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Abstract

Background: We examined effects of trait self-control, constructs from social cognition theories, and intentions on health behaviors. Trait self-control was expected to predict health behavior indirectly through theory constructs and intentions. Trait self-control was also predicted to moderate the intention-behavior relationship.

Methods: Proposed effects were tested in six data sets for ten health-related behaviors from studies adopting prospective designs. Participants (N=3249) completed measures of constructs from social cognition theories and self-control at an initial time point and self-reported their behavior at follow-up.

Results: Results revealed indirect effects of self-control on behavior through social cognition constructs and intentions for eight behaviors: eating fruit and vegetables, avoiding fast food, dietary restrictions, binge drinking, physical activity, walking, out-of-school physical activity, and pre-drinking. Self-control moderated the intention-behavior relationship in four behaviors: dietary restriction, and alcohol-related behaviors.

Conclusions: Mediation effects suggest that individuals with high self-control are more likely to hold beliefs and intentions to participate in future health behavior, and more likely to act. Moderation effects indicate that individuals with high self-control are more likely to enact healthy intentions and inhibit unhealthy intentions, but findings were restricted to few behaviors. Training self-control and managing contingencies that derail goal-directed action may be effective intervention strategies.

Keywords: self-discipline; theory integration; response inhibition; theories of social cognition; dual-process theories; self-regulation

Global rates of chronic diseases such as cancers, cardiovascular disease, and diabetes are rising (OSBBR, 2016). Engaging in four key health behaviors, healthy eating, smoking cessation, regular physical activity, and drinking alcohol only in moderation, is linked to an 11 to 14 year delay in all-cause mortality (Ford, Zhao, Tsai, & Li, 2011). Government health departments, public health offices, and health advocacy organizations have called for behavioral solutions to the mounting human and economic costs of chronic disease (OSBBR, 2016). One approach has been to develop behavior change interventions aimed at promoting participation in behaviors associated with reduced chronic disease risk. Designing effective behavioral interventions necessitates identification of modifiable social psychological factors reliably associated with engagement in the behavior of interest, and the processes by which the factors relate to behavior (Sheeran, Klein, & Rothman, 2017). Formative research testing relations between the factors and health behavior participation may assist in identifying appropriate targets for behavior change (Kok et al., 2016).

Traits and Theories of Social Cognition

Theories of social cognition have played a prominent role in identifying the factors related to health behavior, and the processes involved. The theories identify the belief-based factors (e.g., attitudes, norms, self-efficacy, risk perceptions) that underpin intentional behavior. For example, the theory of planned behavior (Ajzen, 1991), a prototypical theory of social cognition, proposes that individuals' intention to perform a future health behavior is the most immediate determinant of subsequent action, and that intention is a function of three sets of beliefs: attitudes, norms, and perceived behavioral control. An extensive evidence base now exists identifying relations between constructs from these theories and participation in health behavior, and the mediating role of intentions (e.g., Hagger, Polet, & Lintunen, 2018; McEachan, Conner, Taylor, & Lawton, 2011; Rich, Brandes, Mullan, & Hagger, 2015). Research has also suggested that interventions targeting constructs from the theories have been effective in changing health behaviors (Sheeran et al., 2016).

Despite reasonable support across health behaviors, social cognition theories have been criticized for oversimplifying the processes by which the social cognition constructs determine

health behavior (Head & Noar, 2014; Sniehotta, Presseau, & Araújo-Soares, 2014), and for not encompassing dispositional variables like personality traits that may be important determinants of behavior (Bogg, 2008; Conner & Abraham, 2001; Rhodes, Courneya, & Hayduk, 2002). Researchers have therefore augmented social cognition theories to encompass traits with a view to providing more comprehensive explanations of behavior (Bogg, 2008; Conner & Abraham, 2001; Hoyt, Rhodes, Hausenblas, & Giacobbi, 2009).

Two potential effects of traits within theories of social cognition like the theory of planned behavior have been proposed: mediation and moderation effects (Conner & Abraham, 2001; Hagger, 2014b). According to Ajzen (1991), the belief-based constructs and intentions from the theory of planned behavior should be the most proximal determinants of action, while dispositional constructs like personality traits serve as distal influences. Beliefs and intentions reflect individuals' evaluations of their future participation in a specific behavior. Such beliefs likely encompass individuals' evaluation of previous participation in the behavior stored in memory, as well as the merits and detriments of performing the behavior in the specific context. They are, therefore, characterized as more immediate, proximal determinants of behavior. Traits, on the other hand, reflect generalized dispositions that are relatively stable and enduring, and manifest as cognitive biases and tendencies that predispose individuals to certain patterns of behavior (Bermúdez, 1999; Ferguson, 2013). Traits are, therefore, expected to influence multiple behaviors across multiple contexts. They are, therefore characterized as distal determinants of action. Importantly, traits may serve as a potential source of information in the formation of beliefs and intentions regarding future behavior. Consistent with this perspective, individuals' beliefs and intentions are expected to mediate effects of traits on behavior. Testing mediation effects may inform the process by which traits determine health behaviors, and the extent to which the proximal determinants are sufficient in explaining the effects of traits on behavior (Ajzen, 1991).

Traits may also moderate the proposed pattern of effects among the constructs in theories of social cognition, such as effects of social cognition constructs and intentions on health behavior

(Chatzisarantis & Hagger, 2008; Rhodes et al., 2002). For example, individuals with particular traits may be more or less likely to act on their intentions. Testing moderation effects may provide important formative evidence on the intrapersonal conditions that determine whether or not an individual will enact a particular health behavior.

Researchers have tested the mediating and moderating effects of dispositional factors within social cognition theories applied to health behavior. For example, research examining the effects of personality within the theory of planned behavior has identified a prominent role for the conscientiousness trait from multi-dimensional models of personality (Ashton, Lee, & Goldberg, 2007; Costa & McCrae, 1992). Effects of conscientiousness on behavior have been shown to be mediated by the social cognition constructs and intentions (Bogg, 2008; Conner & Abraham, 2001; Vo & Bogg, 2015). However, research has also revealed direct effects, independent of social cognition (Conner & Abraham, 2001; McEachan, Sutton, & Myers, 2010). Such effects may reflect non-conscious processes that bypass the reasoned, intention-mediated 'route' to action, affecting behavior beyond an individual's awareness and resulting in efficient behavioral enactment (Ferguson, 2013; Orbell, 2003). Conscientiousness has also been shown to moderate the intention-behavior relationship (Rhodes et al., 2002). This effect suggests that conscientious individuals are more likely value effortful pursuit of intended goals, and possess capacities that lead to more efficient enactment of planned actions, such as planning skills.

Self-Control and Theories of Social Cognition

Trait self-control is a candidate individual difference variable that is likely to predict health related behavior, and may impact relations among beliefs within social cognition theories. Trait self-control is defined as an individual's general capacity to override impulses, resist temptations, break habits, and overturn the 'dominant response' (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Fujita, 2011; Tangney, Baumeister, & Boone, 2004). Individuals with 'good' self-control demonstrate superior capability in suppressing impulse-driven responses in favor of goal-directed actions aimed at attaining long-term outcomes across behaviors and contexts (de

Ridder et al., 2012; Fishbach, Friedman, & Kruglanski, 2003). As with many constructs in social psychology (Hagger, 2014a), self-control has conceptual similarities with other constructs related to perseverance, particularly the self-discipline component of conscientiousness trait, an overlap that has been corroborated empirically (Hagger, Zhang, et al., 2018). Research indicates that trait self-control is a correlate of many health behaviors and adaptive health outcomes (Bogg, Lasecki, & Vo, 2016; de Ridder et al., 2012; Hoyt et al., 2009; Tangney et al., 2004). Consistent with the generalized nature of the construct, a meta-analysis of self-control research yielded a small-to-medium sized effect of trait self-control on health behavior across multiple behaviors and contexts (de Ridder et al., 2012).

