The consequence of self-regulation failure within a new perspective: an exploratory study on the generalizability of the snowball effect of self-regulation failure to the domain of physical exercise

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Abstract

The present study was designed to test the generalizability of recent findings on the snowball effect of self-regulation failure to the domain of physical exercise. An initial instance of failure of exercise goal related behavior, opposed to initial instance of success, was hypothesized to increase the likelihood of subsequent self-regulation failure. This effect was expected to be moderated by the formation of maladaptive attributions about initial failure, especially at the absence of a justification for the failure. A vignette study was executed, where initial failure versus initial success was manipulated, and a justification was added versus left out to manipulate formation of attributions. Female participants indicated the likelihood of subsequent failure for two self-regulation dilemmas. An initial instance of failure was indeed demonstrated to snowball into subsequent failure, but only for participants who read the vignettes about another person. This snowball effect of self-regulation failure was not moderated by adding or leaving out a justification for the initial failure. A first indication of high habit strength as a protective mechanism against the detrimental snowball effect was found. The present research provided the first suggestion that the findings on the snowball effect of self-regulation failure are generalizable to the domain of physical exercise, underlining the relevance of the effect across domains. To gain more insight into the snowball effect of self-regulation failure in behavior of people themselves, research is recommended to further investigate the effect in actual behavior.

*Keywords***:** Snowball effect; self-regulation failure; attributions; physical exercise; habit strength.

Self-regulation is a hot topic in health psychology, functioning as a key system in regulating our behavior in a healthy manner. But the self-regulation system is also known for its failure in regulating our behavior successfully towards our goals. Instances of failure are both common and inevitable, but fortunately an instance of failure is trivial. However, recent research that focuses on the aftermath of self-regulation failure, shows that the response to the initial instance of failure can pose a threat for long-term self-regulation success. Three main lines of research on the aftermath of failure of self-regulation failure have been proposed. First of all, the abstinence violation effect, build on the concept of attributions, shows how a singular lapse in substance use after a period of abstinence can lead back to regular drug use. The abstinence violation effect has only been studied in specific samples of addicts, and does not involve everyday self-regulation behaviors. Secondly, the 'what the hell' effect proposed that when restrained eaters made a single diet violation, this led to subsequent failure in keeping their diets. This line of research has only been investigated in the domain of eating and in samples of restrained eaters, limiting generalizability to broader samples. The third line of research on the snowball effect of self-regulation failure states that failure leads to subsequent failure, specifically through a decrease in self-efficacy. This line of research involves a broader sample and an everyday behavior, but still fails to test the effect outside the domain of eating. In the present paper we therefore extend the research on the snowball-effect of self-regulation failure, by testing the generalizability of recent findings to the domain of physical exercise.

Acting in a healthy manner involves initiating healthy behaviors (e.g. exercising) and inhibiting unhealthy behaviors (e.g. consuming alcohol). In order to attain successful initiation and inhibition of health behaviors one must resist impulses, which are craving desires to consume a particular item or to engage in a behavior that captures your attention (Kelley, Wagner, & Heatherton, 2015; Wagner & Heatherton, 2015). Doing so is difficult, as

can be witnessed by the about one in five occasions where people fail to resist their desires (Hofman, Vohs, & Baumeister, 2012). Fortunately, humans dispose of a system called *self-regulation,* which enables the self to alter or control its thoughts, behaviors, emotions, and desires in accordance to some standards, ideals, or goals, either stemming from internal or societal expectations (Baumeister, Vohs, & Tice, 2007; Kelley et al., 2015; Wagner & Heatherton, 2015). When individuals are successful in self-regulating their behavior, they manage to forego the immediate gratification offered by giving in to impulses, and in turn behave in favor of a long-term goal (Baumeister & Heatherton, 1996; Kelley et al., 2015). To accomplish this, they use a variety of self-regulation strategies, such as mental contrasting and implementation intentions (Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011; Gollwitzer, 1999; Gollwitzer & Sheeran, 2006).

The ability to self-regulate or to make use of various self-regulation strategies has been shown to lead to positive outcomes, such as in the domain of health behavior (e.g. physical exercising and condom use) (e.g. Galliot & Baumeister, 2007; Hagger, Chatzisarantis, & Biddle, 2002), academic performance (e.g. Neuenschwander, Röthlisberger, Cimeli, & Roebers, 2012), cessation of substance use (e.g. Murgraff, Walsh, & McDermott, 2000), mental health (e.g. Kelley et al., 2015), and interpersonal relationships (e.g. Vohs & Ciarocco, 2004).

Still, the positive relation between self-regulation abilities and goal directed behavior does not imply that individuals always succeed in regulating their behavior towards their goals. In fact, the failure of self-regulation, referring to acting out the impulse and thus violating the person's standards, is actually common and can be the consequence of several circumstances (Baumeister & Heatherton, 1996). Important situations preceding the failure of regulating one self's behavior are exposure to highly tempting cues, impaired or absent self-regulation, and depletion of self-regulatory resources (Kelley et al., 2015). In these difficult

situations our ability to self-regulate often does not suffice to direct behavior in line with one's long-term goals. In fact, one could argue that failure to self-regulate in the long term contributes to various societal problems, such as obesity, drug abuse, alcohol abuse, and increased crime and violence (e.g. Baumeister et al., 2007; Baumeister & Heatherton, 1996; Gottfredson & Hirschi, 1990; Kelley et al., 2015).

