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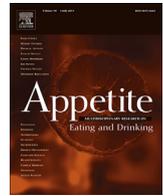


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The habitual nature of unhealthy snacking: How powerful are habits in adolescence?



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ABSTRACT

Many adolescents engage in unhealthy snacking behavior, and the frequency and amount of unhealthy consumption is increasing further. In this study, we aim to investigate the role that habit strength plays in unhealthy snacking during adolescence and whether self-regulation strategies can overcome habitual snacking. A total of 11,392 adolescents aged 10–17 years from nine European countries completed a cross-sectional survey about healthy eating intentions, snacking habit strength, eating self-regulation strategies, and daily intake of unhealthy snacks. The results showed that habit strength was positively associated with intake of unhealthy snack foods, also when healthy eating intentions were accounted for. Use of self-regulation strategies was negatively associated with unhealthy snacking. The interaction effect of habit strength and use of self-regulation strategies was significant. Strong snacking habits were associated with higher consumption, but this effect could be attenuated by use of temptation-oriented self-regulation strategies. The present study highlights that habit strength is associated with unhealthy snacking already in adolescents. The findings suggest that teaching self-regulation strategies may help adolescents to overcome unhealthy snacking habits.

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1. Introduction

The steep rise in overweight and obesity prevalence among children and adolescents has led to concern (Livingstone, 2001; Ogden et al., 2006). Overweight early in life is associated with a number of adverse physical and mental health outcomes in youth, but also later in life (Bell et al., 2011; Wang, McPherson, Marsh, Gortmaker, & Brown, 2011). Further, overweight children and adolescents tend to become overweight adults (Bayer, Krüger, von Kries, & Toschke, 2011; Kvaavik, Tell, & Klepp, 2003).

Unhealthy diets are contributing to overweight, as well as to other health outcomes, and it has been suggested that particularly snack foods consumed between meals contribute to an unhealthy diet. A number of studies indicated that snack consumption (i.e., foods eaten in between meals) is associated with overweight (Berteus Forslund, Torgerson, Sjöstrom, & Lindroos, 2005; Howarth,

Huang, Roberts, Lin, & McCrory, 2007; McDonald, Baylin, Arsenault, Mora-Plazas, & Villemor, 2009). Moreover, snack consumption is associated with diets of poor nutritional quality because snacking patterns typically includes the consumption of high energy-dense foods that are rich in sugar or saturated fat (Feeley, Musenge, Pettifor, & Norris, 2012; Santaliestra-Pasias et al., 2014; Sebastian, Cleveland, & Goldman, 2008).

Snacking is a typical eating behavior that many adolescents engage in. Estimations suggest that approximately 25%–35% of the total daily energy intake of adolescents results from snacking (Dwyer et al., 2001; Jahns, Siega-Riz, & Popkin, 2001; Piernas & Popkin, 2010; Sebastian et al., 2008). Furthermore, snacking incidence has increased in all age groups including adolescents (Jahns et al. 2001; Nielsen, Siega-Riz & Popkin, 2001). It has been suggested that in the U.S. the proportion of people who consume three or more snacks a day has increased fourfold since the 1970s (Cleveland, Goldman, & Moshfegh, 2005). In addition to an increase in snacking frequency, sizes of the consumed portions have increased as well (Kerr et al., 2009). Importantly, the increase in snacking typically reflects an increase in snacking of unhealthy foods (i.e., savory and sweet snacks). This has contributed to an

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increase in total energy intake and energy intake from added and total sugars in the past decades (Larson & Story, 2013). Taking into account that snacking patterns that are formed during childhood continue into adulthood, it is important to establish healthy eating patterns early in life. Hence, reducing the consumption of unhealthy snacks has been recommended to promote good health (e.g., Loyd-Williams, Mwatsama, Ireland, & Capewell, 2008). In order to do so, it is important to gain insight into the origins of adolescent snacking.