Several mechanisms have been proposed to explain why people with good trait self-control are more effective in attaining adaptive outcomes including: better capacity to recognize, monitor, and resolve goal conflicts; capacity to retain goal salience in the face of cues of more immediately-rewarding, but derailing, alternatives; reduced susceptibility to desires through superior emotion regulation; greater capacity to structure the environment to minimize the impact of impulse-related cues and avoid temptations; and formation of habits and routines for adaptive, goal directed behaviors (de Ridder & Gillebaart, 2017; Fishbach et al., 2003; Fishbach & Shah, 2006; Gottfredson & Hirschi, 1990). Research has also implicated basic executive functioning as a mediator of the effects of self-control on action control (Hofmann, Schmeichel, & Baddeley, 2012).

While the effects of trait self-control have been researched extensively (de Ridder et al., 2012), there is a dearth of research examining the processes by which trait self-control affects health behavior within social cognition theories. Such research has potential to offer valuable insight into the role of dispositional self-control as a determinant of health behavior and, critically, the processes involved. Consistent with previous research on personality and individual difference factors within social cognition theories (Bogg, 2008; Conner & Abraham, 2001; McEachan et al., 2010; Rhodes et al., 2002; Vo & Bogg, 2015), two potential pathways are envisaged. First, trait self-control is related to health behaviors through mediation of the proximal social cognition

constructs (Bogg, 2008; Hagger, 2014b; Hankonen, Kinnunen, Absetz, & Jallinoja, 2014). This pathway suggests that trait self-control acts as a source of information for individuals' beliefs regarding their future participation in health behaviors. As self-control reflects a generalized capacity to engage in goal-directed behaviors to attain adaptive outcomes (e.g., engaging in physical activity to maintain weight, or reducing alcohol intake to avoid hangovers), individuals with good self-control will likely form beliefs toward engaging in future behaviors that service those goals.

However, the proposed indirect effects of trait self-control does not rule out the possibility of a simultaneous direct effect unmediated by social cognition constructs and intentions. The direct effect likely models non-conscious automatic routes to action that are not accounted for by the reasoned action route through social cognition constructs and intentions (Hagger, Polet, et al., 2018; Hamilton, Kirkpatrick, Rebar, & Hagger, 2017). In terms of mechanism, individuals with high levels on dispositional constructs like trait self-control or conscientiousness may acquire learned associations between specific cues to engage in adaptive goal-directed behaviors and the behaviors. This is achieved through repeated experience of the cue and action over time such that behavioral enactment becomes highly automated, obviating the need for 'costly' deliberation (Wood, 2017).

A second pathway by which trait self-control relates to health behavior is through its moderating effect on the relationship between intentions and health behavior (Hagger, 2014b). Individuals with good self-control are more likely to enact their intentions to participate in the target health behavior at a future time. As individuals with high self-control have greater propensity to engage in goal-directed action, they are more likely to enact their intentions (Gottfredson & Hirschi, 1990). It is also possible that individuals with good self-control are also more likely to form strong, stable intentions and be more committed to them (Conner, Sheeran, Norman, & Armitage, 2000).

Aims and Hypotheses

In the present study, we aim to test the multiple pathways by which trait self-control relates to health-related behavior in the context of social cognition theories. Two effects will be tested. First, we propose a mediation hypothesis in which trait self-control predicts health behavior through the

social cognition constructs and intentions (see Figures 1, 2, and 3). We also predict residual direct effects of trait self-control on behavior, consistent with previous research (Conner & Abraham, 2001; McEachan et al., 2010; Phillips, Abraham, & Bond, 2003). Second, we propose a moderation hypothesis in which trait self-control moderates the intention-health behavior relationship (see Figure 4). The proposed effects will be tested in six data sets and ten behaviors. Consistent with the conceptualization of trait self-control as having generalized effects across multiple health behaviors, we expect to find support for mediation and moderation effects across samples and behaviors. However, given evidence that the relative strength of the effect of trait self-control varies according to behavior (de Ridder et al., 2012), we propose auxiliary assumptions regarding the potential size of effects in the different behaviors. Specifically, we expect the moderation effect to be more pervasive in the avoiding fast food, cutting down on calorific foods, and binge drinking behaviors. Intentional inhibition of these actions is likely to be highly dependent on good impulse control and, therefore, highly influenced by self-control as a resource. Finally, we tested whether or not the effects would remain when past behavior was included as an additional predictor in the models.

Method

Design and Procedure

Six datasets were used in the current study. All datasets adopted correlational two-wave prospective designs with self-report measures of social cognition constructs and trait self-control taken at an initial point in time (T1) and follow-up behavioral measures taken at a follow-up time point (T2)[1]. Participants completed surveys in quiet conditions with instructions on how to complete the questionnaires and definitions of the target behaviors. Ethical approval for study procedures were secured in advance from the ethics committee of the Hospital District of Helsinki and Uusimaa in Finland for Sample 1, the IRBs of the host institutions for Samples 2, 3, 4, and 6, and the Finnish Ministry of Education and the host institution IRB for Sample 5. Participants in all samples studies were required to provide informed consent in advance of data collection.

Participants

[1]Sample 4 was an exception, adopting a 3-wave design with self-control measured in the interim between T1 and T2.

Sample 1 was derived from the DefenseNutri study (Hankonen et al., 2014) and comprised Finnish males (N = 679, response rate to initial invitation = 78.56%) completing their military service in two military garrisons in southern Finland. Sample 2 comprised university students (N = 1072) recruited from large public Universities in the UK (n = 258), Philippines (n = 114), Luxembourg (n = 172), and Spain (n = 282). Samples 3 and 4 comprised university students from large public universities in the UK (N = 150) and Australia (N = 254), respectively. Sample 5 comprised high school pupils (N = 235) from two government-run schools in southern Finland. Sample 6 (N = 280) comprised undergraduate students from five university campuses in Australia. The final total sample size across all samples was 3249. Full sample characteristics are presented in Appendix A (supplemental materials).

Measures

All study measures were self-report measures based on published guidelines and measures used in previous studies (Ajzen, 2002; Ashton et al., 2007; Caudwell & Hagger, 2015; Hamilton, Bonham, Bishara, Kroon, & Schwarzer, 2016; Hankonen et al., 2014; Schwarzer, 2008; Tangney et al., 2004). Participants provided their responses on scales with between four- and seven-point response options. Complete study measures including items, response scales, sources, and reliability coefficients are provided in Appendix B (supplemental materials).