With regard to the detrimental effects of failing to self-regulate, scholars have devoted a lot of attention to factors predicting failure as well as teaching individuals strategies to improve their ability to self-regulate. This has met with some success, as for example was witnessed in the progress of successful goal pursuit of adolescents after a mental contrasting and implementation intentions intervention (Duckworth et al., 2011). Still, it is evident that self-regulation can be found in many domains and most likely occurs on a daily basis (e.g. Baumeister & Heatherton, 1996; Baumeister et al., 2007; Gottfredson & Hirschi, 1990; Kelley et al., 2015). People try to pursue multiple goals in their daily life, such as getting in shape, excelling in their career, and maintaining relationships. These goals can be conflicting with each other, increasing the risk of failure of behaving in line with your goals. For instance, the goal to pass your study might require late night study sessions, while the goal to improve your sleep quality requires going to bed on time. In addition, the capability of behaving in line with our goals is dependent on the execution of self-control, which relies on a limited, consumable resource. This resource decreases through self-control efforts, making subsequent attempts to exert self-control more likely to fail (Muraven & Baumeister, 2000). Evidently, behavior violations in long-term goal striving are both common and inevitable. Fortunately, a single instance of self-regulation failure in itself is trivial, as for example a single short night of sleep does not have a tremendous impact on your long-term sleeping goal. However, as argued by Baumeister and Heatherton (1996), experiencing a goal violation can set a chain of attributions, thoughts, and subsequent behaviors into motion that can be detrimental to long-

term self-regulation success. To address this notion that the response of people to an initial instance of self-regulation failure holds relevant implications for research on self-regulation failure, recently researchers have also been dedicating their attention to how people respond to failure. Three main lines of research that create more insight in the aftermath of an initial instance of self-regulation failure exist: the abstinence violation effect, the 'what the hell effect', and the more recent snowball effect of self-regulation failure. An elaboration on these three research lines will follow.

The first line of research focuses on the consequence of failure in people trying to quit addictive behaviors. Namely, it has been shown that a singular lapse in substance use following on a period of abstinence can lead back to regular use of drugs or alcohol (Collins & Lapp, 1991; Stephens, Curtin, Simpson, & Roffman, 1994). Marlatt and Gordon (1985) first proposed a relapse model for the responsible dimensional construct, which consists of a cognitive attribution of causality for the lapse and an affective reaction to the attribution. The resulting cognitive affective reaction to an initial slip in abstinence is better known as the *abstinence violation effect (*AVE), and is an important determinant of whether the initial slip will escalate into a full-blown relapse. This effect is even called one of the seven deadly threats to self-regulation by Wagner and Heatherton (2015). The AVE was built on the concept of attributions, which stems from attribution theory; attributions are used in making causal explanations concerning people's own and other people's behavior (Aronson, Wilson, & Akert, 2004; Kelley 1973). The realization of acting against one's own standards and goals, like breaking abstinence, can trigger a negative affective response (Adriaanse, Weijers, De Ridder, De Wit Huberts, & Evers, 2014). This feeling of inconsistency and discomfort, known as cognitive dissonance, leads to the need to make the inconsistent thoughts and behaviors consistent again (Festinger, 1962). Oetingen, Grant, Smith, Skinner, & Gollwitzer (2006) for example found that when behavior could not be explained by a conscious goal or normative

explanations, and thus was norm-violating, negative affect arised. Building on this research, Adriaanse et al. (2014) demonstrated that the negative affect due to inconsistency caused people to fulfill the need for an explanation by *confabulating* reasons; making false claims without the intent to deceive and without knowing that this claim is ill-grounded. It is quite common of people to be inaccurate about influences on their preferences and judgements (Bar-Anan, Wilson, & Hassin, 2010; Nisbett & Wilson, 1977). Adding to that, people can misattribute their actions to the wrong causes, due do not being aware of the actual cause of their behavior (e.g. Bar-Anan et al., 2010; Bem, 1972; Festinger & Carlsmith, 1959; Gazzaniga, 1985; Schachter & Singer, 1962). Misattribution of internal states leads to inaccurate self-knowledge. This can even affect subsequent behavior, since it was demonstrated that people act consistently with their misattributed states (Bar-Anan et al., 2010). This was also shown in experiments concerning AVE by Curry, Marlatt, and Gordon (1987). In their successful attempt to extend the old relapse model, the AVE was operationalized as a combination of internal, stable, and causal attributions. It was shown that the intensity of AVE increases when causal attributions have an internal, global, and stable focus, like “I relapsed into drug use, because I am too weak”. When similar reactions to an initial lapse are incorporated into the self-concept, it will create a self-fulfilling prophecy effect, and chances of relapse in subsequent high-risk situations increase. On the contrary, attributions with an external, specific, and unstable focus decrease the intensity of AVE and in turn decrease the probability of a full-blown relapse. An external, specific, and unstable attribution could be as follows: “I relapsed into drug use, because a death in the family put a lot of stress on me.”. Although the findings on AVE provide relevant experimental evidence on a how a single instance of failure can increase the risk of subsequent instances of failure, addiction cannot be considered an everyday health behavior and involves a specific part of the population.

The second line of research, studying the consequence of a single instance of failure, concerns the 'what the hell effect': temporary violations of one's standards can elicit a wholesome abandonment of self-regulatory goals (Wagner & Heatherton, 2015). That is, a first failure of self-regulation (e.g. eating cake while being on a diet) can actually lead to an increased chance of failure in a subsequent self-regulation dilemma (e.g. getting fast food for dinner that same night). Herman & Mack (1975) first observed this effect in restrained eaters. Subjects were told to partake in a tasting experiment where they would or would not get a milkshake preload before they were asked to taste ice-cream. While unrestrained eaters did regulate for a milkshake preload by eating less ice-cream, subjects classified as restrained eaters surprisingly failed to do the same. The fact that restrained eaters ate even more ice-cream after consummation of a preload, compared to the non-preload condition, suggests counterregulation taking place; restraint seemed to lead to overeating. Especially remarkable, was the occurrence of this effect when restrained eaters only *thought* to have overeaten. Based on these findings, the effect was concluded to be cognitive in nature and was characterized as a dichotomous thinking style: all or none reasoning. In subsequent studies disinhibitive thoughts such as: "I have blown my diet, I might as well continue to eat", were found and were thought to be responsible for the occurrence of the counterregulation in restrained eaters (Polivy & Herman, 1976; Polivy & Herman, 1985; Spencer & Fremouw, 1979). The disinhibited pattern of eating after breaking the restraint has been replicated in multiple subsequent studies (e.g. Heatherton, Herman, & Polivy, 1992; Heatherton, Polivy, & Herman, 1991; Heatherton, Polivy, Herman, & Baumeister, 1993). While Jansen, Merkelbach, Oosterlaan, Tuiten, and Van den Hout (1988) were able to replicate the study of Herman and Mack, they failed to find experimental confirmation for the concept of disinhibitive thoughts to disinhibit restrained eaters, and they perceived non-regulation rather than counterregulation due to disinhibitive thoughts. In sum, although the research on the 'what the hell' effect does

focus on an everyday self-regulation behavior, the studies made use of samples of extreme eaters and tested the effect in specific artificial settings. Therefore, it still fails to allow generalization to a broader population and context. Furthermore, the various findings on the occurrence of the 'what the hell effect' and the involved underlying mechanisms are not in line with each other, limiting the evidence.

