"Are you in full possession of your capacity?". A mechanistic self-control approach at trait and state levels to predict different health behaviors

Cyril Forestier, Philippe Sarrazin, Benoit Allenet, Aurélie Gauchet, Jean-Philippe Heuzé, Aïna Chalabaev

"Are you in full possession of your capacity?". A mechanistic self-control approach at trait and state levels to predict different health behaviors

Cyril Forestier[a], Philippe Sarrazin[a], Benoît Allenet[b], Aurélie Gauchet[c], Jean-Philippe Heuzé[a], Aïna Chalabaev[a]

[a] *SENS, Univ. Grenoble Alpes, Grenoble F-38000, France,* [b]*TIMC-IMAG, Univ. Grenoble Alpes, Grenoble F-38000, France,* [c]*LIP-PC2S, Univ. Grenoble Alpes, Grenoble F-38000, France.*

Author Note

Abstract

This study investigated the role of self-control in health behaviors at both trait and state levels. We examined if trait and state self-control independently predict health behaviors, as well as the mechanisms of these relationships (desire, conflict, and resistance). This question was investigated on unhealthy and healthy behaviors, in the domain of physical activity, diet, and smoking. 325 participants completed a questionnaire assessing trait and state self-control, as well as desire, conflict, resistance, and health behaviors. Path analyses revealed that trait self-control indirectly predicted unhealthy behaviors through reduced desire, conflict, and resistance, and directly predicted healthy behaviors. These relationships remained significant when controlling for state self-control, suggesting that people's general tendency to prioritize distal goals over proximal motives uniquely predicts behaviors. Results also showed that adding state self-control to the model doubled the explained variance in healthy behaviors, highlighting the importance of considering self-control capacity at both trait and state levels.

Keywords: Trait self-control capacity; state self-control capacity; self-control mechanisms; healthy behaviors; unhealthy behaviors.

"Are you in full possession of your capacity?". A mechanistic self-control approach at trait and

state levels to predict different health behaviors

1. Introduction

Despite accumulating evidence that behaviors play a central role in health, most people

have difficulties to adopt a healthy lifestyle (e.g., Ford, Zhao, Tsai, & Li, 2011). Understanding

the determinants of behavior change has thus become a hot topic in psychology, notably within

socio-cognitive models (e.g., theory of planned behavior, Ajzen, 1991). Although these models

have been successful in identifying key determinants of behavioral intention (e.g., self-efficacy,

attitudes), intentions do not systematically translate into behavior change, a phenomenon known

as the "intention-behavior gap". Self-control, which reflects the ability of the self to exert control

over the self (Muraven & Baumeister, 2000), represents a promising concept to address this

limitation (e.g., Sniehotta, Presseau, & Araujo-Soares, 2014). Indeed, individual differences in

self-control have consistently been shown to predict health behaviors. For example, people with

high self-control trait report less use of tobacco and less eating disorders than people with low

self-control trait (for a review see de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister,

2012).

However, the mechanisms through which self-control affects behaviors remain unclear.

Traditionally, self-control is conceived as the ability to inhibit desires or habits (e.g., Hagger,

Wood, Stiff, & Chatzisarantis, 2010). The more people are able to resist desires that conflict with

their long-term goals, the more likely self-control success is to occur (e.g., Kotabe & Hofmann,

2015). Yet, recent research shows instead that high trait self-control is associated with reduced

desire for problematic behaviors, reduced conflict between desires and long-term goals, and less

resistance to conflict (e.g., Hofmann, Adriaanse, Vohs, & Baumeister, 2014; Hofmann, Baumeister, Förster, & Vohs, 2012; Luehring-Jones, Tahaney, & Palfai, 2018). This is in line with a broader conceptualization of self-control as a general process by which people prioritize distal goals over proximal motives (Fujita, 2011). Here, effortful inhibition is one mechanism by which people control their behaviors, but more "proactive" strategies exist, such as avoiding temptations or developing healthy habits.

The goal of this study was to extend this line of research by investigating self-control at the dispositional and state levels. We examined if trait and state self-control independently predict health behaviors, as well as the mechanisms of these relationships (desire, conflict, and resistance). This questioning lies on evidence that although individual differences in self-control exist, this ability may also vary on a daily-life basis (e.g., Buyukcan-Tetik, Finkenauer, & Bleidorn, (2018) and Hofmann et al., (2012). This suggests that people's available resources at a particular point in time may differ from the resources they have most of the time. If this is the case, are self-regulation behaviors affected by both trait and state self-control, and to what extent? On the one hand, we can consider based on the strength model of self-control (e.g., Muraven & Baumeister, 2000) that behaviors are primarily determined by current self-control resources. On the other hand, a recent study on well-being showed that both trait and state self-control contributed to this outcome, and that trait self-control was more predictive than state self-control (Buyukcan-Tetik et al., 2018). This suggests that these two aspects of self-control should both be considered.

We examined the role of trait and state self-control on different types of health behaviors (unhealthy and healthy). Most research assumes that self-control effects on unhealthy behavior (e.g., eating junk food) and healthy behaviors (e.g., eating healthy) rely on the same processes,

but empirical evidence of this assumption is lacking (de Ridder et al., 2012). Yet, such evidence

is necessary because these two types of behaviors differ in an important way. Indeed, unhealthy

behaviors may be attractive in the short term and need therefore to be inhibited; healthy

behaviors may instead be unattractive in the short term and need therefore to be actively initiated

(e.g., de Boer, Van Hooft, & Bakker, 2011). The literature on approach and avoidance motivation

suggests the relevance of distinguishing these two types of behaviors (e.g., achievement goals

theory, Elliot, 2005; regulatory focus theory, Higgins, 1998). For example, the regulatory focus

theory considers that people may pursue different types of goals: they are promotion-oriented

when they pursue desirable outcomes (e.g., gains), and prevention-oriented when they strive to

avoid undesirable outcomes (e.g., losses). Importantly, these goals lead to different emotions,

cognitions and behaviors (Higgins, 2018). This suggests that self-control mechanisms could

differ according to the nature of the behavior.