Social cognition constructs. Participants in Sample 1 completed measures of social cognition constructs from the health action process approach (HAPA; Schwarzer, 2008). Participants completed measures of (a) outcome expectancies from four outcome domains: physical well-being, inconvenience, social punishment, and bad taste; (b) two types of self-efficacy: emotional barriers self-efficacy and social self-efficacy; (c) two risk perceptions: perceived risk of weight gain and perceived risk of health problems; (d) two types of planning: action planning and coping planning; and (e) intentions. Participants in Samples 2, 4, 5, and 6 completed measures of intentions, attitudes, subjective norms, and perceived behavioral control based on Ajzen's (2002) published guidelines. Participants in Sample 3 completed measures of intention only. Measures for Sample 1 were for two

behaviors: eating fruit and vegetables and avoiding fatty foods. Measures for Sample 2 were for three behaviors: restricting intake of high calorie foods ("watching your diet"), binge drinking ("drinking more than 7 'units' of alcohol on a single occasion"), and physical activity ("regular participation in physical activity"). Measures for Sample 3 were for alcohol consumption and going for regular walks, measures for Sample 4 were for regular use of dental floss, measures for Sample 5 were for participation in out-of-school physical activity, and measures for Sample 6 were for drinking alcohol at home prior to "going out", known as *pre-drinking*.

Trait self-control. Trait self-control in Samples 1, 2, 3, 4, and 6 was measured using the self-control scale (Tangney et al., 2004). Participants in Sample 1 completed the short 20-item version, while participants in Samples 2, 3, 4, and 6 completed the brief 13-item version. Trait self-control in Sample 5 was measured using the self-discipline subscale of the conscientiousness trait from the international personality item pool HEXACO scales (Ashton et al., 2007)[2].

Behavior and past behavior. Behavior in Sample 1 was measured using a 36-item food frequency questionnaire for the previous eight weeks. Participants in Sample 2 completed two-item scaled measures of frequency of engaging in dietary restriction and physical activity participation, and an open-ended measure of binge drinking frequency, for the previous for weeks. Participants in Sample 3 completed single-item self-reports of frequency of alcohol consumption and walking for the previous four weeks. Participants in Sample 4 completed two open-ended items of flossing frequency for the previous two weeks. Participants in Sample 5 self-reported their participation in regular physical activity outside of school for the previous four weeks. Participants in Sample 6 completed a two-item self-report of measure of their pre-drinking for the previous four weeks. Behavior measures were taken at T1 and T2, with the exception of Sample 3 which was for T1 only.

Demographic variables. Participants self-reported their gender and age in years.

[2]Research has demonstrated strong correlations between the trait self-control scale (Tangney et al., 2004) and the self-discipline scale from the conscientiousness trait (Ashton et al., 2007; Costa & McCrae, 1992). For example, a recent study examining the factor structures of these scales in multiple samples indicated that the correlation ranged from .62 to .68 (Hagger, Zhang, et al., 2018). These data provide support for the convergence of these measures.

Data Analysis[3]

Preliminary analyses. As a preliminary step we inspected the distributions of all study variables[4]. Variables with excessive skewness and kurtosis were transformed using a natural logarithmic function with a constant added to ensure positive values if required. The transformed variables were used in subsequent mediation and moderation analyses. Attrition bias was tested by examining mean differences in study constructs in participants retained in the study at T2 and those who dropped out. We conducted MANOVAs with trait self-control, social cognition constructs, intentions, and T1 behavior measures as dependent variables and retention status as the independent variable in each sample. MANOVAs were followed up using univariate follow-up *F*-tests. We also tested for systematic bias in age and gender proportion due to attrition using independent samples *t*-tests and Pearson chi-square tests. All analyses were conducted using the psych function in R.

Mediation analyses. Mediation models were tested using path analysis with bootstrapped standard errors consistent with Hayes' (2018) regression-based approach. In all models, missing data was imputed using the full information maximum likelihood (FIML) estimator. Specifically, effects of trait self-control on health behavior were proposed to be mediated by social cognition constructs and intention in all models. Specific and total indirect effects were computed using a maximum likelihood estimator with 1000 bootstrap replications. We controlled for demographic variables in each sample by freeing paths from each demographic variable and all other variables in the model. We controlled for age and gender in all samples, with the exception of Sample 1[5]. We also controlled for national group membership in Sample 2 using three dichotomous dummy-coded variables with the UK sample as the reference group. Goodness of fit of the mediation models with the data were evaluated using multiple criteria comparing the proposed model with the baseline model including the goodness-of-fit chi-square, the comparative fit index (CFI), the Tucker-Lewis

[3]Data files and analysis scripts for all analyses are available online from the Open Science Framework project for this article: https://osf.io/bxezg/

[4]Descriptive statistics, frequency of missing data, skewness and kurtosis estimates for all study variables are available in Appendix C (supplemental materials), and zero-order correlations among study variables are available in Appendix D (supplemental materials).

[5]Due to confidentiality restrictions, data on participants' ages for the DefenceNutri data set (Sample 1) were not available for analysis. Descriptive statistics indicated very low variability in age. All participants in this sample were male.

index (TLI), and the root mean square error of approximation (RMSEA) and its 90% confidence interval. The chi-square should return a result that does not exceed a priori probability levels for statistical significance, values for the CFI and TLI should approach or exceed .95, and values for the RMSEA should be below .05 with a narrow 90% confidence interval. Mediation models were implemented using the lavaan package in R.

Moderation analyses. Moderation effects of trait self-control on the intention-behavior relation were tested using moderated regression analyses using Hayes (2018) methods. Specifically, health behavior was regressed on mean-centered self-control and intention variables, and a multiplicative composite of the two centered variables modeling the interaction effect. Models were estimated with bootstrapped standard errors with 1000 replications. Relevant covariates (planning constructs in Sample 1, perceived behavioral control in Samples 2, 4, 5, and 6) and demographics (age, gender) were also included as predictors of health behavior in the analyses. Interactions were probed by estimating intention-behavior relations at conditional values of self-control: the mean and at one SD above and below the mean. Moderated regression models were implemented using the lavaan package, and conditional moderation plots implemented using the ggplot2 package, in R.

Supplementary analyses. We also conducted a series of sensitivity analyses to test whether our conclusions were altered due to effects of control variables and data imputation. Specifically, we estimated our the mediation and moderation models in each sample excluding control variables and with listwise deletion of cases with missing data rather than FIML imputation. Finally, we also examined the effect of including past behavior in the models. Each model was estimated with and without past behavior included as a direct predictor of all constructs and behavior[6].

Finally, the probability level (alpha) for all analyses was set a priori at .05, consistent with the convention in inferential statistical analyses in the social sciences. Effect size judgements we based on Cohen's rules-of-thumb for small, medium and large sized effects for Cohen's *d* statistic and the standardized coefficients main effects in the mediation models. Effect sizes for the fully

[6]Past behavior measures were not collected in Sample 3, precluding the past behavior analysis for this sample.

standardized coefficients in the mediation models were considered at least small if they exceeded .100 (Preacher & Kelley, 2011).

Results

Preliminary Analyses

We found attrition effects surpassing the conventional probability level for statistical significance in Sample 1 (Wilks' $\Lambda = 0.955$, F (15,820) = 2.573, $p < .001$, $d = 0.111$), Sample 2 (Wilks' $\Lambda = 0.889$, F (16,1011) = 7.921, $p < .001$, $d = 0.176$), and Sample 6 (Wilks' $\Lambda = 0.740$, F (6,328) = 19.255, $p < .001$, $d = 0.479$). Effect sizes were small, with the exception of the effect for Sample 6 which was small-to-medium. In contrast, effects of attrition did not reach the conventional probability level for statistical significance in Sample 3 (Wilks' $\Lambda = 0.965$, F (3,158) = 1.909, p =.130, $d = 0.218$), Sample 4 (Wilks' $\Lambda = 0.991$, F (6,611) = 0.918, $p = .481$, $d = 0.077$), and Sample 5 (Wilks' $\Lambda = 0.959$, F (6,239) = 1.685, $p = .166$, $d = 0.125$), and effect sizes were small.