More recently, building on the former two research lines, Adriaanse and Ten Broeke (2019) proposed that a single instance of failure increases the likelihood of subsequent failure through the tendency to have maladaptive attributions that can spill over to subsequent events. This effect is referred to as the *snowball effect of self-regulation failure.* The formation of maladaptive attributions, which are internal, stable, and specific explanations, were expected to increase chances of subsequent failure especially when people have no situational explanation for the initial failure. Four studies were designed, where the response of non-restrained female eaters to failure of acting in line with an eating goal was measured in hypothetical manipulated situations as well as retrospective reports of real-life behavior. The study showed that participants indeed seemed to recognize the danger of a single instance of failure, as their estimates of subsequent failure increased after an initial instance of failure, compared to an initial instance of success. This was shown for both participants who were reading the hypothetical situations about others and for participants who were reading the hypothetical situations about themselves, and was also found for the measures focused on actual behavior. Surprisingly. the snowball effect of self-regulation failure was not found to be moderated by the presence or absence of a situational explanation for the first instance of failure, but the results did indicate the strong tendency of participants to attribute violations of the diet goal to stable, internal, and uncontrollable causes. While the 'what the hell effect' proposed a decreased feeling of usefulness (i.e. all or none reasoning) as an explanation for the effect of a first instance of failure on subsequent behavior, this study on the snowball

effect of self-regulation failure found consistent support for self-efficacy as an explaining factor instead; a first instance of failure was associated with a decrease in self-efficacy, which in turn lead to subsequent failure and less subjective success. Although the fact that this study, investigated the effect for an everyday health behavior in a relatively broader sample and beyond artificial lab contexts makes this line of research promising, it is a key criticism that it has only been tested in the domain of eating. Adriaanse and Ten Broeke do imply that the snowball effect of self-regulation failure theoretically can be applied to self-regulation behavior in general, but the domain specific data fails to prove possible generalization to other domains.

Considering the lack of evidence on the domain dependency of the promising snowball effect of self-regulation failure, the present study will investigate the generalizability of the findings on the snowball effect of self-regulation failure to a health domain other than eating; physical exercise. Physical exercise is seen as a typical desirable behavior that is promoted by self-control, according to the meta-analysis of De Ridder and Lensvelt-Mulders (2018). Furthermore, the health promoting behavior is of great importance to our health, since failure to self-regulate towards exercise goals is at the core of societal problems such as obesity (Hagger et al., 2002). Physical exercise could therefore function as a relevant alternative domain when studying domain independence of the snowball effect of self-regulation failure.

Besides the similarities between eating and physical exercise as both being health promotion behaviors and typical self-regulation domains, there are several differences that make studying the effect in the domain of physical exercise increasingly theoretically interesting. For self-regulation in eating behavior, the damage cannot be undone. For exercise behavior however, one has more of an opportunity to make up for the first failure by executing exercise behavior on a later moment. Furthermore, when failing at self-regulation

with eating, the problem often lies in unsuccessful inhibition (e.g. not resisting the piece of cake). Opposed to that, with the intention to exercise, one must first of all inhibit tempting behavior distracting from the healthy behavior (e.g. like sitting on the couch) and second of all initiate the exercise behavior (e.g. going to the gym). This is related to differences between inhibitional and acquisitional goals, which are associated with different feedback systems. Avoidance or inhibitional goals, like in dieting, are associated with positive feedback. The goal is to move away from the reference value: not eating something unhealthy leads to positive feedback. Therefore, this avoidance system can never be satisfied. The approach/acquisitional system works differently, as it is associated with negative feedback. The behavior must be directed towards the reference value, so the system can be satisfied when the behavior approaches the reference value (e.g. succeeding in going to the gym) (Cochran & Tesser, 1996). Hence, the question remains whether these differences will or will not limit the generalizability of the snowball effect of self-regulation failure from the domain of eating to the domain of physical exercise.

This study will function as an initial exploration of the generalizability of the snowball effect of self-regulation failure to a domain other than eating, through studying the occurrence of the effect in the domain of physical exercise. Physical exercise is a typical self-regulation behavior, thus setting an exercise goal can lead to minor violations of self-regulation. On that account, despite the differences in consequential self-monitoring from inhibitional and acquisitional goals, it is expected that the snowball effect of self-regulation failure will occur in the domain of physical exercise as well: individuals are more likely to fail in using self-regulation for initiating exercise behavior, when they experienced self-regulatory failure in an earlier attempt. Furthermore, the formation of maladaptive attributions is expected to moderate the snowball effect of self-regulation failure. Building on the abstinence violation effect and recent indications of goal violations leading to stable, internal, and uncontrollable

attributions, it is hypothesized that the formation of maladaptive attributions after a first instance of failure can spill over to the next event and therefore increase the risk of subsequent failure.