   In sum, the current study investigated the mechanisms through which both trait and state

self-control predict unhealthy and healthy behaviors, from a broad self- theoretical perspective.

This questioning was examined in the domains of diet (eating balanced food and avoiding eating

unbalanced food), physical activity (being physically active and avoiding being sedentary), and

smoking (avoiding smoking). We hypothesized that trait and state self-control would predict

behaviors independently from one another (e.g., Buyukcan-Telik et al., 2018). We also

hypothesized that the self-control – unhealthy behaviors relationships would be mediated by

decreased desire for these behaviors, reduced conflict between desires and long-term goals, and

less resistance to conflict (e.g., Hofmann, Baumeister, et al., 2012; Luehring-Jones et al., 2018).

Figure 1 summarizes our hypotheses.

<div align="center">[Insert Figure 1 here]</div>

2. Material and methods

2.1. Participants and procedure

College students from five French universities were contacted through mailing lists to participate in an online study examining the relationships between their personal beliefs and health behaviors. They were further informed that their participation was anonymous and that their responses would be kept confidential. Sample size was determined before any data analysis, following Boomsma's (1985) recommendation to include a minimum of 200 participants when conducting structural equation modeling (we did not continue to collect data after data analysis). After having confirmed their consent to participate in this study, a sample of 422 voluntary individuals completed the online questionnaire (hosted on SurveyMonkey). The study was conducted in accordance with APA ethical principles in the conduct of research with human participants.

Seventy-nine participants were not considered in further analyses because they completed only the first page of the questionnaire (less than 15% of the items). In addition, data beyond three standard deviations from the mean of the variables of interest were removed, resulting in exclusion of eighteen more participants. The final sample was composed of 325 participants (188 women; $M_{age} = 20.90$, $SD_{age} = 4.62$). All measures, manipulations, and exclusions in the studies are disclosed.

2.2. Measures

2.2.1. Trait self-control capacity.

The Brief Self-Control Scale (BSCS) (Tangney, Baumeister, & Boone, 2004) is a largely used scale to assess trait self-control. The BSCS is composed of 13 items (e.g., "I am good at resisting temptations", "I have a hard time breaking bad habits"). Participants responded on a

seven-item Likert scale ranging from 1 (*Completely disagree*) to 7 (*Completely agree*). The scale presented good reliability in the present study (α = .77).

2.2.2. State self-control capacity.

State self-control was indexed by subjective vitality. This operationalization was chosen because subjective vitality corresponds closely to the definition of self-control capacity as one's perception of the mental resources or energy available to the self (Clarkson, Otto, Hassey, & Hirt, 2016). Indeed, subjective vitality is defined as the energy available to the self (Ryan & Deci, 2008). This construct may not be reduced to energy because other energy-related constructs such as anger, anxiety, or arousal, are unrelated or negatively related to it (Ryan & Frederick, 1997). Instead, subjective vitality represents energy that one can harness or regulate for purposive actions (Ryan & Deci, 2008), and is therefore similar to the definition of self-control capacity.

In support to this idea, past research within the ego depletion literature has shown that exerting self-control can reduce subjective vitality (e.g., Hagger et al., 2010; Muraven, Gagné, & Rosman, 2008; Rouse, Ntoumanis, & Duda, 2013). For instance, Muraven et al. (2008) observed that decreased self-control performance after a depleting task was mediated by decreased subjective vitality. This suggests that subjective vitality and behavioral assessments of ego depletion tap into the same resources, with subjective vitality having the advantage of being a highly accessible, phenomenologically based variable (Ryan & Deci, 2008).

More particularly, participants completed the Subjective Vitality Scale (Ryan & Frederick, 1997). This scale began with the stem: "Indicate to what extent each of the following sentence reflects the general feelings you had during the past two days". It was composed of five items (e.g. "I felt alive and vital") and responses ranged on a seven-item Likert scale from 1

(*Completely disagree*) to 7 (*Completely agree*). The scale presented good reliability (α = .70).

Past research showed that this measure may fluctuate over time (e.g., Emile, d'Arripe-

Longueville, Cheval, Amato, & Chalabaev, 2015; Smolders, de Kort, & van den Berg, 2013). For

example, Smolders et al. (2013) observed that more than 65% of the variance in feelings of

vitality occurred within individuals, at the level of time of day. This suggests that this measure

may be appropriate to capture state of self-control capacity.

2.2.3. Self-control mechanisms.

Desire, desire-intention conflict, and resistance were assessed with the items used in

(Hofmann et al., 2012). Items were preceded by the stem: "Among the following behaviors, what

are those you have desired doing and to what extent, during the past two days?". The stem was

followed by five items focusing on the three unhealthy behaviors of interest (i.e., sedentary

activity, unhealthy diet, tobacco consumption). More particularly, desire frequency and strength[1]

were measured by the items: "With which frequency have you experienced a desire for *sedentary*

activities?", and "How strong was the desire for *sedentary activities*?" (words in italic differed

depending on the target behavior). Participants responded on a 8-item scale ranging from 0 (*No*

desire at all) to 7 (*Irresistible desire*). Desire-intention conflict was measured by the item: "To

what extent did this desire conflict with your intention to avoid *sedentary activities*?".

Participants responded on a 8-item scale ranging from 0 (*No conflict at all*) to 7 (*Very high*

conflict). Finally, resistance (i.e., self-control effort) was assessed with the item: "To what extent

---

[1] Given that results were similar for desire strength and desire frequency, we present here only results for
    desire strength, following Hofmann, Baumeister, et al. (2012).

have you attempted to resist the desire for *sedentary activities*?". Participants responded on a 8-item scale ranging from 0 (*No resistance at all*) to 7 (*Very high resistance*).