Results of the MANOVAs in Samples 1, 2, and 6 were followed-up with univariate F-tests. Compared to participants who dropped out of the study at T1, participants retained at T2 reported higher levels of self-control, outcome expectancies – inconvenience and bad taste, and risk perceptions – weight gain in Sample 1; higher levels of dieting attitudes and behavior, and self-control, and lower levels of binge drinking attitudes, intentions, subjective norms, and behavior in Sample 2; and higher levels of pre-drinking attitudes, intentions, subjective norms, and behavior, and lower levels of self-control in Sample 6. Descriptive statistics for study constructs and results of the attrition analyses are presented in Appendix C (supplemental materials). Effect sizes for the differences were small ($d < .287$) for the majority of the univariate tests, with the exception of the differences noted for binge drinking variables in Sample 2, alcohol consumption behavior in Sample 3, and pre-drinking variables in Sample 6 which were larger (range $d = 0.046$ to $d = 0.980$).

We found few differences in age and gender distribution of participants who were retained in the study and those that dropped out. Participants retained in the study were older in Samples 2 (t(1063) = 4.414, $p < .001$, $d = 0.271$) and 4 (t(617) = 4.281, $p < .001$, $d = 0.344$) with small effect

sizes, and exhibited a slightly higher proportion of girls in Sample 5 ($\chi^2(1) = 5.380$, $p = .020$, $d = 0.305$), relative to participants that dropped out. No other differences were found.

Mediation Effects[7]

Parameter estimates and confidence intervals for the direct and indirect effects of self-control on intention and behavioral outcomes from the proposed mediation models in Sample 1 (see Figure 1), Samples 2, 4, 5, and 6 (see Figure 2), and Sample 3 (see Figure 3) are presented in Table 1. All models satisfied published criteria for goodness of fit (Appendix F), although indexes for some criteria were low for models in Sample 2 due to the national group control variables reducing model parsimony. We found evidence for indirect effects of self-control on behavior mediated by the social cognition constructs and intention in eight of the ten tests of mediation. Specifically, there were indirect effects of self-control on fruit and vegetable and fast food consumption in Sample 1; dietary restriction, binge drinking, and physical activity in Sample 2; regular walks in Sample 3; out-of-school physical activity in Sample 5; and pre-drinking in Sample 6, all of which surpassed the conventional probability for statistical significance. Indirect effects were positive for health-promoting behaviors (e.g., dietary restriction, physical activity) and negative for behaviors contrary to healthy goals (e.g., binge drinking, pre-drinking). In terms of effect sizes, fully standardized indirect effects exceeded .100 in most cases indicating at least small effect sizes.

We also found direct effects of trait self-control on behavior independent of the social cognition constructs and intention that exceeded the conventional probability level for statistical significance in five of the ten tests. Specifically, we found direct effects of trait-self-control on fast food consumption in Sample 1; the dietary restriction and physical activity behaviors in Sample 2; alcohol consumption in Sample 3; and out-of-school physical activity in Sample 5. Effect sizes exceeded .100 for all but the effects for dietary restriction and physical activity in Sample 2. These findings provide support for the presence of direct and indirect pathways for self-control on health behavior. However, we found little evidence for indirect effects of trait self-control on alcohol

[7]Full results of the mediation models in each sample including parameter estimates and confidence intervals for direct indirect, and total effects are available in Appendix E (supplemental materials).

consumption in Sample 3 and flossing behavior in Sample 4. Effect sizes for the standardized estimates were also small (< .025). In addition, direct effects for trait self-control on dental flossing behavior in Sample 4 were small and did not exceed the conventional alpha level for statistical significance, so self-control had neither direct nor indirect effects on behavior for this behavior.

Focusing on the indirect effects of trait self-control on behavior through specific social cognition constructs and intention, many of the effects were relatively small and did not exceed the conventional alpha level for statistical significance. This means that the total indirect effects comprised multiple smaller effects through multiple social cognition constructs and intention. However, attitudes was the most pervasive mediator: we found specific indirect effects of self-control on behavior through attitudes and intentions which exceeded conventional alpha levels in the dietary restriction, binge drinking, and physical activity behaviors in Sample 2, and out-of-school physical activity in Sample 5, and pre-drinking in Sample 6. We also found the same pattern of effects for perceived behavioral control, with the exception of pre-drinking in Sample 6. It is also important to note that all indirect effects were directed through intentions. Intention-mediated effects of traits self-control is evidence to support a deliberative, reasoned process by which trait self-control predicts behavior.

Moderation Effects[8]

Relative to evidence for mediation, evidence for effects of trait self-control as a moderator of the intention-health behavior relationship across the samples was less prominent. We found interaction effects that exceeded the conventional alpha level for statistical significance for the dietary restriction (B = 0.110, 95%CI [0.028, 0.189], β = .064, p = .008) and binge drinking (B = -0.012, 95%CI [-0.021, -0.003], β = .107, p = .012) behaviors in Sample 2, alcohol consumption (B = -0.262, 95%CI [-0.503, -0.042], β = .164, p = .025) in Sample 3, and pre-drinking (B = -0.172, 95%CI [-0.337, -0.010], β = .108, p = .038) in Sample 6. Simple slopes analyses for the effects of intentions on health behavior at conditional values of self-control are presented in Appendix H

[8]Full results of the moderated regression models in each sample including parameter estimates and simple slopes analysis for conditional values of self-control are available in Appendix G (supplemental materials)

(supplemental materials). Results revealed that the effect of intention on restricting diet in Sample 2 was stronger at higher levels of self-control. In contrast, effects of intention on binge drinking in Sample 2, alcohol consumption in Sample 3, and pre-drinking in Sample 6 were weaker at higher levels of self-control[9]. Taken together, these effects suggest that individuals with higher levels of self-control were more likely to follow through on their dietary restriction intentions, and were less likely to act on alcohol consumption, binge drinking, and binge-drinking intentions, than those with lower self-control levels. Interaction effects of trait self-control and intention on health behavior for the remaining tests were smaller in size and did not exceed the conventional alpha value for statistical significance.

Supplementary Analyses

Estimating our mediation and moderation models excluding the control variables or omitting imputation of missing values did not result in substantive changes in the pattern of effects or model fit. Full results of the sensitivity analyses are presented in Appendixes E and G. However, including past behavior as an additional predictor of all social cognition constructs in the mediation and moderation models for Samples 1, 2, 4, 5, and 6 resulted in reductions of the effect sizes of the social cognition variables, intentions, and self-control on behavior in the mediation models, and the effect sizes of the self-control x intention interaction term on behavior in the moderation models. In the case of dietary restrictions and physical activity in Sample 2, and pre-drinking in Sample 6, effects of self-control on intentions and behavior were rendered smaller and no longer exceeded the conventional alpha level for statistical significance. In other samples, indirect effects of trait self-control on behavior were attenuated, but alpha values exceeded the .05 criterion. Full results of the analyses including past behavior are presented in Appendixes E and G (supplemental materials).