The present study

The present study investigated the occurrence of the snowball effect of self-regulation failure in the domain of physical exercise, and the moderating mechanism of attributions in this effect, by replicating the study of Adriaanse and Ten Broeke (2019) and adapting it to the domain of physical exercise. In line with their study, the effect was studied through the use of hypothetical situations: participants were asked to read manipulated vignettes to test the influence of initial self-regulation failure of exercise behavior on subsequent self-regulation dilemmas. Participants who were asked to imagine self-regulation failure in the first situation were expected to rate the likelihood of subsequent failure higher, than participants who were initially asked to imagine self-regulation success. The formation of attributions about the initial success or failure was manipulated through the presence or absence of a given justification for the initial behavior. This was based on the assumption that no justification (i.e. no situational explanation), opposed to providing a justification, gives more room to the formation of maladaptive attributions. Therefore, the failure condition without a justification for the self-regulation failure in the first manipulated dilemma is expected to have increased ratings of subsequent failure, compared to the other conditions.

In line with the previous study on the snowball effect of self-regulation failure, two perspectives of the vignettes were included. Half of the participants read vignettes where the main actor was a fictional character, while the other half read vignettes where they were the main actor themselves. With this distinction, the influence of possible overestimation of one's self-regulation can be taken into account when interpreting the results.

Finally, habits of exercise behavior can possibly influence chances of failure, since

habits are activated automatically by the context cues that co-occurred with responses during past performance (Neal, Wood, & Quinn, 2006). The automatic activation is for this reason expected to reduce the impact of the information about hypothetical failure, reducing estimated chances of subsequent failure. Habit strength is therefore included as a factor in the study.

Method

Participants

425 participants were recruited through prolific. This sample size ensured a power of .90 (α = .05) for detecting the main effect of Regulation within the 'self' perspective on the next day, based on power calculations in the software Gpower (Erdfelder, Faul, & Buchner, 1996). Being female was a requirement for participation, in line with the studies of Adriaanse and Ten Broeke (2019). After excluding four male participants based on their gender, and one female participant who was considered an outlier that influenced the results, the final sample consisted of 420 women with a mean age of 28.61 (*SD* = 6.38). A mean BMI of 26.08 (*SD* = 7.14) was found. By participating via Prolific, participants were able to either receive or donate £0,75.

Design & Procedure

The online study had a 2 Regulation (success versus failure) x 2 Justification (present versus absent) x 2 Habit Strength (low versus. high) x 2 Perspective (other versus self) between subjects design, with the estimated likelihood of failure in a self-regulation dilemma on the next day of the goal (failure next day) and in a self-regulation dilemma on the next week of the goal (failure next week) as dependent variables.

Participants recruited via Prolific were redirected to the online survey, created with Gorilla. Participants were informed that participation involved filling out a few questionnaires and that they would be asked to carefully read a description of a certain situation and answer

several questions about this description. They were also informed that participation would be voluntary and anonymous. After providing informed consent, participants received a *demographical questionnaire,* followed by the *self-report habit index (SHRI).* Then, the *introduction* to the vignettes was given in the form of instructions, followed by the exercise-related *goal* of the main actor of the vignettes. Depending on the Perspective condition, participants were either reading the instructions, the goal, and the vignettes about the fictive girl Mary as main actor (i.e. 'Other') or they were instructed to imagine these situations for themselves (i.e. 'Self'). Following on the goal, participants were exposed to the first of three vignettes, which involved the manipulation of regulation and justification. *Vignette 1* described a situation where the main actor was facing a dilemma between a tempting activity and acting in line with the goal. Depending on the justification condition, half of the participants received additional information functioning as a justification for initial failure or success, while the other half did not receive additional information. The absence of a justification was meant to leave more room for attributions about success or failure in the first dilemma, compared to a present justification. Next, depending on the regulation condition, participants learned that the main actor in the vignette was either successful (i.e. success) or unsuccessful (i.e. failure) in regulating her behavior towards the exercise goal. The manipulations resulted in four conditions per perspective: failure-present with *n (other)* = 53 and *n* (self) = 53, failure-absent with *n* (other)= 53 and *n* (self) = 52, success-present with *n* (other) = 52 and *n* (self) = 53, and success-absent with *n* (other) = 53 and *n* (self) = 51. Following the first vignette that involved the experimental manipulation, participants were exposed to two different subsequent vignettes. *Vignette 2 (T1),* described a situation where the main actor was facing another dilemma between a tempting activity and acting in line with her goal, on the next day of the goal. The second subsequent vignette, *vignette 3 (T2),* again described a dilemma between a tempting activity and acting in line with her goal, on the next

week of the exercise goal. The content of the dilemmas was counterbalanced to minimize the influence of specific content on the expected likelihood of failure: the two specific dilemmas were switched for half of the participants, while the two defined time spans after the first dilemma remained the same. For both subsequent vignettes, the predicted likelihood that the main actor would fail at self-regulating her behavior towards her exercise goal was measured, forming the two dependent measures. In order to check the degree to which participants were identifying with the main actor and were able to imagine the situations, they were asked several control questions at the end. Finally, participants were thanked for participation and shortly debriefed on the real purpose of the study. This was accompanied by contact information of the researcher, in case of remaining questions. This whole study took approximately 9 minutes.

Materials

Demographical questionnaire. This questionnaire consisted of questions on age, gender, highest received degree of education, country of residence, native language, height, weight, hours spend on exercising weekly, and most frequently practiced sports.

Self-report Habit-Strength Index (SRHI). The SRHI is a self-report index of habit strength developed by Verplanken and Orbell (2003), consisting of twelve items. These items are accompanied by a five-point Likert answer scale, anchored by ‘agree’ to ‘disagree’. For the purpose of this study, ‘behavior X’ was specified as the occupation with physical exercise. Examples of items are: ‘Exercise is something I do frequently.’ and ‘Exercising is something I do without having to consciously remember.’. No items were reversed. To allow correct interpretation of the index, the resulting scores were reversed. Therefore, a higher score points to stronger habitual exercise behavior. The SRHI showed high reliability in the present sample (Cronbach’s $\alpha = .94$). The resulting habit strength scores were split into two groups at

the median of 1.46, with scores under the median forming the 'low habit strength' group and scores above the median forming the 'high habit strength' group.

Vignettes.