Habit strength may play an important role in eating behaviors (Brug, De Vet, De Nooijer & Verplanken, 2006; Conner, Perugini, O’Gorman, Ayres, & Prestwich, 2007; Verhoeven, Adriaanse, Evers, & De Ridder, 2012; Weijzen, De Graaf, & Dijksterhuis, 2009). Although in colloquial language in the food domain the term habits is often used to refer to eating patterns (Van’t Riet, Sijtsema, Dagevos, & de Bruijn, 2011), habits involve more than just repeated behaviors (Verplanken, 2006). Habits are defined as automatized patterns of behavior in response to a particular situation or external cue (Aarts & Dijksterhuis, 2000; Aarts, Verplanken, & Van Knippenberg, 1998; Ouellette & Wood, 1998). Habits are formed when people repeatedly engage in the same behavior in the same context. For example, when someone regularly eats chocolate while watching a movie, this behavior (eating chocolate) can become a habit, automatically elicited by the specific situation (watching a movie). A large part of our daily behavior is assumed to be habitual because they reflect repeated behaviors performed in a similar context every day, including dietary behaviors (Wood, Quinn, & Kashy, 2002). Eating is something that most people do on a daily basis, and meals and snacks are often consumed at the same place and time every day. A meta-analysis indeed demonstrated that habit strength correlated moderately to strongly with dietary behaviors. Further, the effect size of habit strength was similar to the effect sizes found for major common predictors of dietary behaviors in general, such as intentions (Gardner, De Bruijn, & Lally, 2011). In relation to unhealthy snacking, the role of habit strength in snacking was further established in a prospective study among a representative community sample, which showed that habit strength was the most important predictor of unhealthy snack intake and that habit strength outperformed intentions to eat healthily (Verhoeven et al., 2012). The above findings underscore the importance of habit strength in eating and snacking, but it remains unknown whether snacking has already become habitual during adolescence, and whether habit strength is as strongly associated with snacking in adolescents as it is in adults. This is important to know, because once habitual cue-response associations have been formed, these are difficult to break. Moreover, if snacking proves habitual in adolescents, this would require different type of interventions than the interventions aiming to improve healthy eating intentions that are usually developed for adolescents (Lally & Gardner, 2013). Therefore the main aim of the present study was to identify the association between habit strength and unhealthy snack intake in adolescents.

If snacking is already associated with habit strength among adolescents, then the question arises whether adolescents are capable of overruling these habits. Research has demonstrated that adolescents possess skills and use strategies that help them limit their unhealthy food intake (De Vet et al., 2014; Stok, De Vet, De Ridder, & De Wit, 2012). Use of such self-regulation strategies (e.g., temptation control, avoidance of temptations, distraction, suppression, goal setting and goal deliberation) have been found to attenuate the negative influence of access to tempting foods (De Vet, De Wit, Luszczynska et al., 2013). Adolescents who used these strategies were better able to deal with a tempting food environment than those who were less equipped with self-

regulatory tools (De Vet et al., 2013). If self-regulation strategies attenuate the appeal of food cues in the environment, this may also be of relevance for the relation between habits and snacking since habits are in essence an automatized response to a food cue. Therefore, we also aim to investigate whether self-regulation strategies are useful in reducing the number of consumed unhealthy snacks, independent of the habit strength to consume unhealthy snack foods. Finally, we aim to investigate whether self-regulation strategies may attenuate the association between habit strength and snacking. Once habits are formed, self-regulation strategies may be helpful in reducing the impact habit strength has on actual snack intake.

In sum, the present examines to what extent unhealthy snacking is already habitual in adolescents, and whether adolescents possess strategies that may help them to overrule the habitual nature of snacking. Hereto, a cross-sectional study was conducted among a large and diverse sample of adolescents in nine European countries.