Discussion

The present study tested the multiple pathways by which trait self-control related to health behavior across ten behaviors in six separate samples. Specifically, we hypothesized that trait self-

[9]For these samples, a positive effect of intentions on behavior represents strong intentions to consume alcohol and participate in binge drinking and pre-drinking.

control would have direct effects on behavior, and indirect effects mediated by social cognition constructs and intentions across health behaviors. We also predicted that trait self-control would moderate the intention-behavior relationship. We found consistent support for indirect effects of trait self-control on behavior across multiple behaviors, in line with hypotheses. Attitudes and perceived behavioral control, along with intentions, were the most consistent mediators of trait self-control on behavior. We also found residual direct effects of self-control on behavior in five samples. No indirect effects that exceeded conventional probability levels for statistical significance were found for three of the behaviors (alcohol consumption and regular walking in Sample 3, and dental flossing in Sample 4), and only in the model tested in dental flossing (Sample 4) did we find no effect, direct or indirect, of trait self-control on behavior. Support for the moderation hypothesis was less pervasive, with evidence for the interaction effect found for the moderated regression models in four behaviors: dietary restriction and binge drinking in Sample 2, alcohol consumption in Sample 3, and pre-drinking in Sample 6.

Current results support indirect effects of trait self-control on behavior in most of the samples in the current research consistent with previous theory (Hagger, 2014b) and research (Bogg et al., 2016; Hankonen et al., 2014). Individuals with high trait self-control are more likely report beliefs and intentions to engage in adaptive health behaviors in future. Theory suggests that individuals with high trait self-control have superior capacity to engage in sustained action to achieve distal goals, and forego immediately-rewarding but counter-productive alternatives. People with high trait self-control may be better at recognizing cues to goal directed behavior, hold their goal representations more strongly, and anticipate and manage potentially derailing situations. Forming attitudes, perceptions of control, and intentions to engage in goal-directed behaviors in future is, therefore, an appropriate strategy for goal attainment (Fishbach & Shah, 2006; Gottfredson & Hirschi, 1990). Similarly, individuals with high trait self-control will be less likely to hold positive beliefs and form intentions toward behaviors that may be maladaptive. Taken together, evidence

from the current research provides some evidence in support of social cognition constructs and intentions as a key mechanism by which trait self-control leads to adaptive health behaviors.

Effects of trait self-control should also be interpreted in light of effects for similar constructs, particularly sub-facets of the conscientiousness trait (Ashton et al., 2007; Costa & McCrae, 1992). Conscientiousness is consistently related to health-related behaviors (Bogg & Roberts, 2004), and effects of conscientiousness on behaviors is mediated by beliefs and intentions or motives from theories of social cognition (Bogg, 2008; Conner & Abraham, 2001; Rhodes et al., 2002; Vo & Bogg, 2015), which has parallels with current findings. Although trait self-control is strongly related to conscientiousness, it is most closely aligned with the self-discipline sub-facet. Although trait self-control is also likely to be related to other sub-facets such as industriousness and activity, research suggests that they may predict different behaviors. For example, the industriousness and activity facets have been shown to be uniquely related to the social cognition antecedents of physical activity and the behavior itself (Hoyt et al., 2009; Vo & Bogg, 2015), while self-discipline has been shown to be related to impulse-related behaviors (Hagger, Zhang, et al., 2018).

One possibility is that self-control and self-discipline may be more related to behaviors where capacity for inhibition of impulsive responses is most salient, and industriousness and activity sub-facets are more relevant to behaviors requiring sustained effort. This is consistent with recent work distinguishing between initiation and inhibition components of trait self-control (de Ridder, de Boer, Lugtig, Bakker, & van Hooft, 2011; Hagger, Zhang, et al., 2018; Maloney, Grawitch, & Barber, 2012). We did not find evidence for this selective pattern of effects in our current study, but we did not adopt a multi-component approach. Examining effects for trait self-control alongside the different sub-facets of conscientiousness is a viable avenue for future research.

While current findings indicate consistent effects across the majority of the samples and behaviors in the current research, we found no mediated effect of trait self-control in two samples: alcohol consumption in Sample 3 and dental flossing in Sample 4. Furthermore, although trait self-control had a direct effect on alcohol consumption, it had no effect in predicting flossing behavior.

Instead, intentions were the pre-eminent predictor of flossing. Flossing behavior appears to be only weakly predicted by trait self-control, if at all. Flossing may be a heavily automated behavior, and one that does not require strong impulse control, hence the weak effect of trait self-control for this behavior. However, current findings suggest that flossing is actually strongly predicted by intention, which seems to contradict the notion that it is a behavior largely controlled by non-conscious processes, and is consistent with previous research on this behavior (Zhou, Sun, Knoll, Hamilton, & Schwarzer, 2015). However, we cannot definitively rule out that possibility that habits may be an important predictor of flossing behavior in the current study given that we did not include habit as a predictor. Certainly past behavior, a reasonable proxy for habit, was a pervasive predictor of flossing in the current study. Future research should examine the effects of flossing behavior in the context of habits (Verplanken & Orbell, 2003).

Current research did not support a consistent moderation of the intention-behavior relationship by trait self-control as predicted. Only four of the ten tests of the moderation effect exceeded the conventional alpha level for statistical significance. These findings indicate that trait self-control does not, overall, determine the extent to which individuals enact their intentions. Are there unique characteristics of particular health behaviors that may determine whether an interaction effect pervades? Consistent with our auxiliary assumption, we found moderation effects in samples in which impulse control is heavily implicated, particularly alcohol consumption (Allom, Panetta, Mullan, & Hagger, 2016). These findings are consistent with theory that trait self-control is important for individuals to inhibit responses for behaviors which tend to be determined by impulse control, such as alcohol consumption (Friese & Hofmann, 2009). So one interpretation of the moderating effect of trait self-control on the intention-behavior relationship in alcohol-related behaviors is that individuals with high trait self-control have greater capability for inhibiting pathways leading to alcohol consumption and are, therefore, more effective in exercising restraint over their alcohol consumption. Another interpretation might be that individuals with high trait self-

control have relatively weak intentions to consume alcohol, especially impulsive drinking patterns like binge drinking and pre-drinking.

Research has also implicated impulsivity and trait self-control to dietary restraint (Churchill & Jessop, 2011; Kuijer, de Ridder, Ouwehand, Houx, & van den Bos, 2008). Current findings are consistent with these previous data: individuals with high trait self-control are more effective in following through on their intentions to restrict their diet. However, this finding did not extend to the other dietary behaviors investigated in the current study: eating fruit and vegetables and avoiding fatty foods. A possible reason for this discrepancy might be that dietary intake encompasses multiple behaviors that are strongly driven by impulse control compared to specific behaviors like eating fruit and vegetables or avoiding fast food. In the case of eating fruit and vegetables, for example, acting is less likely to involve suppression of impulse-related cues but, rather, effortful instigation of the behavior (Gardner, Corbridge, & McGowan, 2015). Eating fast food, on the other hand, may involve suppression of satiety-related cues (Hankonen et al., 2014), so, strictly speaking, one would expect self-control to moderate the intention-behavior link for this behavior. It may be that eating fast food is more related to contextual and environmental factors rather than impulse control, such as food availability and lack of alternatives. However, these explanations are speculative. Current findings only provide preliminary data to suggest that trait self-control moderates the intention-behavior relationship for some impulse-related behaviors. Furthermore, variations in the methods, contexts and sample characteristics means that we cannot unequivocally rule out the possibility that our moderation tests were confounded by methodological artifacts. Replication studies with identical measures and designs that systematically compare the proposed moderation effects in impulse-related and non-impulse-related behaviors are needed.