Introduction. All participants read the same introduction to the first vignette, in which they were informed to be provided with several scenarios about a person. Participants were asked to sympathize as much as possible with the main character and to really picture the scenarios. Adding to that, they were informed that they would be asked to predict the behavior, feelings and thoughts of this main character after reading the descriptions and were asked to answer the questions as seriously and honestly as possible.

Goal. The goal component specified an exercise-related goal with the instruction to imagine the situation of setting the goal. The 'other' condition read the following goal: 'Mary started exercising, because she wants to increase her endurance. She set the goal to go to the gym every other day for an hour', while the 'self' condition read: 'You started exercising, because you want to increase your endurance. You set the goal to go to the gym every other day for an hour.'.

Vignette 1 (Experimental manipulation). Vignette 1 specifies that the main actor faces a dilemma on the 10th day of her exercise-related goal, between spending a sunny evening in the park nearby or going to the gym in line with her goal. The vignette states how spending time in the park is not compatible with the exercise goal to go to the gym every other day for an hour, but also emphasizes how the main actor finds it very tempting. Depending on the justification condition, information about how choosing to go to the gym instead of spending time in the park together would lead to disappointment of her roommate was added (justification present condition) or left out (justification absent condition). Subsequently, depending on the regulation condition, participants read that the main actor decided to go to the gym (success condition) or decided not to go to the gym (failure

condition).

Vignette 2 and 3: Dependent measures (T1, T2). Vignette 2 described a situation where the main actor was facing a dilemma between going to the cinema and going to the gym in line with her goal, taking place on the next day of the goal. Vignette 3 described a situation where the main actor was facing a dilemma between watching a sport match and going to the gym in line with her goal, taking place the next week of the goal. For both dilemmas, it was stated how the tempting activity was not compatible with the exercise goal. The excitement of the main actor for the tempting activity was also emphasized. For each of these subsequent dilemmas, participants were asked to indicate the likelihood of failure at a scale from '0' (e.g. 'Definitely not go to the cinema') to '100' (e.g. 'Definitely go to the cinema'). Higher scores corresponded to subsequent failure seen as more likely.

Results

Descriptives and Intercorrelations

The majority of the sample of 420 females consisted of highly educated women, with 58,4% having completed an associate degree, bachelor's degree, master's degree, or PhD degree. The remaining women received a high school or secondary school degree, or did not receive any degree. 73.6% of the women reported to perform a type of exercise. On average, 3.4 hours (*SD* = 3.5) was reported to be spent on exercise weekly, with 14.3% of the women spending three hours on exercise weekly, and the majority of 24.5% not spending any time on exercise weekly. For means, standard deviations, and intercorrelations of the key variables of this study, please see Table 1.

Randomization Check

Separate analyses of variance (ANOVAs), with Age, Exercise hours, BMI, and Habit Strength as dependent variables, and manipulation as the independent variable, were conducted to test whether these factors were equally distributed across the conditions. The

resulting *F* values were non-significant, all $p > .532$. Therefore, the randomization of these variables was considered successful. A chi-square analysis was conducted to test the random distribution of education and country of residence. The resulting non-significant values, both $p > .258$, indicated successful randomization.

Main analyses

The snowball effect - one day later (T1). A 2 Regulation (success versus failure) x 2 Justification (present versus absent) x 2 Habit Strength (low versus high) x 2 Perspective (other versus self) ANOVA was conducted to examine the effect of regulation, justification, habit strength, and perspective on the expected likelihood of failure of goal-directed behavior for the first dependent measure (T1). As hypothesized, a main effect for regulation was found, with F (1, 404) = 42.55, $p = .000$, $\eta p^2 = .10$. Participants in the failure condition (M = 68,78, SD = 1.94) rated the likelihood of failure in the subsequent dilemma significantly higher than participants in the success condition (M = 50,83, SD = 1.96). No significant main effects were found for justification ($p = .249$), habit strength ($p = .156$), and perspective ($p = .849$).

The main effect of regulation was qualified by a significant regulation x perspective interaction, F (1, 404) = 33.80, $p = .000$, $\eta p^2 = .08$. Simple main effects analysis within the two perspectives separately showed that within the perspective of 'other', people rated the likelihood of failure significantly higher in the failure condition (M = 77.05, SD = 2.39), than in the success condition (M = 43.08, SD = 2.41). Within the 'self' perspective this effect was non-significant ($p = .653$).

Furthermore, a significant interaction between habit strength and perspective was found, F (1, 404) = 16.59, $p = .000$, $\eta p^2 = .04$. After decomposition of this effect through splitting the two perspectives, it was shown that among participants within the 'other' perspective those with a higher habit strength (M = 63.72, SD = 2.46) were rating the likelihood of failure significantly higher than those with a lower habit strength did (M =

56.42, *SD* = 2.35). However, the direction of the effect was the opposite among participants within the 'self' perspective; people with a higher habit strength (*M* = 51,97, *SD* = 3.00) rated the likelihood to fail significantly lower than people with a lower habit strength did (*M* = 67.11, *SD* = 3.13).

None of the other two-way, three-way, or four-way interactions proved to be significant, all $p > .079$. An overview of the values for the different levels of the variables is provided in Figure 1, with justification merged among the other groups.

The snowball effect - one week later (T2). To test the influence of regulation, justification, habit strength, and perspective on the second dependent measure (T2) another 2 Regulation (success versus failure) x 2 Justification (present versus absent) x 2 Habit Strength (low versus high) x 2 Perspective (other versus self) ANOVA was conducted. Again, a main effect of regulation was found, indicating that participants who were manipulated to fail in the first dilemma (*M* = 64.02, *SD* = 1.99) rated the likelihood to fail in the subsequent dilemma significantly higher than participants who were initially manipulated to succeed (*M* = 45.69, *SD* = 2.01), F (1, 404) = 41.98, $p = .000$, $\eta p^2 = .09$. The effect of justification on failure in the subsequent dilemmas remained non-significant ($p = .182$.), as did the main effects of habit strength ($p = .098$), and perspective ($p = .861$).

