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**"Both/And" Instead of "Either/Or":
How Focusing on Goals at Different Levels of Abstraction Can Motivate Goal
Pursuit**

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Bern, August 2019
Bettina Höchli

Introduction

Concrete, challenging goals are powerful motivators and boost performance more than abstract goals (Locke & Latham, 2002, 2013). To illustrate, the concrete goal of “exercising on Wednesday evening for 60 minutes” should boost performance more than the abstract goal of “be healthy.” So far, research has mostly focused on concrete goals. While achieving concrete goals is seen as something positive, many of today’s social, environmental, and economic challenges require more than achieving a concrete goal. For example, exercising once does not lead to a healthy life; recycling glass bottles does not make you an environmentally friendly person. In these cases, a concrete goal—i.e., a subordinate goal—is only one of many steps that contribute to what people ultimately aspire to: an abstract, superordinate goal. Accordingly, successful goal pursuit requires not only the achievement of single steps, but also effort over the long term and across various situations, overcoming setbacks, resisting the pull of competing goals and temptations (Bonezzi, Brendl, & De Angelis, 2011; Fujita & MacGregor, 2012; Rothman, Baldwin, Hertel, & Fuglestad, 2004). In light of these challenges, focusing solely on a subordinate goal may not be the best solution (Ordóñez, Schweitzer, Galinsky, & Bazerman, 2009).

An idea that might help overcome these difficulties is to focus additionally on superordinate goals. The purpose of this dissertation is to investigate possible benefits of superordinate goals (which have received less attention in research than subordinate goals), and to explore the idea that focusing on a *combination* of goals at different levels of abstraction fosters broad, long-term goal pursuit more than focusing on either a superordinate or subordinate goal alone.

The dissertation consists of four papers that all adopt a goal-theoretical perspective to explore how superordinate goals and a combination of goals at different levels of abstraction influence goal pursuit in different contexts. Before presenting the four papers, I first provide a theoretical foundation on how goals differ in their level of abstraction, and how goals at different levels of abstraction are

related to each other. Then I outline advantages and disadvantages of goals at different levels of abstraction for goal pursuit, focusing on the less well-known detrimental side effects of subordinate and beneficial effects of superordinate goals. I then argue that goals at different levels of abstraction are by no means mutually exclusive, but on the contrary are possibly most beneficial when combined. Finally, the four papers are briefly sketched and conclusions drawn about the whole dissertation project.

Goal Hierarchy: How Goals Differ in Their Level of Abstraction

Goals are mental representation of desired end states (Fujita & MacGregor, 2012). People typically hold similar goals that are related to each other. For example, one person may have the goals to “be in good physical shape,” “do 40 push-ups on Wednesday afternoon” and “be healthy.” It is obvious that these goals are all related yet somehow different from one another. What they have in common is that they all relate to being healthy; however, they differ in their level of abstraction (Carver & Scheier, 2001; Vallacher & Wegner, 1987). “Do 40 push-ups on Wednesday afternoon” is the most concrete and specific goal; “being healthy” is the broadest and most abstract; “be in good physical shape” lies somewhere in the middle. Technically speaking, these goals can be understood as a hierarchy consisting of three levels of abstraction (see Figure 1 and Carver & Scheier, 2001).

The most concrete goals at the lowest level of abstraction are *subordinate* goals. They specify what a person plans to do, how to do it, and in which context to do it, for example, by defining the where and when of pursuing the goal. Subordinate goals define how goals at the next highest level—intermediate goals—can be achieved. To illustrate, the subordinate goal “do 40 push-ups on Wednesday afternoon” could contribute to the intermediate goal “be in good physical shape.” Goals at the intermediate level, in turn, contribute to goals at the highest level of abstraction: *superordinate* goals. Superordinate goals refer to idealized conceptualizations of oneself—who and how a person

wants to be; they provide a general orientation about what is important to a person (Boekaerts, de Koning, & Vedder, 2006; Schwartz et al., 2001).