We also found direct effects of trait self-control on health behavior in the current study. These findings are consistent with an expanding literature demonstrating consistent relations between trait self-control and health behavior (de Ridder et al., 2012). This suggests that trait self-control is related to health behavior independent of social cognition constructs and intentions that represent

the reasoned process of behavioral enactment. Direct effects likely reflect impulsive, spontaneous, non-conscious processes that lead to behavioral enactment, consistent with dual-process theories of behavior (Strack & Deutsch, 2004). One intriguing possibility is that individuals with high trait self-control are more likely to form 'healthy' habits for behaviors that are functional in attaining daily or long-term goals (de Ridder & Gillebaart, 2017; Wood, 2017). Such individuals would, over time, incorporate these behaviors into their routine so that they are enacted with high efficiency and little need for deliberative input. Of course, this is a speculative explanation. Future research should seek to test whether the direct effect can be explained by habit. For example, a potential study may test the extent to which the direct effects of trait self-control on health behavior are mediated by habit or automaticity as measured by validated self-report measures (Verplanken & Orbell, 2003).

It is also possible that direct effects of trait self-control may be mediated by other unmeasured constructs, such as those that reflect volitional processes (Schwarzer, 2008). Action planning is a self-regulatory strategy that augments intentions with specific plans (Hagger, Luszczynska, et al., 2016). Action control comprises sets of strategies used to monitor behavioral performance according to standards (Zhou et al., 2015). Action planning is typically conceptualized as a mediator of the intention-behavior relationship, and would be expected to mediate effects of self-control through intentions (Schwarzer, 2008). This effect was not, however, supported in Sample 1 in the current study. However, as trait self-control affords individuals greater capacity to manage cues associated with highly-rewarding actions that could derail goal-directed behavior, action planning and action control may be strategic means to assist with this endeavor (Gottfredson & Hirschi, 1990). The indirect effect of trait self-control on fruit and vegetable consumption through action planning in Sample 1 provided some initial support for this pattern of effects. We look to future research to further test the planning-mediated effect, and explore action control as a mediator of the effect of self-control on health behavior.

It is important to note that inclusion of past behavior resulted in a substantive attenuation in the strength of the indirect effects of trait self-control on intentions and behavior, which, in the case

of the dietary restrictions and physical activity in Sample 1, and pre-drinking in Sample 6, rendered the effects trivial. This pattern of effects has been observed in numerous studies (Hagger, Chan, Protogerou, & Chatzisarantis, 2016; Hagger, Polet, et al., 2018; McEachan et al., 2011). Ajzen (1991) proposed that the inclusion of past behavior is a test of the sufficiency of social cognition theories. Lack of capacity to account for past behavior indicates that the theory is inadequate or even redundant as a means to explain behavior. This also presents a problem for the use of social cognition theories as a basis for intervention, as affecting change any of the component constructs is unlikely to bring about concomitant change in behavior. Although the tested models could not be considered redundant, it seems that effects of self-control were entirely accounted for by past behavior in some cases. The strong behavioral consistency may indicate that self-control effects are akin to habits (Triandis, 1977). That residual effects remain provides some evidence that trait self-control may be an important determinant of behavior beyond habits.

Strengths, Limitations, and Future Research

The current research has numerous strengths including adoption of appropriate theoretical perspectives on the proposed mediation and moderation effects of trait self-control on health behavior, testing predictions in six independent samples and across ten health behaviors, and adoption of rigorous confirmatory approaches to test mediation and moderation models using bootstrapped standard errors. However, some limitations of the current research should be noted. While most measures of the study constructs used across samples in the present study were almost identical, there were variations, for example, in Sample 1, we used measures of outcome evaluations and self-efficacy, and in Sample 5 we used a measure of self-discipline rather trait self-control. While these constructs demonstrate good convergence at the conceptual level (Hagger, Zhang, et al., 2018; Protogerou, Johnson, & Hagger, 2018), differences in measures still has potential to contribute to error variance. Further direct replication of the effects tested in the current study using identical measures is advocated to verify their robustness.

It is also important to note that we relied exclusively on self-report measures of behavior. While there is evidence supporting concurrent validity of behavioral self-reports alongside objective measures, the potential for reporting and recall bias is a real one. Future research should seek to corroborate current findings in datasets that include objective measures of behavior. In addition, all current data are correlational, which means that any directional effects in the current research is inferred from theory not the data. Future research may provide stronger evidence by adopting longitudinal cross-lagged panel designs, which may enable causal inference and tests or reciprocal effects. Intervention research that manipulated self-control through training (Allom, Mullan, & Hagger, 2016; Friese, Frankenbach, Job, & Loschelder, 2016), may also shed light on the moderating effect of self-control on the intention-health behavior relationship. A further issue is that may have affected effect sizes in the current models is the variation in the time lag between T1 and T2. However, good temporal correspondence between the social cognition and behavior measures in the current studies (c.f., Ajzen, 2002) and the fact that time lag does not tend to moderate relations in social cognition theories (Hagger, Polet, et al., 2018; Protogerou et al., 2018; Rich et al., 2015) suggest this may not be a major source of error variance.

A further limitation is that the current samples are drawn from disparate populations and contexts (e.g., high school, university, military) with an overrepresentation of student and younger-aged participants. Although promotion of health behavior in these populations is a legitimate public health goal, and current data may point to decision making processes that may apply more broadly, it would be remiss to make definitive population-level generalizations regarding the reported patterns of effects based on data from these samples alone. Future research should replicate current findings in representative, general population samples.

In addition, we found evidence for attrition bias in study measures across data collection occasions. Our attrition analyses identified differences in key variables such as self-control and past participation in health behavior in three of the six samples. Effect sizes for the attrition analyses were relatively small in most cases, but were large for many of the analyses in Sample 6. We

cannot, therefore, claim that our conclusions were unaffected by error variance attributable to attrition bias. Future research should adopt strategies to minimize attrition bias, such as oversampling in hard-to-reach groups and pro-active efforts to contact non-responders.

Conclusions and Implications for Practice

The current study provided preliminary evidence for two processes by which trait self-control may relate to health behavior within social cognition theories: a mediation effect through social cognition constructs and intentions, and an interactive effect with intentions. We found consistent support for the mediation effect in six separate samples and ten behaviors. However, we only found support for the moderation effect in specific behaviors: dietary restrictions, alcohol consumption, binge drinking, and pre-drinking. We also found direct effects of trait self-control on behavior, indicating that trait self-control may have both direct and indirect effects on behavior, which may reflect dual pathways to action: a reasoned, deliberative pathway mediated by social cognition constructs and intentions, and a non-conscious, impulsive pathway independent on intentions. Results provide important formative research that may inform future research and practice. For example, manipulations that promote better self-control may be effective in promoting adaptive intentions toward health behavior and, in certain behaviors, may lead to individuals acting on their intentions. However, given the relative stability of trait-control, such interventions may require long-term resources and chronic manipulations. Knowledge that individuals with low self-control may be less likely form adaptive beliefs and intentions toward health behavior, and, for certain behaviors, may be less likely to act on their intentions, suggests that structuring the environment to minimize or eliminate presentation of cues that instigate impulsive behaviors that may out-compete and derail intentions to engage in goal-directed behaviors. Future research should also seek to examine the mediation of the direct effect of trait self-control on health behavior by habit, and explore how manipulation of self-control through self-control training promotes change in social cognition constructs and intentions, and greater enactment of intentions, particularly among individuals with low trait self-control.