The main effect of regulation was again qualified by a statistically significant interaction between regulation and perspective, F (1, 404) = 22.41, $p = .000$, $\eta p^2 = .05$. Simple main analysis within the two perspectives separately demonstrated participants who were manipulated to fail in the first dilemma (*M* = 70.47, *SD* = 2.47) only rated the likelihood to fail in the subsequent dilemma significantly higher than participants who were manipulated to succeed at first (*M* = 38.74, *SD* = 2.50), when they were placed in the 'other' perspective. In the 'self' perspective, no significant difference in T2 scores for the different regulation groups was found.

None of the other two-way, three-way, or four-way interactions were significant, all $p > .134$, with the exception of a significant three-way interaction of regulation x justification x perspective, $F\ (1, 404) = 4.75$, $p = .030$, $\eta p^2 = .01$. However, decomposing the effect by separating the perspectives showed no significant contrasts, all $p > .107$.

The plotted values for the different levels of the variables at T2 can also be found in Figure 1, where justification is again merged among the other groups.

Table 1

Correlations, means, and standard deviations.

	1	2	3	4	5	6
Age	-					
Exercise Hours	-.04	-				
BMI	.17**	.002	-			
Habit Strength	-.02	.15**	-.21**	-		
T1 score	-.03	.01	.04	-.07	-	
T2 score	-.02	.05	-.04	-.11*	.44**	-
M	28.61	3.38	26.08	1.51	59.75	54.81
SD	6.38	3.54	6.95	1.04	31.07	31.09

Note. * $p < .05$, ** $p < .01$ ***, $p < .001$ (two-tailed)