2.2.4. Health behaviors.

Physical and sedentary activities were measured with the French version of the International Physical Activity Questionnaire (Craig et al., 2003), which assesses moderate and vigorous physical activity. For each of these intensities, participants were asked to indicate the number of days during which they did at least 10 min sessions of physical activity, and how many minutes, during the last week. We then summed the scores on the moderate and vigorous physical activity items, to obtain the Moderate to Vigorous Physical Activity score (MVPA score). The IPAQ also assesses walking time in minutes during the last week, and sedentary time, defined as the time in minutes spent in a sitting position during the last week.

Healthy and unhealthy diet were measured with the Healthy Eating Behaviour Scale (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004). This 8-item scale is composed of two subscales assessing diet behavior during the last week. Four items measure healthy diet: "I eat vegetables, fruits and grain products", "I eat a variety of foods which balance the four alimentary groups (fruits and vegetables, dairy products, starches, meat/fish/eggs)", "I eat foods that are low in fat, saturated fat, and cholesterol", and "I drink water". The other four items measure unhealthy diet: "I eat food such as chips, chocolate, and candies", "I eat fried food", "I use white sugar", and "I use salt". Participants indicated their consumption frequency on a seven-item scale ranging from 1 (*Once or twice per month*) to 7 (*More than three times per day*). In contrast to Pelletier et al. (2004), who averaged the items of each subscale, we decided instead to sum the responses of each subscale to obtain the Healthy Diet Score (ranging from 4 to 28) and the Unhealthy Diet Score (ranging from 4 to 28). Indeed, following (Steca et al., 2015)'s reasoning,

we considered that eating one particular type of unhealthy food (e.g., white sugar) may be

unrelated to the consumption of other types of unhealthy food (e.g., fried food). It seems

therefore conceptually irrelevant to aggregate items that may be independent from each other. A

sum may instead better quantify the consumption of unhealthy or healthy food. Finally, tobacco

consumption was measured with a single-item "*How many cigarettes do you smoke per week?*".

3. Results

3.1. Preliminary analyses

All data is available upon request to the first author. We checked that variables were

normally distributed by examining their skewness and kurtosis. Distribution of all variables were

normal, except MVPA score, sedentary time, and number of cigarettes smoked. A square root

transformation was therefore applied to these variables. Means, standard deviations, and

Cronbach's alpha coefficients are presented in the supplementary materials, as well as Pearson

correlations between the variables of interest. Results showed that MVPA was not significantly

related to sedentary time, $r(324) = -.03$, $p = .62$, and unhealthy diet was not significantly

correlated with healthy diet, $r(324) = .01$, $p = .89$. This indicates that healthy and unhealthy

behaviors within the same domain are independent from one another.

3.2. Primary analyses

3.2.1. Analytic strategy.

We ran path analyses to test our predictions using AMOS 23.0 with maximum likelihood

estimation. The same path analytic models were tested for each behavior domain (physical

activity, diet, and smoking). The baseline model included all variables (i.e., trait self-control

capacity, desire, conflict, and resistance) except state self-control, which was added in the final

model. This two-step method allowed us to examine whether state self-control added explained

variance in health behaviors. Chi-square differences tests of the baseline versus final models were also conducted to evaluate if these increases in explained variance were significant.

The models' fit was assessed by examining the minimum discrepancy (CMIN/DF), the probability level (p-value), the Bentler-Bonett normed fit index (NFI), the comparative fit index (CFI), the Tucker–Lewis-Index (TLI), and the root-mean-square error of approximation (RMSEA). A satisfactory model fit is indicated by a CMIN/DF ratio below 2.00 (Byrne, 2012), a p-value over .05 (Arbuckle & Wothke, 2001), a NFI over .95 (Schumacker & Lomax, 2004), a TLI over .90 (Tabachnick & Fidell, 2001), a CFI over .93 (Byrne, 1994), and a RMSEA below .05 (Stieger et al., 1990). All non-significant paths were deleted according to the methods described by (MacCallum, 1986).

In addition, the cross-sectional nature of the design prevents from drawing causal inferences. We therefore tested for each behavior a reverse model in which behavior was the predictor and self-control capacity the outcome, in order to rule out the alternative hypothesis that adopting health behaviors predicts self-control capacity. Indeed, given that health behaviors adoption is related to well-being (Cheng, Weiss & Siegel, 2015), and that subjective vitality is a component of well-being (Ryan & Frederick, 1997), one could predict the reverse relationships to the ones we predicted. Indices of these reverse models were not adequate, ruling out this alternative hypothesis (CMIN/DF = 4.00, $p < .001$, NFI = .72, TLI = .41, CFI = .75, RMSEA = .10, for the physical and sedentary activity model; CMIN/DF = 3.24, $p = .00$, NFI = .87, TLI = .78 , CFI = .90, RMSEA = .08, for the healthy and unhealthy diet model, and CMIN/DF = 8.47, $p = .00$, NFI = .87, TLI = .73, CFI = .88, RMSEA = .15 for the smoking model).

3.2.2. Path analyses.

3.2.2.1.   *Self-control components predicting physical and sedentary activity.*

Results of the baseline and final models are presented in Figure 2. Both models provided good fit to the data (CMIN/DF = 1.49, p = .16, NFI = .90, TLI = .89, CFI = .96, RMSEA = .04, for the baseline model; CMIN/DF = 1.07, p = .38, NFI = .93, TLI = .99, CFI = .99, RMSEA = .02, for the final model). Desire positively predicted conflict, which positively predicted resistance, which in turn negatively predicted sedentary activity. In other words, the more participants reported a strong desire for sedentary activity, the more they experienced conflict between this desire and their intention to be physically active, and the more they resisted this desire; in turn, the more they resisted it, the less they spent time being sedentary. A direct positive relationship between desire and sedentary activity was also observed. Results concerning self-control capacity showed that both trait and state self-control negatively predicted desire for sedentary activity. Additional results showed that state self-control directly and positively predicted physical activity, and that trait self-control negatively predicted conflict.