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Table 1
Parameter Estimates for the Direct, Indirect, and Total Effects for the Hypothesized Model for Each Sample

Sample	Behavior	Effect	B	95%CI		β
				LB	UB	
1	Fruit & vegetable	Direct effects				
		Intention→Behavior	0.354	0.279	0.433	.328***
		Self-control→Behavior	0.218	-0.027	0.448	.068
		Self-control→Intention	0.364	0.156	0.566	.153***
		Indirect effects				
		Self-control→Intention→Behavior	0.163	0.082	0.260	.051***
		Self-control→Social cognition constructs→Behavior	0.450	0.333	0.575	.141***
		Self-control→Social cognition constructs→Intention	0.362	0.209	0.531	.123***
		Total effects				
		Self-control→Behavior	0.668	0.427	0.903	.210***
		Self-control→Intention	0.823	0.608	1.029	.279***
1	Fast food	Direct effects				
		Intention→Behavior	-0.020	-0.037	-0.005	-.109**
		Self-control→Behavior	-0.087	-0.139	-0.038	-.144***
		Self-control→Intention	0.402	0.157	0.617	.125**
		Indirect effects				
		Self-control→Intention→Behavior	-0.008	-0.018	-0.001	-.014
		Self-control→Social cognition constructs→Behavior	-0.022	-0.042	-0.003	-.036*
		Self-control→Social cognition constructs→Intention	0.291	0.138	0.453	.090***
		Total effects				
		Self-control→Behavior	-0.109	-0.156	-0.061	-.180***
		Self-control→Intention	0.693	0.441	0.915	.215***
2	Dietary restriction	Direct effects				
		Intention→Behavior	0.627	0.554	0.696	.565***
		Self-control→Behavior	0.135	0.006	0.271	.059*
		Self-control→Intention	-0.033	-0.141	0.067	-.016
		Indirect effects				
		Self-control→Intention→Behavior	-0.021	-0.090	0.041	-.009
		Self-control→Social cognition constructs→Behavior	0.190	0.081	0.304	.083**
		Self-control→Social cognition constructs→Intention	0.301	0.184	0.438	.146***
		Total effects				
		Self-control→Behavior	0.324	0.137	0.510	.142**
		Self-control→Intention	0.268	0.101	0.438	.130**

2	Binge drinking	Direct effects				
		Intention→Behavior	0.113	0.091	0.139	.141***
		Self-control→Behavior	-0.022	-0.070	0.033	-.011
		Self-control→Intention	-0.157	-0.279	-0.043	-.061**
		Indirect effects				
		Self-control→Intention→Behavior	-0.018	-0.033	-0.005	-.009*
		Self-control→Social cognition constructs→Behavior	-0.072	-0.102	-0.045	-.035***
		Self-control→Social cognition constructs→Intention	-0.436	-0.580	-0.287	-.170***
		Total effects				
		Self-control→Behavior	-0.094	-0.149	-0.037	-.046**
		Self-control→Intention	-0.594	-0.788	-0.396	-.232***
2	Physical activity	Direct effects				
		Intention→Behavior	0.585	0.500	0.679	.495***
		Self-control→Behavior	0.188	0.034	0.335	.081*
		Self-control→Intention	0.003	-0.096	0.112	.002
		Indirect effects				
		Self-control→Intention→Behavior	0.002	-0.056	0.065	.001
		Self-control→Social cognition constructs→Behavior	0.125	0.045	0.217	.054***
		Self-control→Social cognition constructs→Intention	0.215	0.107	0.326	.109***
		Total effects				
		Self-control→Behavior	0.314	0.142	0.490	.134***
		Self-control→Intention	0.219	0.082	0.377	.110**
3	Regular walks	Direct effects				
		Intention→Behavior	1.751	0.944	2.931	.331**
		Self-control→Behavior	-0.073	-0.480	0.330	-.026
		Self-control→Intention	0.092	0.009	0.180	.173
		Indirect effect				
		Self-control→Intention→Behavior	0.162	0.018	0.339	.057*
		Total effect				
		Self-control→Behavior	0.254	0.027	0.508	.230*
3	Alcohol	Direct effects				
		Intention→Behavior	0.176	0.004	0.348	.166*
		Self-control→Behavior	0.688	0.110	1.266	.185*
		Self-control→Intention	0.078	-0.577	0.733	.022
		Indirect effect				
		Self-control→Intention→Behavior	0.014	-0.113	0.141	.004
		Total effect				
		Self-control→Behavior	0.092	-0.676	0.860	.026
4	Flossing	Direct effects				

		Intention→Behavior	0.897	0.779	1.020	.648***
		Self-control→Behavior	-0.230	-0.740	0.301	-.052
		Self-control→Intention	0.244	-0.080	0.579	.076
		Indirect effects				
		Self-control→Intention→Behavior	0.219	-0.075	0.533	.049
		Self-control→Social cognition constructs→Behavior	0.291	-0.057	0.668	.066
		Self-control→Social cognition constructs→Intention	0.081	-0.140	0.303	.025
		Total effects				
		Self-control→Behavior	0.062	-0.518	0.661	.014
		Self-control→Intention	0.325	-0.063	0.731	.102
5	Physical activity	Direct effects				
		Intention→Behavior	0.540	0.429	0.656	.626***
		Self-control→Behavior	0.328	0.064	0.591	.132**
		Self-control→Intention	0.412	0.122	0.704	.143**
		Indirect effects				
		Self-control→Intention→Behavior	0.223	0.063	0.397	.090**
		Self-control→Social cognition constructs→Behavior	0.642	0.441	0.887	.259***
		Self-control→Social cognition constructs→Intention	0.681	0.428	0.970	.237***
		Total effects				
		Self-control→Behavior	0.970	0.700	1.253	.391***
		Self-control→Intention	1.093	0.747	1.418	.380***
6	Pre-drinking	Direct effects				
		Intention→Behavior	0.166	0.129	0.204	.491***
		Self-control→Behavior	-0.037	-0.127	0.056	-.044
		Self-control→Intention	-0.115	-0.318	0.098	-.046
		Indirect effects				
		Self-control→Intention→Behavior	-0.019	-0.052	0.017	-.022
		Self-control→Social cognition constructs→Behavior	-0.091	-0.147	-0.041	-.107**
		Self-control→Social cognition constructs→Intention	-0.271	-0.503	-0.060	-.108*
		Total effects				
		Self-control→Behavior	-0.128	-0.233	-0.024	-.151*
		Self-control→Intention	-0.386	-0.697	-0.095	-.154**

Note. [a]Effect falls marginally short of conventional probability level for statistical significance ($p < .055$); [b]$p = .086$. B = Unstandardized parameter estimate; 95% CI = 95% confidence intervals of unstandardized parameter estimate using bootstrapped standard errors (replications, $N = 1000$); LB = Lower bound of 95% CI; UB = Upper bound of 95% CI; β = Standardized parameter estimate. * $p < .05$ ** $p < .01$ *** $p < .001$

Figure 1. Hypothesized relations among trait self-control, social cognition constructs, intentions, and health behavior for Sample 1. SE = Self-efficacy; OE = Outcome expectancies; RP = Risk perceptions; Indirect effects of trait self-control on health behavior through the social cognition constructs were found for fruit and vegetable consumption and fast food consumption. Correlations among self-efficacy, outcome expectancy, and risk perception constructs are not shown. Direct effects of trait self-control on health behavior were found for fast food consumption.