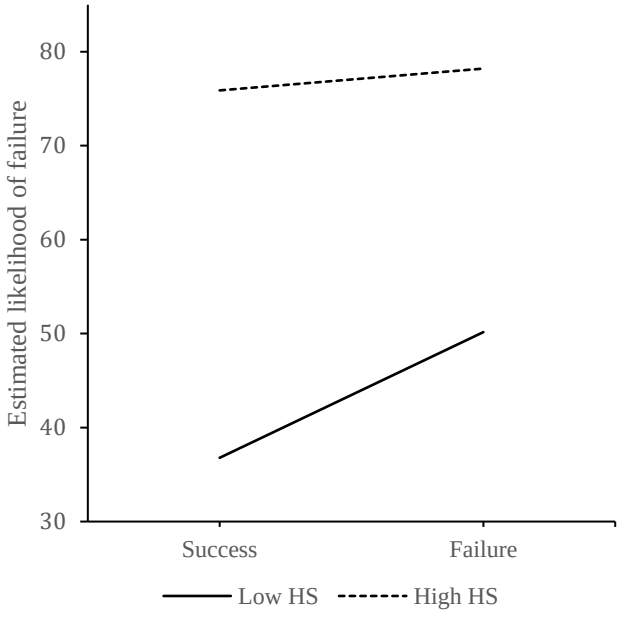

Figure 1a. Other next day

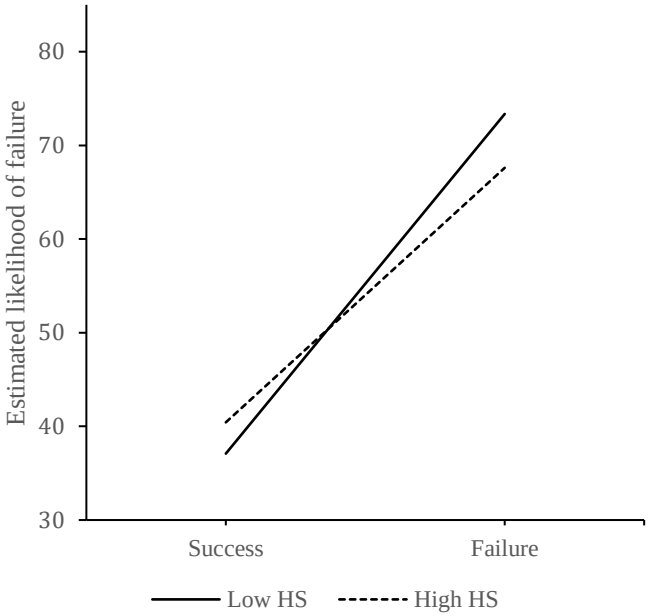

Figure 1b. Other next week

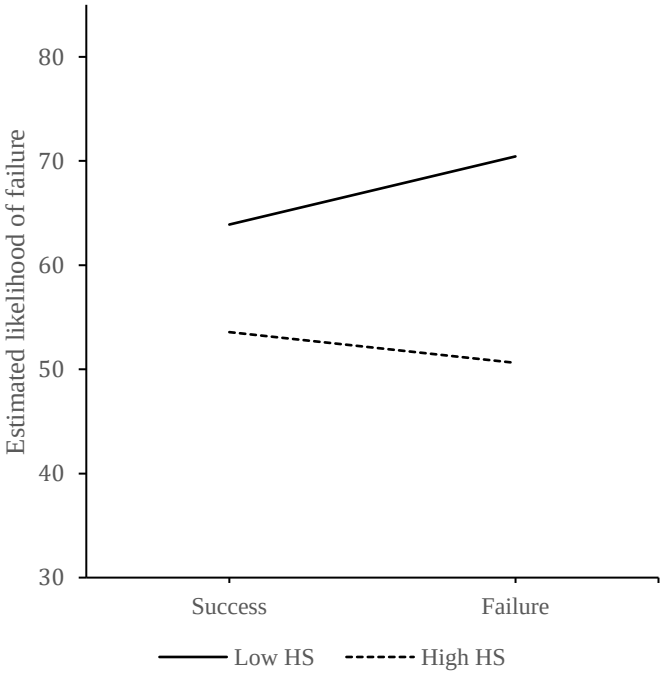

Figure 1b. Self next day

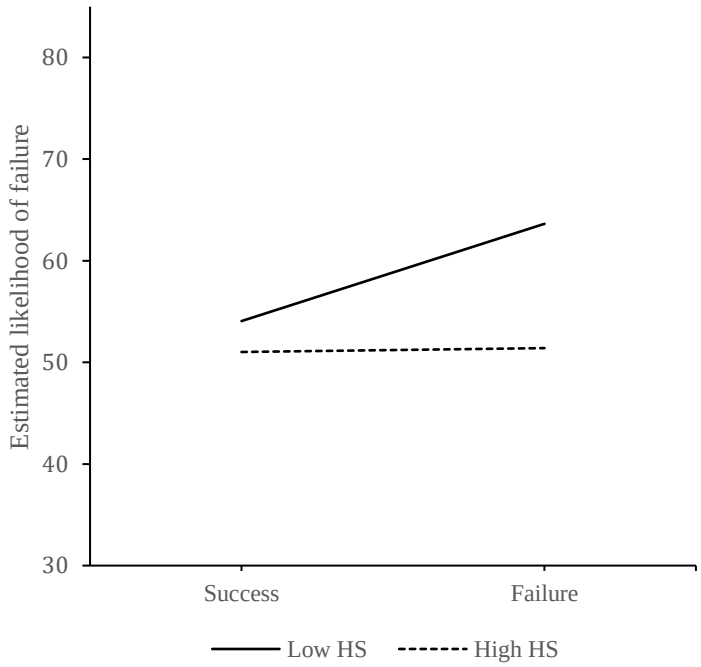

Figure 1b. Self next week

Figure 1. Mean estimated likelihood of failure at T1 and T2, separated for perspective, regulation, and habit strength conditions.

Discussion

Failure of self-regulation has detrimental consequences for long-term success of many behaviors and is at the core of various societal issues (e.g. Baumeister et al., 2007; Kelley et al., 2015). The failure of behaving in line with long-term goals appears to be inevitable, and most likely occurs on a daily basis. Fortunately, a single goal violation will not have a tremendous impact on long-term self-regulation success and is therefore trivial. However, the danger increases when that single instance of failure snowballs into subsequent failure. For this reason, research has shifted its focus from researching strategies that prevent failure in the first place to investigating how people respond to a single instance of failure. Initial evidence has shown that an instance of failure indeed snowballs into more failure within the domain of eating behavior (Adriaanse & Ten Broeke, 2019). In spite of the claim that this phenomenon occurs for a variety of daily goals, empirical evidence does not yet support such translation of the snowball effect of self-regulation failure to other domains. The present study investigated whether previous findings on the snowball effect of self-regulation failure in the domain of eating can be translated to the domain of physical exercise, and thereby tested the domain dependency of the effect. As a first step, vignettes were used to test the hypotheses in a controlled situation, where the inclusion of vignettes about another person was used to control for overestimation of one's own behavior.

Essentially, the study showed that the detrimental effects of failure (as opposed to success) on subsequent failure of self-regulation also applied to exercise behavior; failure in regulating one's behavior towards an exercise goal snowballed into subsequent failure of behaving in line with that exercise goal. The occurrence of the snowball effect of self-regulation failure was found in both the next day and the next week of the goal, showing that the effect of single instance of failure on subsequent self-regulation success can last for a longer period of time than just one day. Nevertheless, the results of the study also showed that

the effect was only significant for the vignettes about a fictional character, and not for the vignettes in which participants were asked to imagine enacting the behavior themselves. This is not in line with the previous findings of Adriaanse and Ten Broeke (2019) in which the snowball effect of self-regulation failure was found for the self-vignettes as well. It should nonetheless be noted that these studies also found a notably smaller effect for the 'self' condition, compared to the 'other' condition.

Crucially, the absence of the snowball effect of self-regulation failure for 'self' cannot be explained by overestimation of one's owns behavior, since the 'self' group did not rate their expected likelihood of failure significantly lower than the 'other' group did. The amount of information that a participant disposes of is a more likely explanation of the moderating function of perspective in the effect of regulation on subsequent failure. The vignettes of the 'other' perspective provided solely the given information on the decision for failure or success, which possibly led to a higher impact of the given information and therefore to a more extreme rating of expected subsequent failure. The participants in the 'self' perspective, on the contrary, had access to additional information outside the vignettes based on their own experiences and self-knowledge, which may have led to a decreased impact of the given information. In turn, this could have resulted in less extreme scores and therefore led to smaller differences between the regulation groups as a consequence.

On top of the occurrence of the snowball effect of self-regulation failure in the domain of physical exercise, attributions were hypothesized to have a moderating factor on this effect. Specifically, it was expected that leaving out (as opposed to adding) a justification to the decision in the first dilemma would increase the formation of maladaptive attributions, which consequently would influence the chance of failure snowballing into subsequent failure. Similar to the findings of Adriaanse and Ten Broeke (2019), this potential moderating role of attributions in the snowball effect of self-regulation failure was not demonstrated by the

results of the study. This can possibly be led back to the use of vignettes. As the vignettes describe hypothetical situations, attributions may have been difficult to manipulate. That is, as proposed in studies of Adriaanse et al. (2014), Festinger (1962), and Oetingen et al. (2006), attributions are formed as a result of the realization of acting against one's own standards and goals, triggering a negative affective response. The use of hypothetical situations, including a non-personal goal, may not have resulted in cognitive dissonance, and thereby removed the need for forming attributions. Consequently, the groups may not have differed in the amount of formed attributions, unabling a conclusion on the moderating mechanism of attributions.

Interestingly, it was also shown that the level of habit strength had an influence on the expected likelihood of failure, but that this was influenced by the perspective of the hypothetical situations. Participants reading vignettes about another person were rating failure in the subsequent dilemma as more likely when they had higher levels of habit strength. Nonetheless, since the measurement of habit strength is related to one's own exercise behavior and unrelated to the exercise behavior of a fictional character, this finding is difficult to interpret. A finding of higher relevance showed that higher levels of habit strength actually led to lower estimates of failure in the subsequent self-regulation dilemma for people who were answering the vignettes about themselves. This finding suggests that higher levels of habit strength might be decreasing people's susceptibility to expected failure in subsequent self-regulation dilemmas. The effect of high habit strength leading to lower estimates of expected failure was only found for the first dependent measure, the next day of the goal, but it cannot be explained why.