2. Methods

2.1. Participants, design and procedure

For this study, we used cross-sectional data derived from the Tempest survey (See also De Vet et al., 2014), a survey on eating behaviors among 10–17-year old European adolescents. The survey was administered in 2010. Data were collected in schools in nine European countries (The Netherlands, Belgium, Germany, UK, Finland, Denmark, Poland, Portugal and Romania); selected to represent a range of socio-economic and socio-cultural backgrounds. Schools were selected to represent variety in rural and urban regions as well as higher and lower socioeconomic status (SES) areas.

The data collection protocol complied with the ethical guidelines in each country (i.e., when medical ethical approval was required, approval was established). Passive (i.e., participation unless objection is made by signing the opting-out form) or active (i.e., participation only upon signing the opting-in form) consent from adolescents and their parents was obtained, depending on the guidelines from each country’s ethical review board.

Adolescents aged 10 to 17 were asked to complete the questionnaire in one session at school in the classroom setting. For the present study, we use information about background characteristics, self-regulation strategies for eating, the extent to which snacking is habitual, and snack consumption. Completing the questionnaire took approximately 30 min. Schools were allowed to choose between computer-based or paper-and-pencil questionnaires. Of the total sample, 15.3% of the (pre-) adolescents completed a computerized version of the questionnaire.

A total of 121 schools participated, with 58.5% of these schools located in urban areas and 52.5% of these schools being situated in areas with a high socio-economic status. The questionnaire was completed by 11,392 adolescents. Mean age was 13.21 years ($SD = 2.00$). A total of 23.3% of the sample was 10 or 11 years old, 34.0% were 12 or 13 years old, 27.0% were 14 or 15 years old, and 15.8% were 16 or 17 years old.

Of the sample, 50.5% were girls, and 90.7% spoke the country’s national language as their primary language at home. Of the respondents, 13.0%, 39.3% and 47.8% were from low, middle or high affluent families. The majority of the sample had a normal weight (74.8%). A total of 10.5% were classified as underweight, 12.5% as overweight, and 2.1% as obese according to age-adjusted BMI categories used by the International Obesity Task Force (Cole, Bellizzi, Flegal et al., 2000).

2.2. Measures

Perceived healthiness of current diet was assessed with one item, i.e., “What do you think of your diet?” (1 = I eat very unhealthy, 5 = I eat very healthy) for descriptive purposes.

Healthy eating intentions was assessed with four items conform earlier research among adolescents on eating behavior (Stok et al., 2015). Example items are. “I would like to eat healthier and “I intend to eat healthier” (1 = strongly disagree, 5 = strongly agree). The internal consistency was satisfying (Cronbach's alpha $\alpha = .75$) and a mean score was computed.

Habit strength was assessed with six items from the self-reported habit index (SRHI) (Verplanken & Orbell, 2003), comprising two core elements of the SRHI (i.e., frequency and automaticity) and adapted to snacking behavior. Self-identity (the third component of the SRHI) was not assessed, as self-identity is not an essential component of habit (See for a discussion: Gardner, Abraham, Lally & De Bruijn, 2012; Sniehotta & Presseau, 2012) and may even reflect a distinct concept that impacts on behavior in a different way than habits do (Gardner, De Bruijn, & Lally, 2012). The self-reported habit index has been used before in adolescents (Kremers, van der Horst, & Brug, 2007). Sample items are ‘unhealthy snacking is something I do frequently’ and ‘unhealthy snacking is something I do without thinking’ (1 = strongly disagree, 5 = strongly agree). Internal consistency was good (Cronbach's alpha = .86) and a mean score was computed.

Self-regulation strategies for eating were assessed with the TESQ-E. This is a 24-item instrument to assess dietary self-regulation strategies that has been validated among adolescents (De Vet et al., 2014). Individuals are asked to rate on a five-point Likert scale ranging from 1 (never) to 5 (always) how often they use six specific self-regulation strategies which represent three broader categories. Each category includes two strategies which are assessed with four items each, and a mean score was calculated for each category. The first category reflects strategies for *addressing the food environment* directly and includes items describing temptation control and avoidance (Cronbach's alpha = .83). The second reflects strategies for *changing the meaning of the food environment*, and includes items describing distraction and suppression (Cronbach's alpha = .86). The third reflects strategies for *addressing the goal to eat healthily* and includes items describing goal and rule setting and goal deliberation (Cronbach's alpha = .86). Mean scores were computed for the three categories of self-regulation strategies separately.