Finally, inclusion of state self-control added explained variance in physical activity, which increased from R^2 = .03 to R^2 = .07. However, the chi-square difference test revealed that the final model did not significantly differ from the baseline model ($\Delta\chi^2$ = .91, Δdf = 4, p > .05).

[Insert Figure 2 here]

3.2.2.2.   *Self-control components predicting healthy and unhealthy diet.*

Results of the baseline and final models are presented in Figure 3. Both models provided good fit to the data (CMIN/DF = 1.05, p = .39, NFI = .96, TLI = .99, CFI = .96, RMSEA = .01, for the baseline model; CMIN/DF = 1.58, p = .08, NFI = .93, TLI = .94, CFI = .97, RMSEA = .04, for the final model). Again, desire positively predicted conflict, which positively predicted

resistance. In other words, the more participants reported a strong desire for unhealthy food, the

more they experienced conflict between this desire and their intention to eat healthy, and the

more they resisted this desire. However, resistance did not significantly predict unhealthy food

consumption. A direct positive relationship between desire and unhealthy food consumption was

nevertheless observed. Results concerning self-control capacity showed that both trait and state

self-control directly and positively predicted consumption of healthy food, while trait self-control

also negatively predicted consumption of unhealthy food. Moreover, inclusion of state self-

control added explained variance in healthy food consumption, which increased from $R^2 = .08$ to

$R^2 = .13$. Finally, the chi-square difference test showed that the final model significantly differed

from the baseline model ($\Delta\chi^2 = 11.05$, $\Delta df = 4$, $p < .05$).

[Insert Figure 3 here]

3.2.2.3.   *Self-control components predicting smoking.*

Results of the baseline and final models are presented in Figure 4. The final model

provided better fit to the data (CMIN/DF = 3.66, $p = .00$, NFI = .97, TLI = .93, CFI = .98,

RMSEA = .09, for the baseline model; CMIN/DF = 2.78, $p = .01$, NFI = .96, TLI = .98, CFI

= .98, RMSEA = .07, for the final model). Similar to physical activity behaviors, desire

positively predicted conflict, which positively predicted resistance, which in turn negatively

predicted cigarette consumption. In other words, the more participants reported a strong desire

for smoking, the more they experienced conflict between this desire and their intention not to

smoke, and the more they resisted this desire; in turn, the more they resisted it, the less they

smoked. A direct positive relationship between desire and smoking was also observed. Results

concerning self-control capacity showed that neither trait nor state self-control directly predicted

smoking. However, trait self-control negatively predicted desire while state self-control

negatively predicted conflict. Finally, inclusion of state self-control did not explain more variance in cigarette consumption. This observation was confirmed by the chi-square difference test, which indicated that the final model did not significantly differ from the baseline model ($\Delta\chi^2$ = 3.78, Δdf = 3, p > .05).

[Insert Figure 4 here]

4. Discussion

Role of trait self-control capacity

When considering self-control at the trait level only, results were in line with recent research (Hofmann et al., 2014; Hofmann, Baumeister, et al., 2012; Luehring-Jones, et al., 2018): the more individuals had high trait self-control, the less they experienced desires for unhealthy behaviors (sedentary activities, unhealthy food, and smoking). In turn, less desire was generally associated with less conflict, less resistance, and less behavior enactment. Interestingly, results showed that trait self-control affected both unhealthy and healthy behaviors, whereas these behaviors differ in an important way: the former need to be inhibited and the latter need to be initiated. Taken together, these findings are in line with a broad conceptualization of self-control, in which inhibition represents only one manner to control behavior among other manners (e.g., avoiding temptations, developing healthy habits) (e.g., de Ridder et al., 2011; Fujita, 2011; Galla & Duckworth, 2015).

This interpretation was reinforced by the result that trait self-control still predicted behaviors when controlling for state self-control (except physical activity). This indicates that people's current available resources are not sufficient to explain self-control success or failure, and that their general tendency to prioritize distal goals over proximal motives uniquely predicts behaviors. This result corroborates the idea that high trait self-controllers use self-control

strategies that enable them to be successful in different situations and extended periods of time, and notably effortless strategies (e.g., avoiding temptations) (e.g., Gillebaart & de Ridder, 2015).

Role of state self-control capacity

Concerning state self-control, its role was more manifest with regard to healthy behaviors. Indeed, including state self-control to the baseline model doubled the explained variance in physical activity and healthy diet. This suggests that such behaviors may more particularly necessitate available self-control resources or energy available to the self, in order to be actively initiated. However, this increase in explained variance was significant for diet but not for physical activity, which could be due to the low level of explained variance for the physical activity model. This suggests that the role of state self-control capacity differ according to the behavior domain. In addition, these findings corroborate the idea that self-control mechanisms may differ for healthy and unhealthy behaviors. This is in line with the literature on approach and avoidance motivation, which shows that pursuing something desirable and striving to avoid something undesirable are associated with different psychological and behavioral outcomes (e.g., Higgins, 1998).

In sum, this study shows the relevance of considering self-control capacity both at the trait and state levels. While research on these two facets has developed separately, our results showed that they both predicted behavior independently from each other. Taking into account these two aspects of self-control may therefore be useful to better understand the role of self-control in health behaviors (e.g., Buyukcan-Tetik et al., 2018). Overall, our findings raise the question of what processes drive the direct relationships between self-control capacity and healthy behaviors.