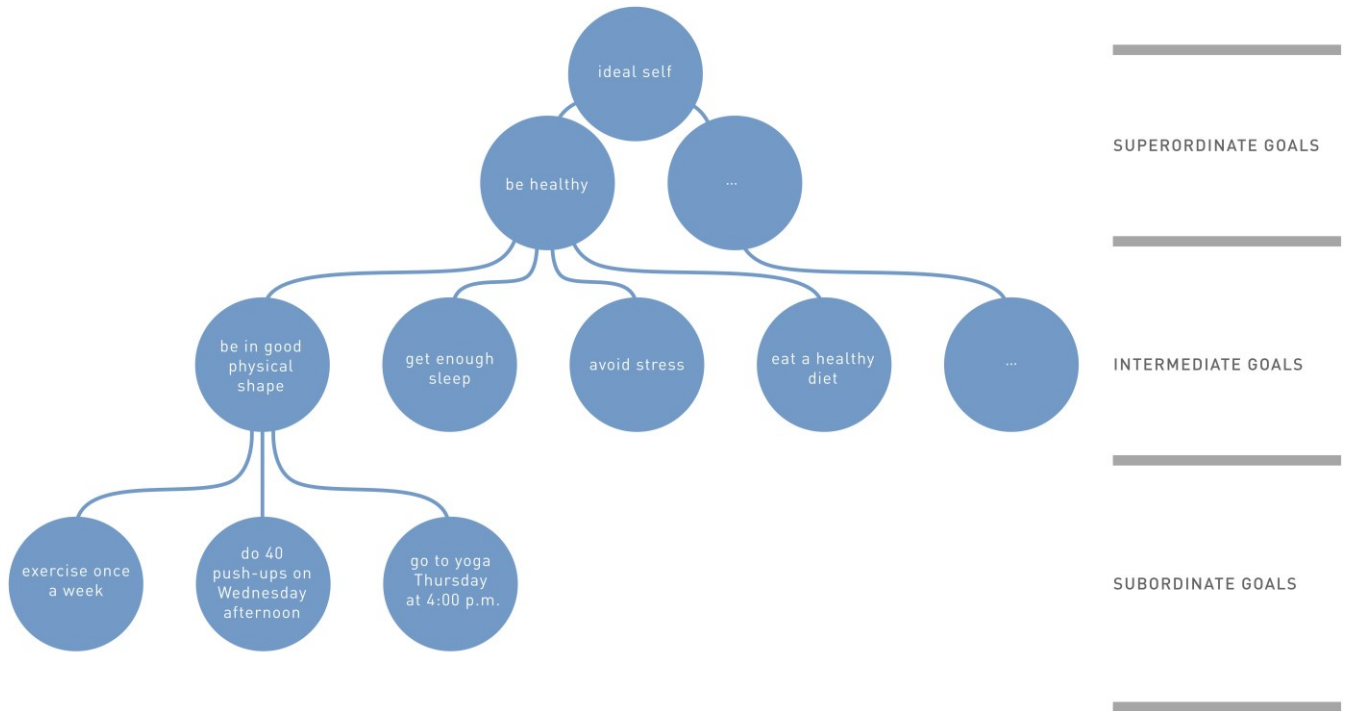


Figure 1. Schematic representation of goals at three levels of abstraction (Höchli, Brügger, & Messner, 2018).

The branching of superordinate goals into intermediate and then further into subordinate goals indicates that several lower-level goals contribute to achieving a goal further up in the hierarchy. Thus, superordinate goals can be seen as the *end*, and all goals lower in the hierarchy as the *means* to achieve it (Kruglanski et al., 2002).

As indicated above, existing research has focused primarily on the beneficial effects of subordinate goals, with less attention to superordinate goals. This is important in two ways: There are possible detrimental side effects when focusing solely on subordinate goals, and possible beneficial effects when additionally taking into account superordinate goals. These are examined below.

Detrimental Side Effects of Subordinate Goals

While the majority of research on goal setting focuses on the beneficial effects of subordinate goals, some research shows that subordinate goals are not always beneficial, and can even have detrimental side effects (Ordóñez et al., 2009). Three such detrimental side effects are outlined below.

Subordinate Goals Can Be Detrimental When They Allow Too-Early Goal Disengagement

Subordinate goals clearly specify what needs to be done during what time period in order to achieve them. This facilitates goal achievement and allows an easy determination of whether a person achieved the goal. Although achieving goals is typically seen as something positive—a success—it can also be negative. This is the case when goal achievement allows a person to disengage from the goal, even when further goal-consistent behavior would be in the person’s best interests.