Unhealthy snack intake was assessed with one item asking “How many snacks do you eat on an average day? (conform earlier research in adolescents; De Vet et al., 2013; Lally, Bartlett, & Wardle, 2011) Adolescents were asked to indicate consumption on a six-point scale ranging from 0 (none or less than 1 per day) to 5 (more than 4 per day). Unhealthy snacks had to be reported in number of snacks and examples of country-specific unhealthy snacks were provided. It was explained what would count as one snack.; e.g., a handful of crisps, a candy bar, a sausage roll).

3. Results

Descriptives and Associations between unhealthy snack intake, healthy eating intentions, habit strength and self-regulation strategies.

Participants perceived their diet as moderately healthy ($M = 3.28$, $SD = .79$) and generally had positive intentions to eat healthier ($M = 3.56$, $SD = .77$) Habit strength was moderate and participants sometimes to regularly used the eating self-regulation strategies. Participants reported to consume on average 1.91 ($SD = 1.43$) unhealthy snacks per day.

Based on Cohen's (1988) interpretation of effect sizes, the correlations between healthy eating intentions and habit strength, between healthy eating intentions and unhealthy snack intake, and between habit strength and the different categories of self-regulation strategies can be considered weak (r 's $\leq .30$). The correlations between healthy eating intentions and the different categories of self-regulation strategies, between self-regulation strategies addressing the food environment directly, strategies changing the meaning of the food environment and unhealthy snack intake, and between habit strength and unhealthy snack intake can be considered moderate (r 's between .30 and .50). The three categories of self-regulation strategies correlated strongly (r 's $> .50$; see Table 1).

3.1. Associations between background characteristics and habit strength

Table 2 presents results of multiple linear regression analyses with habit strength as the dependent variable and age, sex, family affluence, immigrant status and weight status as independent variables. The results showed that age, family affluence and weight status were statistically significantly associated with habit strength, but sex and immigrant status were not. Older adolescents, adolescents from low as compared to high affluent families, and overweight or obese adolescents, reported the strongest unhealthy snacking habits, though family affluence and weight status were only very weakly associated with habit strength.

3.2. Multiple linear regression analyses of unhealthy snack intake

Multiple linear regression analyses were conducted with unhealthy snack intake as the dependent variable. In step 1, background characteristics were included in the regression model. In step 2 healthy eating intentions were entered, followed by habit strength and three categories of self-regulation strategies in step 3 and 4, respectively. In the final step, step 5, the interactions between habit strength and the three categories of self-regulation strategies were added to the regression model. All variables were standardized before being entered in the model (see Table 3).

In step 1, it was found that older adolescents, boys, adolescents from low affluent families compared to medium and high affluent families, immigrants and non-overweight adolescents reported to eat more unhealthy snacks. The results showed that in step 2 healthy eating intentions were significantly associated with a lower intake of unhealthy snacks. Whereas healthy eating intentions remained negatively associated with snack intake in step 3, habit strength was more strongly and positively associated with snack intake. In step 4, healthy eating intentions and habit strength remained significantly associated with unhealthy snack intake. Unhealthy snack intake was further associated with three

Table 1

Means (M), standard deviations (SD) and bivariate Pearson correlations between healthy eating intentions, habit strength, self-regulation strategy use and unhealthy snack intake.