Adding to the idea of high levels of habit strength as decreasing estimates of subsequent failure in general, an interesting and possibly promising trend can be noticed within the 'self' perspective. Although the results did not indicate a moderating role of habit strength in the effect of initial behavior regulation on subsequent expected failure, this trend

does suggest the possibility of such a mechanism. The trend shows that people low in habit strength rated the likelihood of failure higher when they were manipulated to fail, compared to when manipulated to succeed. Opposed to that, for people high in habit strength the trend suggests a more consistent rating of the likelihood of failure across both regulation groups (i.e. success and failure). In other words, higher levels of habit strength reduced the impact of a single instance of failure on subsequent self-regulation dilemmas, functioning as a protective mechanism against the snowball effect of self-regulation failure. The suggestion that habit strength may protect against the detrimental effects of a single instance snowballing into subsequent failure, hints towards habit strength as a potentially relevant target for an intervention directed at decreasing the consequences of failure instances. This requires further research on the role of habit strength levels in the snowball effect of self-regulation failure.

Taken together, the snowball effect of self-regulation failure was, in line with previous findings in the domain of eating, found to occur in the domain of physical exercise as well. The present study only demonstrated this effect for participants who were answering vignettes about a fictional character. There was no indication of a moderating role of attributions, but the results did put habit strength forward as a possibly protective mechanism against the potentially negative consequences of initial failure on subsequent behavior.

Limitations and Recommendations for Future Research

There are several limiting aspects of this study that should be noted. First of all, two characteristics of the present study limit the generalizability of the findings to the population. The exclusion of male participants was a deliberate decision in this study, in order to replicate the vignette study of Adriaanse and Ten Broeke (2019) in the domain of physical exercise. However, a sample consisting of solely women unables drawing a conclusion about the behavior of men in the studied effect. On top of this, more than half of the sample can be classified as highly educated (i.e. associate degree, Bachelor, Master, or PhD), which is not

representative of the education level percentages that can be found in participants' countries of residence (HESA, n.d.; "Educational Attainment", 2018). Secondly, with regards to the research design, the opportunity for insights on attributions as a moderating mechanism in the snowball effect of self-regulation failure is limited by the absence of a manipulation check for justification and further measurement of causal attributions for success and failure. For this reason, it stays unclear whether the absence of the moderation is due to a failed manipulation, or whether attributions simply are not involved in the snowball effect of self-regulation failure. Finally, while the choice for testing the hypotheses through vignettes does allow for a controlled test, it limits the ecological validity. The findings of this study cannot be generalized to uncontrolled situations, until further investigated in actual behavior.

Despite these limitations, the present study expands existing insights by providing exploratory evidence on the relevance of the snowball effect of self-regulation failure across domains. Building on these insights, future research is recommended to further explore the domain dependency of the effect, by executing explorational research within similar health domains. Condom use is an example of an alternative typical self-regulation behavior (De Ridder et al., 2018), that is related to positive outcomes when successfully regulated (Galliot & Baumeister, 2007).

These future studies should most importantly consider the inclusion of a manipulation check for justification, and further measurement of the causality of formed attributions. Maladaptive attributions as an underlying mechanism is still a theoretically promising effect, which this study has not yet been able to reject. Therefore, a study design that can examine the formation of attributions will add valuable information about the moderating mechanism of attributions in the snowball effect of self-regulation failure. This will also allow further insight into the role habit strength may play in the influence that a given justification has on the decision making. Namely, considering people with high habit strength tend to use

automatic cues instead of conscious information processing in the behavior in question (Kremers, van der Horst, & Brug, 2007), they may be less susceptible to the influence of the absence or presence of a justification. This could provide additional suggestions for the function of habit strength in averting the consequences of failure. In addition, Adriaanse and Ten Broeke (2019) suggested that there was much room left for change in helping people shift on the attribution scale to more external, unstable, and controllable attributions, considering the majority of their participants had a strong tendency to attribute their diet violations to stable, internal, and uncontrollable causes. The question whether this tendency is applicable to violations in exercise behavior as well, increases the relevance of further investigation of attributions.

Besides focusing future research on the expansion of exploratory evidence on the snowball effect of self-regulation failure across domains, there are sufficient implications to explore the snowball effect of self-regulation failure for participants' own behavior in actual behavior instead of hypothetical situations. Adriaanse and Ten Broeke (2019) demonstrated that the snowball effect of self-regulation failure also occurred in real life eating behavior, as measured by the retrospective reports. Considering the impact of failure might be greater in real life situations compared to information about hypothetical instances of failure, it is expected that the findings on the snowball effect of self-regulation failure in actual eating behavior for 'self' can be translated to the domain of physical exercise, providing more insight into the snowball effect for behavior of people themselves. Moreover, investigation of the snowball effect of self-regulation failure in actual behavior allows for better insight into the moderating role of attributions. Namely, a violation of a real-life goal, compared to a hypothetical goal, most likely leads to more cognitive dissonance, and therefore results in a higher need to form attributions about the instance of failure (e.g. Adriaanse et al., 2014; Festinger, 1962; Oetingen et al., 2006). Finally, habit strength is recommended to be included

in the retrospective measures of actual behavior, to gain further insight into the potential protective role against the snowball effect of self-regulation failure and thereby its potential to function as a target for failure-decreasing interventions.

Concluding Remarks

The present research was the first to suggest that the snowball effect of self-regulation failure is not dependent on the domain of eating, but can be generalized to the domain of physical exercise as well. Failure of acting in line with an exercise goal snowballed into subsequent failure for participants imagining self-regulation dilemmas for a fictional character. For further insight into the effect in people's own behavior, future studies targeting actual behavior were recommended. Habit strength was put forward as a possible protective mechanism against this effect, holding potential implications for interventions directed at decreasing the detrimental consequences of initial failure leading to subsequent failure. The present findings add to the suggestion of the snowball effect of self-regulation failure as a relevant concept for typical self-regulation behaviors across domains.

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