Goals act as reference points; people monitor where they stand in relation to the goal. In case of a discrepancy between the current state and the desired end state, people make an effort to reduce the discrepancy (Carver & Scheier, 2001). The discrepancy can thus be regarded as a motivational instigator, and as long as a discrepancy exists, one is motivated to act in a goal-consistent way (Lewin, 1936; Moskowitz, 2012). Crucially, this implies that as soon as the discrepancy disappears, its motivational impetus disappears as well, signaling to the person that they can stop pursuing the goal (Moskowitz, 2012). This pattern is consistent with prospect theory (Kahneman & Tversky, 1979) and its application to goals, which states that people who are below their goal will perceive their current performance as a *loss* relative to the goal, and thus make an effort to reach it. After people reach their goal and enter the domain of *gains*, the marginal benefits of additional performance will be substantially smaller, and thus people are likely to disengage from the goal (Heath, Larrick, & Wu, 1999).

Disengaging from an achieved goal can be adaptive, as people simultaneously hold different goals but have only limited resources (attention, physical strength, time, money; Kruglanski et al., 2002). Thus, disengaging from a fulfilled goal means that people do not invest more of their limited resources in achieving the goal than is necessary, and that resources are available to achieve other, yet unaccomplished goals.

However, disengaging from an achieved goal is not always in the individual's best interests. This is particularly true when pursuing broad, long-term goals such as "being healthy" that cannot be achieved by single actions. In that case, disengaging from goal-aligned behaviors hinders the pursuit of the superordinate goal and may even induce a justification for a subsequent behavior that nullifies or reverses previous effort. For instance, when a person attains the goal of losing 10 pounds, disengaging from behaviors aligned with the goal (e.g., avoiding snacks and sweets) may lead to regaining the weight (Knäuper, Rabiau, Cohen, & Patriciu, 2004; Lowe, Miller-Kovach, & Phelan, 2001). Such compensatory behavior can be seen also in other domains, such as smoking (Hajek et al., 2013; Nides et al., 1995) and energy consumption (Sorrell, 2007).

Subordinate Goals Can Be Detrimental When They Have Too Narrow a Focus

Goals direct behavior because they focus attention (Moskowitz, 2012). However, goals can be too specific, focusing attention so narrowly that people overlook other important features of a task. When people set their focus on a single, narrowly defined behavior or time span, they run the risk of ignoring issues that are not defined by the goal but that may nevertheless be important for its overall achievement. For example, Staw and Boettger (1990) asked students to correct a paragraph that contained both grammatical and blatant content errors. The students who were given a narrow, subordinate goal (correct either grammatical or content errors) were less likely to correct both grammatical and content errors than those who were set a broad goal (do your best). An applied example would be managers who set specific, short-term goals, such as high half-year sales, and

therefore encourage employees to focus exclusively on short-term profits, overlooking potentially harmful long-term effects on the company (Ordóñez et al., 2009). Another example is people who do not eat meat for ecological reasons but take airplane trips. This suggests that the disadvantages of a too-narrow goal focus come to the fore especially when people face major long-term challenges that require several different behaviors over a longer period of time (Höchli et al., 2018).

Subordinate Goals Can Be Detrimental When They Are Too Challenging

Goal-setting theory assumes a positive linear relationship between the difficulty of a goal and performance. However, theoretical research (Koch & Nafziger, 2011b) and experimental studies (Agarwal et al., 2017) show that the relationship holds only up to a certain point. From that point onward, more challenging goals do not lead to higher performance, and can even result in detrimental effects, such as causing people to cheat on tasks (Schweitzer, Ordóñez, & Douma, 2004). In an experiment in which participants had to solve anagrams, participants with an unmet subordinate goal (to create nine words during one minute using seven letters) were more likely to misreport their performance than people focusing on the vague goal of “do your best” (Schweitzer et al., 2004). In the applied context, this is reflected, for example, by executives cooking the books to meet the quarterly goals that Wall Street analysts expect, or college administrators excluding students with low scores on standardized tests in order to hit target pass rates (Ordóñez et al., 2009; Schweitzer et al., 2004). A possible reason for such unethical behavior is that people incur psychological costs from admitting goal failure (Heath et al., 1999; Koch & Nafziger, 2011b; Schweitzer et al., 2004). Given a subordinate goal with a clearly defined endpoint, there is no room for ambiguity as to whether a person has reached it. Therefore, the more challenging the subordinate goal, the higher the risk of goal failure. When a person can achieve the goal by unethical means, the costs associated with goal failure are eliminated. If the costs of not achieving the goal outweigh the costs of behaving