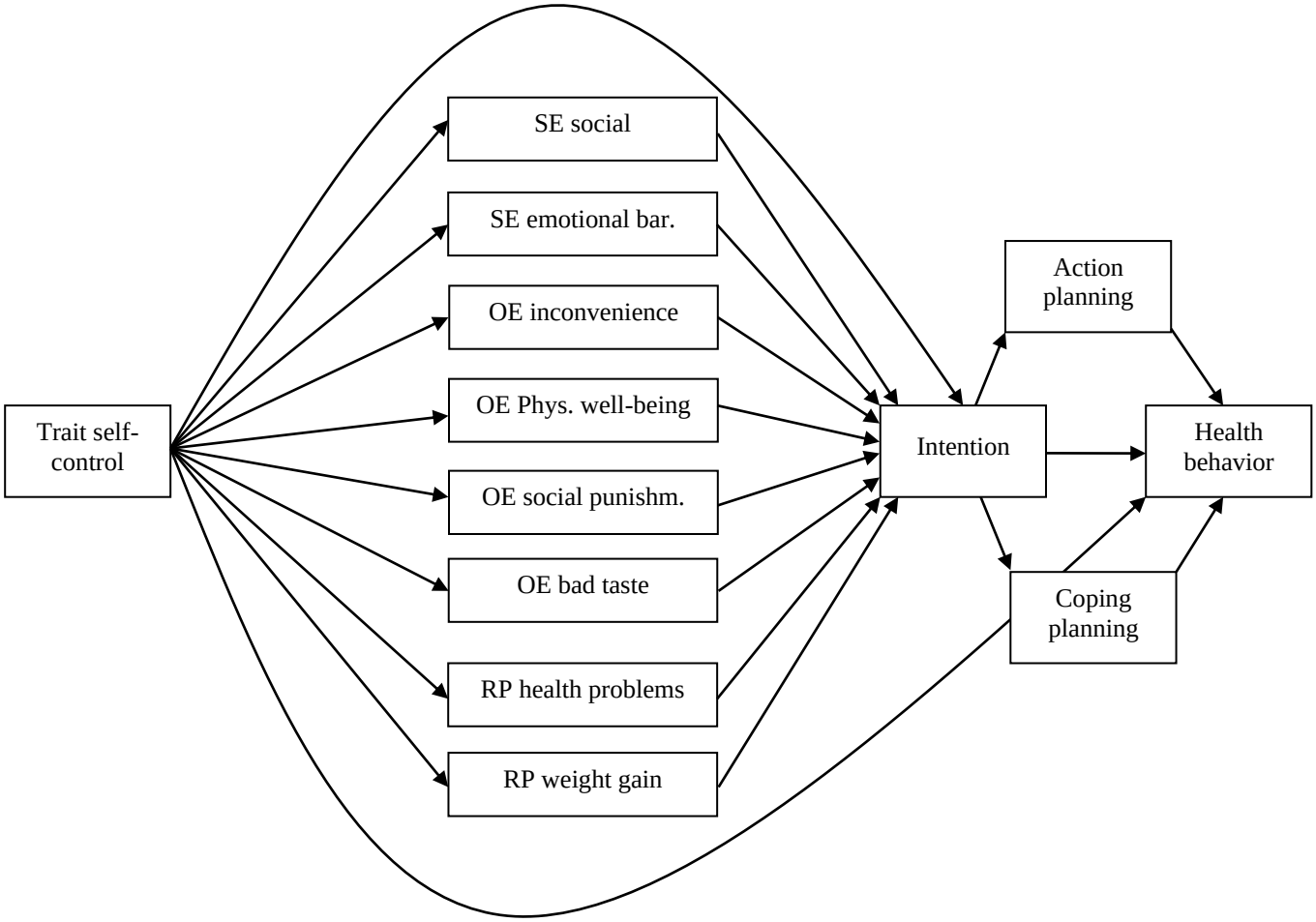

Figure 2. Hypothesized relations among trait self-control, social cognition constructs, intentions, and health behavior for Samples 2, 4, 5, and 6. All effects were controlled for gender and age. Correlations among the attitude, subjective norm, and perceived behavioral control constructs are not shown. Indirect effects of trait self-control on health behavior through the social cognition constructs were found for the dietary restriction, binge drinking, and physical activity behaviors in Sample 2, out-of-school physical activity in Sample 5, and pre-drinking in Sample 6. Direct effects of trait self-control on health behavior were found for the dietary restriction and physical activity behaviors in Sample 2, and out-of-school physical activity in Sample 5.

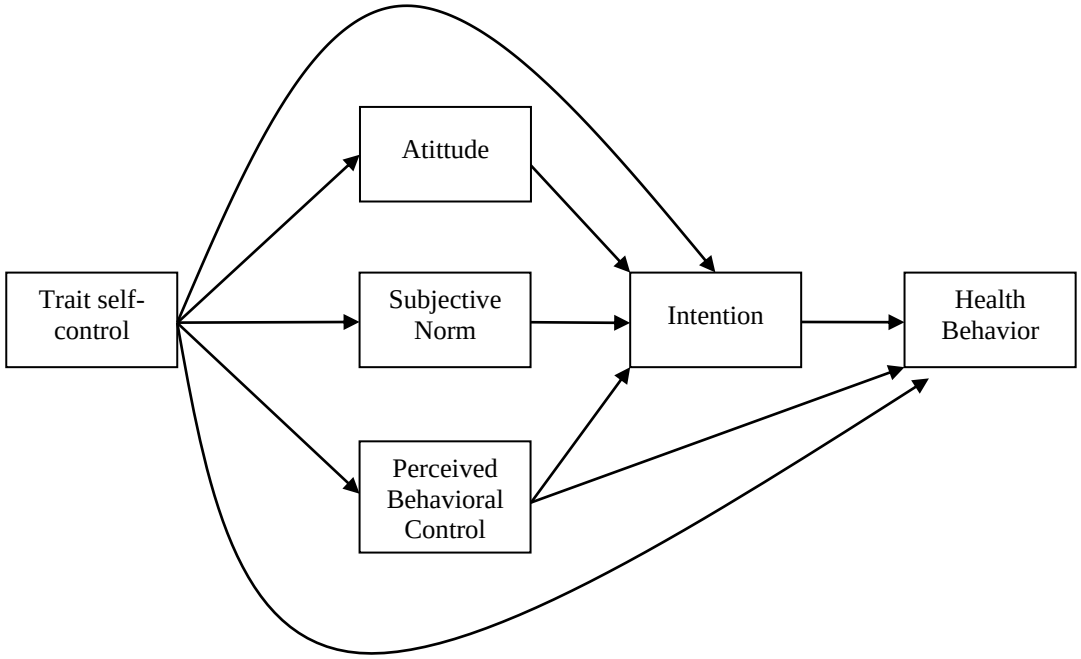

Figure 3. Hypothesized relations among trait self-control, intentions, and health behavior for Sample 3. All effects were controlled for gender and age. An indirect effect of trait self-control on health behavior through intentions was found for regular walks. A direct effect of trait self-control on health behavior was found for alcohol consumption.

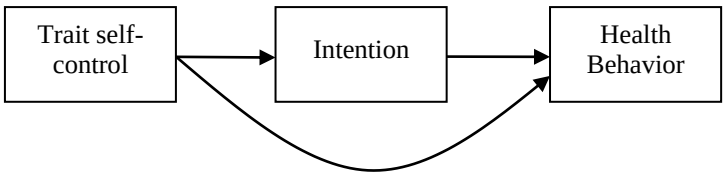

Figure 4. Hypothesized moderation model of the main and interactive effects of trait self-control and intention on health behavior with perceived behavioral control as a covariate. All effects were controlled for gender and age. Am interaction effect of trait self-control and intention on health behavior was found for dietary restriction and binge drinking behaviors in Sample 2, alcohol consumption in Sample 3, and pre-drinking in Sample 6.