Self-control mechanisms are behavior-dependent

Finally, some differences were observed in self-control processes depending on behaviors. While desire directly predicted all unhealthy behaviors, this relationship was much stronger for smoking than for sedentary activity and unhealthy diet. This may be explained by the fact that smoking is addictive, and therefore particularly susceptible to desire strength. In addition, resistance was found to significantly predict sedentary activity and smoking, but not unhealthy diet. These findings suggest that the causes of self-control failures may differ according to the behavior domain, with desire playing a major role especially in smoking. This is in line with the idea that theories that are applicable to one particular behavior may not be applicable to another one, and that identifying the underlying processes of health behaviors requires to accurately define the target behavior (Michie, Johnston, Abraham, Lawton, Parker, & Walker, 2005). This reasoning is further reinforced by the differences observed in the variance in behaviors explained by the final models (69% in cigarette consumption, 13% in healthy diet, 8% in unhealthy diet, 7% in physical activity, and 3% in sedentary activity). Finally, results for the physical activity model showed a direct relationship between trait self-control and conflict after controlling for desire. This suggests that high self-controllers use other strategies than temptation avoidance, for example, they may be better able to draw their attention away from the problematic desire (e.g., when they are tempted by a sedentary behavior, they may focus on another activity, reducing in turn the experienced conflict).

Limits and future directions

This study is not without limitations, notably due to the cross-sectional nature of the design, which presents limits that are specific to the study of psychological states fluctuating over time. Indeed, even if participants were asked to rate their subjective vitality within a short

time frame (two days), there was only one measurement occasion and fluctuations were not assessed. Although this study represents an initial step in the identification of the distinctive role of trait and state of self-control capacity, future studies should adopt a longitudinal methodology such as experience sampling method (e.g., Hofmann et al., 2012), or rely on a latent state-trait approach (Steyer et al., 1999), which is particularly relevant to assess and distinguish precisely states variations from trait of a psychological construct.

Another promising avenue of research would be to articulate research on self-control with socio-cognitive models of behavior change, such as the Health Action Process Approach (Schwarzer, 2008). This model identifies action planning (defining when, where, and how to act) and coping planning (defining strategies to prioritize long-term goals over habitual responses when obstacles are faced) as key self-regulatory mechanisms to translate health goals into action. These strategies appear as likely candidates to explain the self-control capacity – behavior relationship, and future research should examine this possibility.

Conclusion

Results highlight that self-control mechanisms differ according to the health behavior considered, and suggest the importance of distinguishing trait from state self-control capacity in these mechanisms. Future research may help to better understand these processes by articulating them with more traditional socio-cognitive models of behavior change, and by adopting a longitudinal design such as the experience sampling method.

5. References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behaviour and Human Decision Processes*, *50*(2), 179-211. http://dx.doi.org/10.1016/0749-5978(91)90020-t

Arbuckle, J., & Wothke, W. (2011) Structural equation modeling using AMOS: An Introduction [EB].

Boomsma, A. (1985). Nonconvergence, improper solutions, and starting values in Lisrel maximum likelihood estimation. *Psychometrika*, *50*(2), 229-242. http://dx.doi.org/10.1007/bf02294248

Buyukcan-Tetik, A., Finkenauer, C., & Bleidorn, W. (2018). Within-person variations and between-person differences in self-control and wellbeing. *Personality and Individual Differences, 122*, 72-78. http://dx.doi.org/10.1016/j.paid.2017.10.013

Byrne, B. M. (1994). Structural equation modeling with EQS and EQS/Windows: Basic concepts, applications, and programming. (1994). *Applied Psychological Measurement*, *18*(2), 191-194. http://dx.doi.org/10.1177/014662169401800208

Byrne, B. (1989). *A primer of LISREL: Basic applications and programming for confirmatory factor analytic models.* New York: Springer Verlag.

Clarkson, J. J., Otto, A. S., Hassey, R., & Hirt, E. R. (2016). Perceived mental fatigue and self-control. *Self-Regulation and Ego Control*, 185.

Cheng, C., Weiss, J., & Siegel, J. (2015). Personality traits and health behaviors as predictors of subjective wellbeing among a multiethnic sample of university-attending emerging young adults. *International Journal of Wellbeing*, *5*(3), 21-43. http://dx.doi.org/10.5502/ijw.v5i3.2

Craig, C. L., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., et al. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise*, *35*(8), 1381-1395. http://dx.doi.org/10.1249/01.mss.0000078924.61453.fb

de Boer, B., van Hooft, E., & Bakker, A. (2011). Stop and start control: A distinction within self-control. *European Journal of Personality*, *25*(5), 349-362. http://dx.doi.org/10.1002/per.796

de Ridder, D., de Boer, B., Lugtig, P., Bakker, A., & van Hooft, E. (2011). Not doing bad things is not equivalent to doing the right thing: Distinguishing between inhibitory and initiatory

self-control. *Personality and Individual Differences*, *50*(7), 1006-1011. http://dx.doi.org/10.1016/j.paid.2011.01.015

de Ridder, D., Lensvelt-Mulders, G., Finkenauer, C., Stok, F., & Baumeister, R. (2012). Taking stock of self-control. *Personality and Social Psychology Review*, *16*(1), 76-99. http://dx.doi.org/10.1177/1088868311418749

Elliot, A. J. (2005). A conceptual history of the achievement goal construct. In A. Elliot & C. Dweck (Eds.), *Handbook of competence and motivation* (pp. 52–72). New York: Guilford Press.

Emile, M., d'Arripe-Longueville, F., Cheval, B., Amato, M., & Chalabaev, A. (2014). An ego depletion account of aging stereotypes' effects on health-related variables. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *70*(6), 876-885. http://dx.doi.org/10.1093/geronb/gbu168

Ford, E., Zhao, G., Tsai, J., & Li, C. (2011). Low-risk lifestyle behaviors and all-cause mortality: Findings from the National Health and Nutrition Examination Survey III mortality study. *American Journal of Public Health*, *101*(10), 1922-1929. http://dx.doi.org/10.2105/ajph.2011.300167

Fujita, K. (2011). On conceptualizing self-control as more than the effortful inhibition of impulses. *Personality and Social Psychology Review*, *15*(4), 352-366. http://dx.doi.org/10.1177/1088868311411165

Galla, B., & Duckworth, A. (2015). More than resisting temptation: Beneficial habits mediate the relationship between self-control and positive life outcomes. *Journal of Personality and Social Psychology*, *109*(3), 508-525. http://dx.doi.org/10.1037/pspp0000026