unethically, people have an incentive engage in unethical behavior (Schweitzer, Ordóñez, & Douma, 2002; Schweitzer et al., 2004).

Beneficial Effects of Superordinate Goals on Goal Pursuit

While much is known about how focusing on subordinate goals affects goal pursuit, less is known about superordinate goals (Locke & Latham, 2013). Therefore, three main ways in which superordinate goals can promote broad, long-term goal pursuit are outlined next (for a more comprehensive review, see Höchli et al., 2018).

Superordinate Goals Are Beneficial Because They Extend Over a Long Time Period

The first characteristic of superordinate goals that may be beneficial for goal pursuit is that they extend over a long time period. This leads to a sustained discrepancy between the status quo and the desired end state, and can thus help to maintain motivation in the long run.

Research on goal setting and goal pursuit usually refers to a time-limited period. But what happens after goal achievement? If a person focuses only on a subordinate goal and achieves it, the discrepancy between the status quo and the desired end state disappears, and with it the motivation to keep pursuing goal-aligned behaviors (Carver & Scheier, 2001; Moskowitz, 2012). In the case of broad, long-term goal pursuit, such goal disengagement can be too early—it would be in the person’s best interest to continue the goal-aligned behavior. If discrepancy is what fuels people’s motivation to work toward a goal, sustaining this discrepancy may be a helpful strategy to prevent goal disengagement. One way of sustaining discrepancy (and thereby maintaining motivation) is to think about the goal in a way that reduces the likelihood of achieving it by a single action—in other words, to focus additionally on a superordinate goal.

Consider a person with the goal of “doing 40 push-ups on Wednesday afternoon” but with an additional superordinate goal such as “being healthy.” In contrast to the subordinate goal, the superordinate goal lacks clear criteria to evaluate progress and achievement (Moskowitz, 2012).

Because goal achievement is more difficult to ascertain with a greater amount of abstraction, the discrepancy between one's current status and one's goal persists. One may even question whether goals at a very high level of abstraction are ever fully attained (Wicklund & Gollwitzer, 1982). Thus, focusing on superordinate goals may sustain a state of discrepancy, which in turn maintains people's motivation to work toward the goal, preventing premature goal disengagement.

Superordinate Goals Are Beneficial Because They Extend Over Many Contexts

A second benefit of superordinate goals is that they have a broad contextual scope. This can increase the motivation to engage in behaviors in different behavioral contexts and increase resilience in case of setbacks.

Focusing on a superordinate goal may make it more likely that one engages in other behaviors that contribute to the same overall goal. A superordinate goal is linked to several subordinate goals across different behavioral contexts and thereby interconnects several behaviors across contexts. The hierarchical structure of goals means that multiple tasks are required to achieve a superordinate goal, and the various subordinate goals are bound to different contexts. Consider again the superordinate goal "being healthy": it is apparent that the subordinate goal "exercising once a week" is not enough; it must be supplemented by other subordinate goals related to diet, stress, sleep, and so on. While these behaviors might appear to be unrelated to each other when considered in isolation, their interconnection is apparent when their common superordinate goal is brought to mind (Dolan & Galizzi, 2015). Thus, when pursuing a superordinate goal, a person may engage in goal-related activities in different behavioral contexts (Unsworth, Dmitrieva, & Adriasola, 2013). Provided that a person focuses on a superordinate goal, they should be less likely to engage in behaviors (e.g., smoking, cancelling an exercise session) that contradict other subordinate goals (e.g., eating a healthy lunch, exercising).