	1	2	3	4	5	6
Healthy eating intentions (1)	–	–.14	.37	.39	.48	–.18
Habit strength (2)		–	–.30	–.23	–.25	.34
Action towards temptations (3)			–	.71	.69	–.36
Change meaning of temptations (4)				–	.76	–.33
Action towards goals (5)					–	–.28
Unhealthy snack intake (6)						–
M	3.56	2.66	2.36	2.30	2.50	1.91
SD	0.77	0.90	0.87	0.85	0.93	1.43

All p -values are below $<.001$.

Table 2

The association between background characteristics and habit strength for unhealthy snacking.

	B	SE (B)	β	p
Age (in years)	.07	.01	.16	<.001
Gender (1 = boy, 2 = girl)	-.001	.02	.000	.96
Middle (=1) versus Low (= 0) family affluence	-.04	.03	-.02	.17
High (=1) versus Low (=0) family affluence	-.11	.03	-.06	<.001
Immigrant status (0 = non-immigrant, 1 = immigrant)	.05	.03	.02	.10
Overweight (1 = overweight or obese, 0 = non-overweight)	.11	.03	.04	<.001

Model F (6, 9338) = 47.46, $p < .001$, $R^2 = .03$.**Table 3**

Stepwise multiple linear regression analyses with unhealthy snack intake as dependent variable.

Variables in the regression model	Step 2		Step 3		Step 4		Step5	
	B	P	B	p	β	P	β	p
Healthy eating intentions	-.17	<.001	-.12	<.001	-.02	.036	-.02	.093
Habit strength			.32	<.001	.26	<.001	.25	<.001
Action towards temptations					-.20	<.001	-.20	<.001
Change meaning of temptations					-.17	<.001	-.18	<.001
Action towards goal					.06	.001	.05	.001
Habit strength \times action towards temptations							-.03	.051
Habit strength \times change meaning of temptations							-.03	.047
Habit strength \times action towards goals							.003	.87
Model F	F (7, 9095) = 57.15		F (8, 9095) = 186.34		F (11, 9095) = 218.42		F (14, 9095) = 174.82	
R ²	.04		.14		.21		.21	

Note. Step 1: Age ($\beta = .09$, $p < .001$), gender ($\beta = -.05$, $p < .001$), medium versus low affluence ($\beta = -.06$, $p = .001$), high versus low affluence ($\beta = -.08$, $p < .001$), immigrant status ($\beta = .04$, $p < .001$) and overweight status ($\beta = -.05$, $p < .001$). Model F (6, 9095) = 25.03, $p < .001$. $R^2 = .02$.

categories of self-regulation strategy use, in particular strategies that address the food environment directly and strategies that change the meaning of the food environment. This suggests that irrespective of the extent to which snacking is habitual, use of self-regulation strategies is associated with a lower intake of snacks, and vice versa: irrespective of the frequency with which self-regulation strategies are used, stronger habits are associated with higher intake of snacks. In step 5 it was found that in addition to habit strength and self-regulation strategy use, the interaction between habit strength and dealing with the food environment directly and the interaction between habit strength and changing the meaning of the food environment were (borderline) significant. No significant interaction between habit strength and addressing the goal to eat healthily directly was found.

3.3. Interaction between habit strength and self-regulation strategy use

Next, simple slope analyses (cf. Aiken & West, 1991) were conducted to decompose the interaction between habits and self-regulation strategy use. Linear regression analyses were used to evaluate the association between habits and snack consumption, for low ($M + 1SD$) and high ($M - 1SD$) levels of self-regulation strategy use. First, the interaction between habit strength and strategies addressing the food environment directly was decomposed, followed by the interaction between habit strength and strategies changing the meaning of the food environment. In the simple slope analyses, only the standardized variables of habit strength and self-regulation strategies were entered, no control variables were included.

In participants with a low use of strategies dealing with the food environment directly, habit strength was positively associated with snack intake (Intercept = 2.30, $B = .42$, $SE (B) = .02$, $CI (B) = .39-.45$, $p < .001$). In participants with a high use of strategies dealing with the food environment directly, habit strength was positively but less strongly associated with snack intake (Intercept = 1.47, $B = .30$, $SE (B) = .02$, $CI (B) = .26-.33$, $p < .001$).

