanced to the more proximal case of bridging the narrow planning-behavior gap, confirming that action control appears to be a promising candidate to explain why exercise levels are being maintained or not. This is in line with the research on self-monitoring which may be the most active ingredient of the action control construct (Schwarzer et al., 2014).

This work may have implications for intervention designs and future research. Behavior change techniques that generate high action control levels need to be implemented to facilitate and maintain physical activity. Moreover, further variables might be included, such as intention stability (Rhodes & Dickau, 2012) to better understand how motivational factors may explain or further qualify some of the effects of volitional variables.

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Table 1

*Descriptive statistics and correlations of the variables in the models*

	(1)	(2)	(3)	(4)	(5)	(6)	Mean	SD
(1) Intention (T1)	-						3.24	.87
(2) Action Planning (T1)	.59***	-					2.86	1.05
(3) Coping Planning (T2)	.37***	.38***	-				1.90	1.02
(4) Action Control (T2)	.56***	.54***	.57***	-			2.44	.93
(5) Exercise (T1)	.48***	.51***	.39***	.50***	-		135.98	130.73
(6) Exercise (T2)	.46***	.47***	.47***	.64***	.77***	-	123.82	127.14

*Note.* \*\*\* $p < .001$ 

Accepted



Table 2.

*Standardized Factor Loadings of the Confirmatory Factor Analysis*

Items	Factors			
	Intention	Action Planning	Coping Planning	Action Control
1. Intention on a regular basis	0.85			
2. Intention at least 30 minutes per bout	0.84			
3. Intention several times per week	0.84			
4. Planned on which days to exercise		0.77		
5. Planned where to exercise		0.90		
6. Planned how to exercise		0.83		
7. Planned what to do with interferences			0.91	
8. Planned what to do with difficult situations			0.96	
9. Planned what to do with possible setbacks			0.95	
10. Monitored if I do enough exercise				0.83
11. Observed if I did at least 30 minutes per bout				0.82

12. I have been aware of my plans of doing exercise 0.80
13. I have tried to exercise regularly 0.85

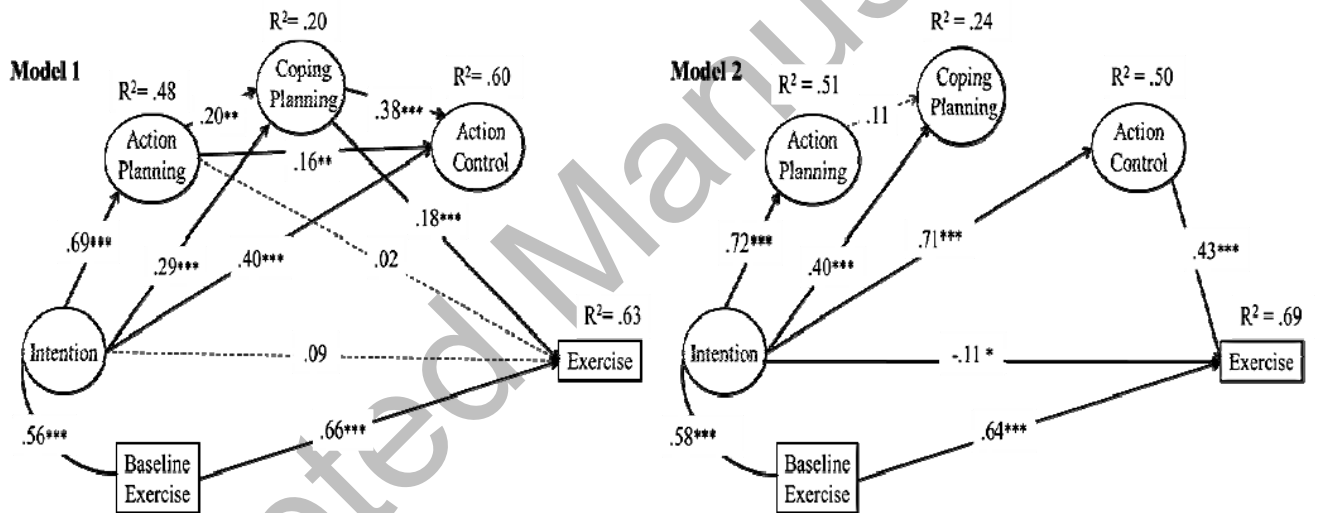


Figure 1.  $N = 487$ . Model 1 and 2 with standardized coefficient estimates. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ . Intention and Action Planning were measured at T1, Coping Planning, Action Control and Exercise were measured at T2.

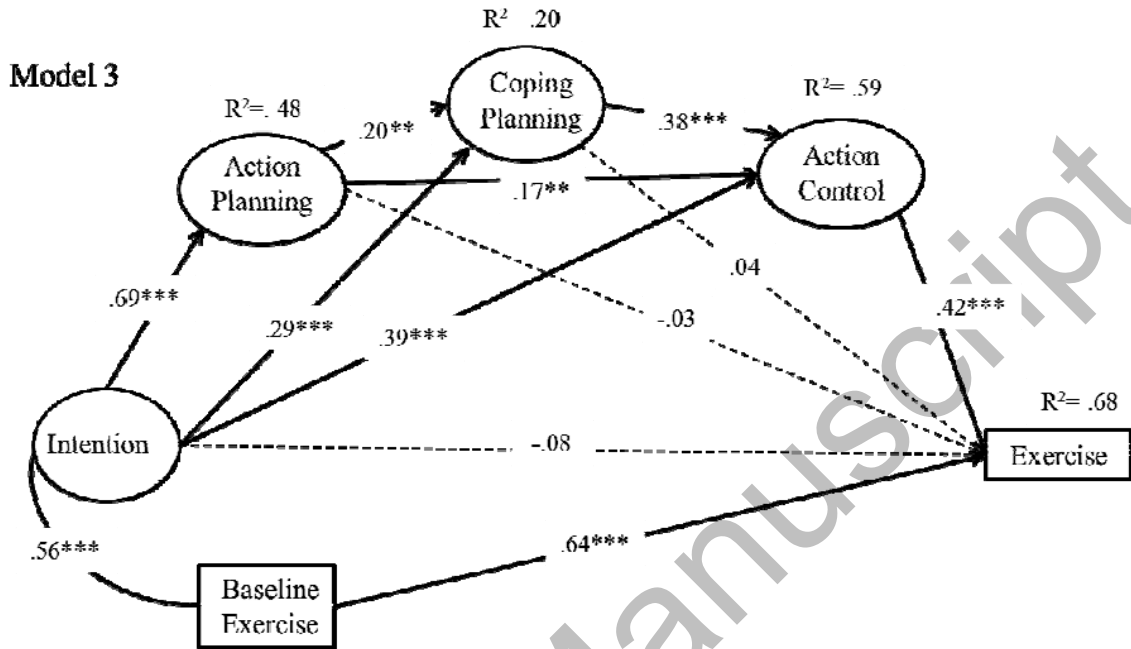


Figure 2.  $N = 487$ . Model 3 with standardized coefficient estimates. \*\* $p < .01$ ; \*\*\*  $p < .001$ . Intention and Action Planning were measured at T1, Coping Planning, Action Control and Exercise were measured at T2.