A broad contextual scope also allows for resilience in the case of setbacks (Robinson & Moeller, 2014). When pursuing broad, long-term goals, it is likely that people will suffer setbacks, so that the intended way of pursuing the goal is no longer possible (Rothman et al., 2004). When a particular way to achieve a goal no longer works, focusing on a superordinate goal can be a strategy for overcoming such setbacks, as it allows people to change the way they approach a goal without changing the goal itself (Kruglanski et al., 2002). Again consider the superordinate goal of being healthy. To achieve this goal, a person goes jogging twice a week. Suppose a torn ligament prevents further pursuit of the subordinate goal. However, this setback does not deter the person from pursuing the superordinate goal of being healthy, as the jogging can be replaced with other activities such as meditation or healthier eating. The more possible means a person identifies for goal pursuit, the greater their resilience in the face of setbacks (for a more detailed discussion, see Höchli et al., 2018).

The benefits of focusing on a superordinate goal when encountering setbacks is further supported by research on goal setting and “mental accounting,” which refers to how self-control depends on the “brackets” in which a person evaluates goal-related outcomes (Koch & Nafziger, 2009, 2011a). To illustrate, students can evaluate themselves by focusing on one exam (narrow brackets) or on the whole academic year (broad brackets). (Narrow and broad brackets are thus analogous to subordinate and superordinate goals; for a detailed discussion, see Brendl, Markman, & Higgins, 1998). Broad brackets can—given substantial risk of goal failure, loss-averse individuals, and fixed decision levels—lead to higher utility, because they allow risks to be pooled (Gneezy & Potters, 1997; Koch & Nafziger, 2011a; Kőszegi & Rabin, 2007; Thaler, Tversky, Kahneman, & Schwartz, 1997). Consider a student who, despite working hard, does poorly on an exam because they’re having a bad day. Viewed with narrow brackets, the result is goal failure. Viewed with broad brackets, bad luck in one exam is often compensated by good luck in another, and goal attainment is

still possible (Koch & Nafziger, 2009).¹ Applied to the present research, we could say that if there is substantial risk of goal failure, a person would benefit from a focus on superordinate goals.

Superordinate Goals Are Beneficial Because They Are High in Intrinsic Importance

A third benefit of superordinate goals is their high level of intrinsic importance. This can improve a person's ability to prioritize goal-aligned behaviors and help them resist competing goals and temptations.

When someone pursues a single goal for a limited period of time, all available resources can be devoted to the focal goal; distraction from other goals is low (Louro, Pieters, & Zeelenberg, 2007). In everyday life, on the other hand, it is often the case that a person pursues several goals that compete for resources. A person therefore has to prioritize one goal over other goals and temptations (Cavallo & Fitzsimons, 2012; Louro et al., 2007; Sun & Frese, 2013). Focusing on a superordinate goal can help prioritize goal-aligned behaviors. Superordinate goals describe what is most important to a person—how a person wants to be (Boekaerts et al., 2006). As such, superordinate goals (e.g., being healthy) provide vision and guidance, and are fundamental for an overriding sense of self (Masuda, Kane, Shoptaugh, & Minor, 2010). In short, superordinate goals are intrinsically more important than goals at lower hierarchical levels (Carver & Scheier, 2001). Goals with a high level of importance are more likely to be prioritized over less important goals. This implies that superordinate goals that are intrinsically more important than goals at a lower hierarchical level will more likely be prioritized (Cavallo & Fitzsimons, 2012).

Furthermore, to consistently pursue a goal, a person not only needs to put effort toward it, but also to inhibit alternative goals (Shah, Friedman, & Kruglanski, 2002). Alternative goals and temptations are distracting; they pull away resources that are necessary for the original goal. The

¹ Note that the model of Koch and Nafziger (2009) is more complex than this summary suggests; also, it sheds light on several forces that may lead to better outcomes when narrow brackets are used (e.g., leaning-back effect and resting-on-your-laurels effect).

better a person can inhibit such interfering goals, the more persistent they are in their original pursuit. The more important the goal, the more strongly other goals are inhibited during its activation (Shah et al., 2002). Thus the focus on superordinate goals—given their intrinsic importance—can suppress distractions and promote persistent goal pursuit.