In participants with a low use of strategies changing the meaning of temptation, habit strength was positively associated with snack intake (Intercept 2.28, $B = .46$, $SE (B) = .02$, $CI (B) = .43-.49$, $p < .001$). In participants with a high use of strategies changing the meaning of the food environment directly, habit strength was positively but less strongly associated with snack intake (Intercept = 1.50, $B = .33$, $SE (B) = .02$, $CI (B) = .30-.37$, $p < .001$).

See Figs. 1 and 2 for a graphical depiction of the interaction between habit strength and self-regulation strategies dealing with the food environment and strategies changing the meaning of the food environment, respectively.

4. Discussion

The present study illustrates that habit strength is an important correlate of unhealthy snack intake already in adolescents. Habit strength increases with age. The results are remarkably comparable

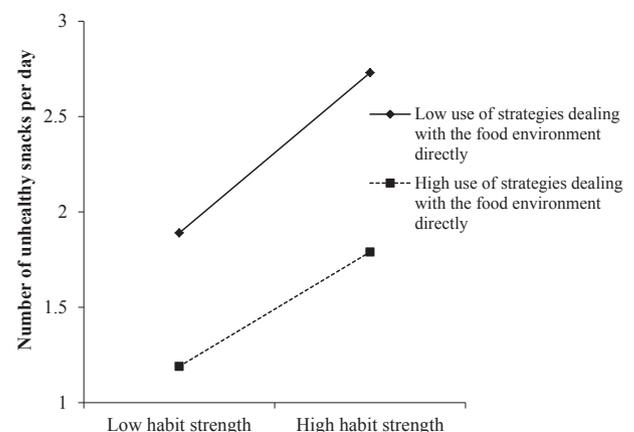


Fig. 1. Interaction between habit strength and use of strategies dealing with the food environment directly.

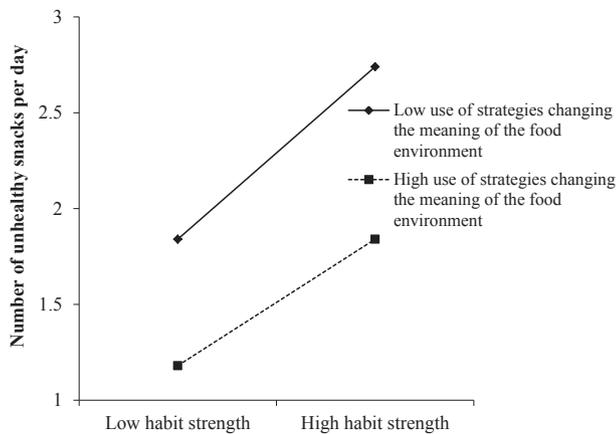


Fig. 2. Interaction between habit strength and use of strategies changing the meaning of the food environment.

to those found in studies with adults. The strength of the unhealthy snacking habit in the present sample ($M = 2.66$; $SD = .90$) was comparable to the habit strength in a representative community sample of adults (Verhoeven et al., 2012; $M = 2.46$, $SD = 1.30$). Further, the correlation between habit strength and unhealthy snacking is comparable to those found in adult samples (e.g., Adriaanse, de Ridder, & Evers, 2011; Conner et al., 2007; Verhoeven et al., 2012). Also similar to studies in adults is the finding that habit strength outperforms healthy eating intentions in such a way that despite good intentions to do otherwise habits lead to the unwanted performance of behavior. Now that the present study identifies habit strength as an important correlate of unhealthy snack intake, a next step would be to gain understanding of why and how adolescents develop habits. Adolescence is characterized by a search for autonomy. Research indicated that a typical means for adolescents to attain and express autonomy is by purchasing unhealthy snacks (Stok, De Ridder, Adriaanse, & De Wit, 2010). Unhealthy snacking is thus valued by adolescents and reflects a common volitional behavior, which may gradually develop into habits that may become unwanted at a later point.