Gillebaart, M., & Ridder, D. T. (2015). Effortless self-control: A novel perspective on response conflict strategies in trait self-control. *Social and Personality Psychology Compass, 9*(2), 88-99. doi:10.1111/spc3.12160

Hagger, M., Wood, C., Stiff, C., & Chatzisarantis, N. (2010). Ego depletion and the strength model of self-control: A meta-analysis. *Psychological Bulletin*, *136*(4), 495-525. http://dx.doi.org/10.1037/a0019486

Higgins, E. T. (1998). Promotion and prevention: Regulatory focus as a motivational principle. *Advances in Experimental Social Psychology, 46*, 1-46. doi:10.1016/s0065-2601(08)60381-0

Hofmann, W., Adriaanse, M., Vohs, K., & Baumeister, R. (2014). Dieting and the self-control of
    eating in everyday environments: An experience sampling study. *British Journal of
    Health Psychology*, *19*(3), 523-539. http://dx.doi.org/10.1111/bjhp.12053

Hofmann, W., Baumeister, R., Förster, G., & Vohs, K. (2012). Everyday temptations: An
    experience sampling study of desire, conflict, and self-control. *Journal of Personality and
    Social Psychology*, *102*(6), 1318-1335. http://dx.doi.org/10.1037/a0026545

Hofmann, W., Vohs, K., & Baumeister, R. (2012). What people desire, feel conflicted about, and
    try to resist in everyday life. *Psychological Science*, *23*(6), 582-588.
    http://dx.doi.org/10.1177/0956797612437426

Kotabe, H., & Hofmann, W. (2015). On integrating the components of self-control. *Perspectives
    on Psychological Science*, *10*(5), 618-638. http://dx.doi.org/10.1177/1745691615593382

Luehring-Jones, P., Tahaney, K. & Palfai, T. (2018). The effect of self-control on drinking
    outcomes is mediated by automatic appetitive responses to alcohol. *Personality and
    Individual Differences*, 125, 116-119. https://doi.org/10.1016/j.paid.2018.01.011

MacCallum, R. (1986). Specification searches in covariance structure modeling. *Psychological
    Bulletin*, *100*(1), 107-120. http://dx.doi.org/10.1037/0033-2909.100.1.107

Michie, S., Johnston, M., Abraham, C., Lawton, R., Parker, D., & Walker, A. (2005). Making
    psychological theory useful for implementing evidence based practice: A consensus
    approach. *Quality and Safety in Health Care*, *14*(1), 26-33.
    http://dx.doi.org/10.1136/qshc.2004.011155

Muraven, M., & Baumeister, R. (2000). Self-regulation and depletion of limited resources: Does
    self-control resemble a muscle?. *Psychological Bulletin*, *126*(2), 247-259.
    http://dx.doi.org/10.1037//0033-2909.126.2.247

Muraven, M., Gagné, M., & Rosman, H. (2008). Helpful self-control: Autonomy support,
    vitality, and depletion. *Journal of Experimental Social Psychology*, *44*(3), 573-585.
    http://dx.doi.org/10.1016/j.jesp.2007.10.008

Pelletier, L., Dion, S., Slovinec-D'Angelo, M., & Reid, R. (2004). Why do you regulate what you
    eat? Relationships between forms of regulation, eating behaviors, sustained dietary
    behavior change, and psychological adjustment. *Motivation and Emotion*, *28*(3), 245-277.
    http://dx.doi.org/10.1023/b:moem.0000040154.40922.14

Rouse, P., Ntoumanis, N., & Duda, J. (2013). Effects of motivation and depletion on the ability to resist the temptation to avoid physical activity. *International Journal of Sport and Exercise Psychology*, *11*(1), 39-56. http://dx.doi.org/10.1080/1612197x.2012.717779

Ryan, R., & Deci, E. (2008). From ego depletion to vitality: Theory and findings concerning the facilitation of energy available to the self. *Social and Personality Psychology Compass*, *2*(2), 702-717. http://dx.doi.org/10.1111/j.1751-9004.2008.00098.x

Ryan, R., & Frederick, C. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality*, *65*(3), 529-565. http://dx.doi.org/10.1111/j.1467-6494.1997.tb00326.x

Schumacker, R., & Lomax, R. (2004). *A Beginner's guide to structural equation modeling*. Mahwah (New Jersey): L. Erlbaum Associates.

Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology*, *57*(1), 1-29. http://dx.doi.org/10.1111/j.1464-0597.2007.00325.x

Smolders, K. C. H. J., de Kort, Y. A. W., & van den Berg, S. M. (2013). Daytime light exposure and feelings of vitality: Results of a field study during regular weekdays. Journal of Environmental Psychology, 36, 270–279. doi:10.1016/j.jenvp.2013.09.004

Sniehotta, F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behavior. *Health Psychology Review*, *8*(1), 1-7. http://dx.doi.org/10.1080/17437199.2013.869710

Steca, P., Pancani, L., Greco, A., D'Addario, M., Magrin, M., & Miglioretti, M. et al. (2015). Changes in dietary behavior among coronary and hypertensive patients: A longitudinal investigation Using the Health Action Process Approach. *Applied Psychology: Health and Well-Being*, *7*(3), 316-339. http://dx.doi.org/10.1111/aphw.12050

Steiger, J. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioural Research*, *25*(2), 173-180. http://dx.doi.org/10.1207/s15327906mbr2502_4

Tabachnick, B. G., Fidell, L. S., & Osterlind, S. J. (2001). *Using multivariate statistics*. Boston: Allyn and Bacon

Tangney, J., Baumeister, R., & Boone, A. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality*, *72*(2), 271-324. http://dx.doi.org/10.1111/j.0022-3506.2004.00263.x

Acknowledgements

1   Acknowledgments

2   Authors wish to express their gratitude to University Grenoble Alpes for their funding.

Figure 1. Hypothetical model of self-control correlates of unhealthy and healthy behaviors

Figure 2. Physical and sedentary activity baseline model (without state self-control capacity) and final model (with state self-control capacity). All coefficients are unstandardized. t represents $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 3. Healthy and unhealthy diet baseline model (without state self-control capacity) and final model (with state self-control capacity). All coefficients are unstandardized. t represents $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 4. Tobacco consumption baseline model (without state self-control capacity) and final model (with state self-control capacity). All coefficients are unstandardized. t represents $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Figure(s)

Figure 1.