“Both/And” Instead of “Either/Or”: Combining Goals at Different Levels of Abstraction Can Foster Broad, Long-Term Goal Pursuit

In the foregoing pages I have highlighted potential detriments of subordinate goals and potential benefits of superordinate goals. This is not to say, however, that subordinate goals are useless or that superordinate goals are a panacea. On the contrary, subordinate goals also have advantages and superordinate goals disadvantages.

An advantage of subordinate goals is that they facilitate beliefs that one is capable of carrying out the steps required to achieve the intended effect (i.e., self-efficacy beliefs; Bandura, 1997). Self-efficacy beliefs are important because they increase the likelihood of goal-consistent actions. In turn, goal-consistent actions can affect self-efficacy beliefs (Bandura, 1997). When subordinate goals are in addition combined with specific mental links between situational cues and anticipated goal-related actions, they are particularly effective at initiating goal-directed actions and overcoming situational obstacles (Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997). Another important quality of subordinate goals is that they have clear start and end points. For example, the goal to “do 40 push-ups on Wednesday afternoon” clearly specifies what needs to be done when. Goal progress and goal achievement are easy to determine when pursuing subordinate goals, and therefore the frequency of feedback is increased (Sun & Frese, 2013). Feedback can facilitate task strategy, helping people learn from their mistakes, which also contributes to goal pursuit (Sun & Frese, 2013; for a comprehensive discussion of the benefits of subordinate goals, see Locke & Latham, 2002, 2013).

A disadvantage of superordinate goals is that they run the risk of being too abstract, too disconnected from actual behavior, and thereby not providing enough information on how to actually pursue the goal (Bandura, 1997; Höchli et al., 2018; Moussaoui & Desrichard, 2016). Superordinate goals that are not linked to concrete action knowledge evoke a desired future unrelated to the present situation. As such, they are akin to wishing and fantasizing. Fantasizing about a positive outcome can have adverse effects on goal pursuit because it induces a feeling of accomplishment without actually engaging in goal-aligned behaviors. Thus the discrepancy between current and end state seems to be reduced, but it is not (Baumeister, Vohs, & Oettingen, 2016; Oettingen, 2012).

Rather than setting different goal types against each other, however, it is possible to combine them. Focusing on *both* subordinate and superordinate goals can highlight their advantages and balance their disadvantages (Höchli et al., 2018; Miller & Brickman, 2004; Rabinovich, Morton, Postmes, & Verplanken, 2009). A focus on superordinate goals can reduce the potential harmful side effects of subordinate goals—i.e., too-early goal disengagement, too narrow a focus, and too high a challenge—and help people maintain long-term motivation. A focus on subordinate goals can provide people with the necessary action knowledge to actually initiate a behavior and thus relate a superordinate goal to the situation at hand.

In summary, combining goals at different levels of abstraction may be a promising strategy for successfully pursuing goals: it may elicit their respective benefits while offsetting their disadvantages. Understanding how goals at different levels of abstraction interact with each other is an essential part of understanding how goals work.

Overview of the Experimental Research

Four experimental papers explore the role of goals at different levels of abstraction in goal pursuit. Each embraces the goal-theoretical background outlined here.

Paper 1 (Höchli, Brügger, & Messner, 2019) addresses New Year's resolutions. At New Year, many people make resolutions to do better, to complete projects—in general, to achieve goals. While motivation is often very high on January 1, it seems to fade over time; people often fail to achieve their goals. This situation offers an opportunity from everyday life to test the hypothesis that combining superordinate and subordinate goals contributes to successful goal pursuit, especially in the long run. Paper 1, an experimental field study, uses a 2 (superordinate goal: yes/no) × 2 (subordinate goal: yes/no) design to test whether a simultaneous focus on both superordinate and subordinate goals helps people ($N = 256$) keep their resolutions. The results provide partial, preliminary support for the beneficial effect of combining goal types. Focusing on both goal types increased the self-reported amount of effort in goal pursuit three months after the start of the study. A group difference was found only between participants focusing on both goals and those focusing on only a superordinate goal. Goal manipulation did not affect other dependent variables, such as the intention to pursue the goal after the end of the study.