Habits are hard to change once formed, so it is worrisome that snacking has become habitual already at such a young age. Habits can be formed in relatively short periods of time (Lally, Wardle, & Gardner, 2011) and apparently this process may already take place during adolescence. Fortunately, people are not slaves to their impulses and unwanted habits. Even though habits may have been formed at a young age and are associated with unhealthy snack intake, self-regulation strategies appear important in reducing the intake of unhealthy snacks. These findings suggest that also adolescents with strong habits to snack unhealthy can simultaneously apply strategies that could contribute to limiting one's snack intake. This idea is further illustrated by the finding that particularly self-regulation strategies dealing with the food environment or strategies changing its meaning seem to slightly attenuate the association between habit strength and unhealthy snack intake. Adolescents who apply these cue-driven self-regulation strategies regularly may be less influenced by their habits to snack unhealthy. Although the interaction effect is small and the impact of habits on unhealthy snack intake does not disappear, the reduction is of relevant magnitude. For adolescents with a strong habit of unhealthy snacking, high users of self-regulation strategies consume about one daily serving of snacks less than low users of self-regulation strategies. Interestingly this was only found for strategies that help individuals to deal with the food environment, but not for self-regulation strategies that address the goal to eat

healthily. This begs the question how exactly habit strength and self-regulation are related. The cross-sectional design of the present study cannot shed light on the underlying processes that explain the negative correlation between self-regulation and habits. It might be that habits impede the use of (specific types of) self-regulation strategies. Yet, it might also be that with using self-regulation strategies, people may prevent that habits are established in the first place. Further, self-regulation strategies may interfere with the execution of habits once a cue is encountered that would normally elicit the learned response. For example, if one has the habit to eat chocolate (habitual response) when watching television (situational cue), one might apply the temptation avoidance strategy to make sure that chocolate are not bought in large quantities. Alternatively, use of self-regulation strategies may prevent that people encounter particular cues that would elicit habitual responses. Relating to the same example, one might apply self-regulation by postponing switching on the television. Although habit strength correlated weakly with self-regulation strategies, suggesting that they are independent constructs, one would expect that good self-regulation will over time gradually lead to weaker habits. Habituation occurs when repeatedly the same behavior is performed in the same context. If self-regulation strategies repeatedly interfere in the cue-response association, eventually extinction may occur. In a prospective study among a representative community sample, some preliminary evidence was found for this notion. Those with better pro-active coping skills (a concept related to self-regulation) reported weaker habits to snack unhealthy one month later (Maas, De Ridder, De Wit, & De Vet, 2014). Future experimental research should shed more light on the relation between self-regulation and habit.

The present study bears practical implications. Given the association between habit strength in adolescent snacking behavior, it is important to acknowledge the habitual character of snacking in dietary interventions for adolescents. Perhaps self-regulation strategies are easier taught, than unwanted habits are broken. Training of self-regulation strategies may provide an interesting avenue for future interventions, which may eventually also lead to weaker habits.

Some strengths and limitations of the present study need to be acknowledged. The cross-sectional design of the study limits the possibility to identify causal relationships. Further, the use of self-report measures for self-regulation, habit strength and unhealthy snack intake is an important limitation. People may not always be fully aware of their habits and behaviors, which make these measures vulnerable to recall bias. Yet, we used the SRHI which is a well-established measure to assess self-reported habits. Further, the average snack intake found in the present study is very comparable to the snack intake found in earlier studies among adolescents (Jahns et al., 2001; Macdiarmid et al., 2009). The present study was conducted among a large and diverse sample of adolescents from nine European countries, and is one of the first studies to explore habit strength in adolescents as well as to investigate self-regulation strategies and habits simultaneously.

To conclude, the present study highlights the importance of habit strength in unhealthy snacking by adolescents, but also identifies self-regulation strategies as a means to deal with unhealthy snacking habits.

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