4.48** [1.38, 7.29]

Physical Activity R²=.03

Desire R²=.03

.20** [.05, .34]

Conflict (Desire – intention) R²=.08

.39*** [.29, .49]

Resistance R²=.15

-.32** [-.51, -.09]

1.74** [.50, 2.92]

-.87ᵗ [-1.83, .14]

Sedentary activity R²=.03

-.46*** [-.71, -.19]

Trait self-control capacity

State self-control capacity

4.74*** [2.72, 6,57]

Physical Activity R²=.07

-.22** [-.36, -.07]

.33*** [.42, .22]

Desire R²=.06

.20** [.05, .34]

Conflict (Desire – intention) R²=.08

.39*** [.29, .49]

Resistance R²=.15

-.20ᵗ [-.42, .02]

1.73** [.50, 2.92]

-.87ᵗ [-1.83, .14]

Sedentary activity R²=.03

-.46*** [-.71, -.19]

Trait self-control capacity

Figure 2.

1.23*
[.67, 1.83]

Healthy Diet
R²=.05

Desire
R²=.02

.61**
[.48, .73]

Conflict
(Desire – intention)
R²=.25

.48**
[.39, .56]

Resistance
R²=.28

-.31*
[-.55, -.06]

.32**
[.15, .63]

Unhealthy Diet
R²=.08

Trait self-control capacity

-1.07**
[-1.68, -.67]

State self-control capacity

1.02**
[.63, 1.43]

.74*
[.12, 1.34]

Healthy Diet
R²=.13

.33**
[.42, .22]

Desire
R²=.02

.61**
[.48, .73]

Conflict
(Desire – intention)
R²=.25

.48**
[.39, .56]

Resistance
R²=.28

-.31*
[-.55, -.06]

.32**
[.15, .63]

Unhealthy Diet
R²=.08

Trait self-control capacity

-1.07**
[-1.68, -.67]

Figure 3.

Figure 4.

Table 1

Means, Standard Deviations and Cronbach's Alpha Coefficient

Variable category	Variable name	M	SD	Alpha
Unspecific variables				
	Trait self-control capacity	4.24	0.85	.76
	State self-control capacity	4.14	1.31	.85
Physical activity variables				
	Desire	4.15	1.62	
	Conflict (desire – intention)	3.27	1.98	
	Resistance	3.06	1.95	
	MVPA score	1850	2093	
	Sedentary time	1448	1234	
Alimentation variables				
	Desire	4.35	1.88	
	Conflict (desire – intention)	3.83	2.30	
	Resistance	3.65	2.06	
	Healthy food score	20.18	4.60	
	Unhealthy food score	11.51	4.03	
Tobacco variables				
	Desire	2.25	2.01	
	Conflict (desire – intention)	2.44	2.34	
	Resistance	2.53	2.33	
	Number of cigarettes	9.27	22	

Table 2.

Pearson correlations between the variables of interest

		Unspecific variables		Physical activity variables					Alimentation variables				Tobacco consumption variables			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Unspecific variables	1 Trait self-control capacity	—															
	2 State self-control capacity	.33***	—														
Physical activity variables	3 MVPA	.16**	.26***	—													
	4 Sedentary time	-.05	-.00	-.03	—												
	5 Desire	-.16**	-.22***	-.18**	.15**	—											
	6 Conflict	-.23***	-.08	-.02	-.02	.19**	—										
	7 Resistance	-.01	-.07	-.04	-.08	.12*	.39***	—									
Diet variables	8 Healthy food score	.23***	.33***	.20***	-.02	-.06	-.03	.02	—								
	9 Unhealthy food score	-.25***	-.13**	-.11*	-.00	.07	.02	-.05	-.01	—							
	10 Desire	-.14*	-.12*	-.13*	.07	.19***	.11*	.10'	-.06	.18**	—						
	11 Conflict	-.05	-.10'	-.03	.01	.01	.24***	.25***	.06	.09	.49***	—					
	12 Resistance	.02	-.12*	-.09	-.01	.05	.20***	.31***	.10'	-.00	.29***	.53***	—				
Tobacco consumption variables	13 Cigarettes	-.31***	-.20***	-.06	.04	.04	.07	-.11*	-.13*	.11*	-.11'	-.10'	-.07	—			
	14 Desire	-.34***	-.18**	-.03	.03	.08	.08	-.08	-.11*	.09	.01	-.05	.02	.82***	—		
	15 Conflict	-.13*	.03	.03	-.04	.05	.14*	.02	.08	.05	.00	.12*	.11*	.19***	.42***	—	
	16 Resistance	-.14*	-.07	-.03	-.01	.06	.08	.05	-.07	.05	.11'	.09	.13*	.07	.24***	.51***	—

Note. ^{T} represents $p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. Significant correlations are bolded

Table 1. Physical and sedentary activity models. All coefficients are unstandardized. Significant coefficients are bolded. * $p < .05$, ** $p < .01$, *** $p < .001$. Numbers into brackets represent 95% confidence intervals.

	Independant variables	Indirect effects					Total effects				
		State self control capacity	Trait self control capacity	Desire	Conflict	Resistance	State self control capacity	Trait self control capacity	Desire	Conflict	Resistance
Baseline model	*Dependant variables*										
	Desire	-	-	-	-	-	-	**-.32*** [-.56; -.09]	-	-	-
	Conflict	-	**-.06*** [-.13; -.01]	-	-	-	-	**-.52**** [-.80; -.23]	**.20*** [.03; .35]	-	-
	Resistance	-	**-.20**** [-.34; -.09]	**.08*** [.01; .14]	-	-	-	**-.20**** [-.34; -.09]	**.08*** [.01; .14]	**.39**** [-.75; -.06]	-
	MVPA	-	-	-	-	-	-	**4.48*** [1.20; 7.13]	-	-	-
	Sedentary time	-	-.37	**-.07*** [-.18; -.01]	**-.34*** [-.75; -.06]	-	-	-.37	**1.67*** [.58; 3.00]	**-.34*** [-.75; -.06]	**-.87*** [-1.93; -.17]
Final model	Desire	-	-	-	-	-	**-.22**** [-.38; -.10]	-.20	-	-	-
	Conflict	**-.04*** [-.10; -.01]	-.04	-	-	-	**-.04*** [-.10; -.00]	**-.50**** [-.78; -.20]	**.20*** [.03; .35]	-	-
	Resistance	**-.02*** [-.04; -.00]	**-.19**** [-.33; -.08]	**.08*** [.01; .14]	-	-	**-.02*** [-.04; -.00]	**-.19**** [-.33; -.08]	**.08**** [.01; .14]	**.34**** [.26; .48]	-
	MVPA	-	-	-	-	-	**4.75**** [2.92; 6,88]	-	-	-	-
	Sedentary time	**-.37*** [-.84; -.10]	-.19	**-.07*** [-.18; -.01]	**-.34*** [-.75; -.06]	-	**-.37**** [-.84; -.10]	-.19	**1.67*** [.58; 3.00]	**-.34*** [-.75; -.06]	**-.87*** [-1.93; -.17]

Table 2. Healthy and unhealthy diet models. All coefficients are unstandardized. Significant coefficients are bolded. * p < .05, ** p < .01, *** p < .001. Numbers into brackets represent 95% confidence intervals.

	Independant variables	Indirect effects					Total effects				
		State self control capacity	Trait self control capacity	Desire	Conflict	Resistance	State self control capacity	Trait self control capacity	Desire	Conflict	Resistance
Baseline model	*Dependant variables*										
	Desire	-	-	-	-	-	-	**-.32*** [-.54; -.08]	-	-	-
	Conflict	-	**-.19*** [-.34; -.05]	-	-	-	-	**-.19*** [-.34; -.05]	**.61*** [.50 ; .71]	-	-
	Resistance	-	**-.09*** [-.16; -.02]	**.29*** [.22; .38]	-	-	-	**-.09*** [-.16; -.02]	**.29*** [.22 ; .38]	**.48*** [.39 ; .58]	-
	Healthy diet score	-	-	-	-	-	-	**1.23*** [.56; 2.02]	-	-	-
	Unhealthy diet score	-	**-.10*** [-.22; -.01]	-	-	-	-	**-1.18*** [-1.62; -.67]	**.32*** [.07 ; .60]	-	-
Final model	Desire	-	-	-	-	-	-	**-.31*** [-.54; -.08]	-	-	-
	Conflict	-	**-.19*** [-.34 ; -.05]	-	-	-	-	**-.19*** [-.34; -.05]	**.61*** [.09; 1.47]	-	-
	Resistance	-	**-.09*** [-.16 ; -.02]	**.29*** [.22; .38]	-	-	-	**-.09*** [-.16; -.02]	**.29*** [.22; .38]	**.48*** [.39; .59]	-
	Healthy diet score	-	-	-	-	-	**1.02*** [.65; 1.35]	**.74*** [.09; 1.47]	-	-	-
	Unhealthy diet score	-	**-.10*** [-.22 ; -.01]	-	-	-	-	**-1.17*** [-1.62; -.67]	**.32*** [.07; .60]	-	-

Table 3. Cigarette consumption model. All coefficients are unstandardized. Significant coefficients are bolded. * p < .05, ** p < .01, *** p < .001. Numbers into brackets represent 95% confidence intervals.

	Independant variables	Indirect effects					Total effects				
		State self control capacity	Trait self control capacity	Desire	Conflict	Resistance	State self control capacity	Trait self control capacity	Desire	Conflict	Resistance
Dependant variables											
Baseline model Desire		-	-	-	-	-	-	**-.81** [-1.05; -.58]	-	-	-
Conflict		-	**-.39** [-.56; -.24]	-	-	-	-	**-.39** [-.56; -.24]	**.49** [.35; .62]	-	-
Resistance		-	**-.20** [-.31; -.12]	**.25** [.15; .34]	-	-	-	**-.20** [-.31; -.12]	**.25** [.35; .62]	**.51** [.38; .64]	-
Number of cigarettes		-	**-.89** [-1.23; -.64]	**-.04** [-.07; -.02]	**-.08** [-.13; -.04]	-	-	**-.89** [-1.23; -.64]	**1.10** [1.00; 1.29]	**-.08** [-.13; -.04]	**-.16** [-.25; -.08]
Final model Desire		-	-	-	-	-	-	**-.81** [-1.05; -.58]	-	-	-
Conflict		-	**-.41** [-.59; -.26]	-	-	-	**.20** [.01 ; .36]	**-.41** [-.59; -.24]	**.51** [.37; .64]	-	-
Resistance		**.10** [.01 ; .19]	**-.21** [-.32; -.13]	**.26** [.16; .36]	-	-	**.10** [.01 ; .19]	**-.21** [-.32; -.13]	**.26** [.16; .36]	**.51** [.38; .64]	-
Number of cigarettes		**-.02** [-.04 ; -.00]	**-.89** [-1.23; -.64]	**-.04** [-.08; -.02]	**-.08** [-.13; -.04]	-	**-.02** [-.04 ; -.01]	**-.89** [-1.23; -.63]	**1.10** [1.00; 1.29]	**-.08** [-.13; -.04]	**-.16** [-.25; -.08]