Paper 2 (Höchli, Brügger, Abegglen, & Messner, 2019) examines a behavioral intervention in the health context. Such interventions often target a specific behavior over a limited time period. This was the case in the nationwide bike-to-work campaign, which aimed to motivate employees to cycle to work more frequently. Although interventions like these have been shown to successfully foster the initiation of a single behavior, they run the risk of premature goal disengagement (i.e., as soon as the intervention period is over), as well as the risk of fostering compensatory behavior not specified by the intervention goal. Paper 2 is an experimental field study ($N = 1269$) using a longitudinal multilevel design to explore whether an additional focus on superordinate goals, concrete action steps, or both can reduce the risk of premature goal disengagement and facilitate positive spillover effects not specified by the campaign (e.g., cycling in leisure time or eating healthily). All participants pursued the subordinate goal of cycling to work on at least half of the working days for a

maximum of two months. Corresponding to a 2 (superordinate goal: yes/no) \times 2 (action steps: yes/no) design, a quarter of the participants additionally generated a superordinate goal, action steps, or both. Participants across all goal conditions increased the frequency of cycling during the campaign, and the increase was maintained up to two months afterwards. Furthermore, an increase in cycling to work spilled over to increases in leisure-time cycling and eating fruits and vegetables. Although participants with a superordinate goal cycled more at the end of the campaign than participants with only a subordinate goal, the maintenance of cycling over time and the positive spillover effects to related behaviors did not differ due to the goal manipulation. Thus, Paper 2 provides only partial support for the advantage of superordinate goals in long-term goal pursuit, and shows the need for additional experimental field studies.

Paper 3 (Höchli, 2019) addresses the role of goals at different levels of abstraction in a context where behavioral interventions—predominantly engaging subordinate goals—are widely applied: physical activity; in particular, exercising in a gym. In addition to self-reported behavior, this study allows the recording of electronically measured behavior using login data from the gyms. The experimental field study ($N = 132$) examines the long-term effect of an intervention aimed to increase exercise frequency. All participants committed to the subordinate goal of exercising three times per week for three weeks. Corresponding to a 2 (superordinate goal: yes/no) \times 2 (action steps: yes/no) design, a quarter of the participants additionally generated a superordinate goal, action steps, or both. The dependent measure was exercise frequency during the intervention period (self-reported and electronically measured) and up to six months afterwards (electronically measured). Contrary to expectation, goal manipulation did not affect electronically measured frequency either in the short or long term. Goal manipulation did affect self-reported frequency during the intervention period: The results show an interaction between a superordinate goal and action steps: In the absence of action steps, a superordinate goal had a negative effect, but this negative effect dissolved when action steps

were present. Similarly, action steps exerted a positive effect in the presence of a superordinate goal, but this effect dissolved in the absence of a superordinate goal. When considering goal achievement (i.e., nine completed training sessions), the beneficial effect of a combination of superordinate goals and action steps and detrimental effect of focusing only on a superordinate goal or action steps was even more pronounced. Possible explanations for the observed effects and the differences between self-reported and electronically measured exercise frequencies are discussed.

Finally, Paper 4 (Brügger & Höchli, 2019) consists of two experiments in the context of pro-environmental and health behavior. When pursuing broad, long-term goals, people need to engage in several successive actions. Despite the need for consistent behavior, it is unclear how an action that helps achieve a given goal affects subsequent actions that contribute to the same goal. The literature provides compelling theoretical explanations and empirical evidence for positive as well as negative effects of a first goal-conducive behavior on a second goal-conducive behavior (i.e., spillover effects), which in turn raises the question of possible moderating factors. Paper 4 comprises two online experiments that explore the moderating role of personal importance on spillover effects. Thereby, a goal-theoretical perspective with a focus on the role of superordinate goals in goal pursuit is applied to elaborate the idea that the more relevant an issue is to a person, the more an initial goal-conducive act should promote positive and inhibit negative spillover. Personal relevance was operationalized using attitude considered a behavior-based latent trait (Kaiser, Byrka, & Hartig, 2010).

Study 1 ($N = 378$) provided partial support for the predicted moderating role of personal relevance in the context of pro-environmental behavior. Participants first recalled either an environmentally friendly or unfriendly action. Then we examined their likelihood of carrying out a second goal-conducive action. Persons for whom pro-environmental behavior was very important were more likely—and persons for whom pro-environmental behavior was less important were less

likely—to carry out a successive goal-conducive behavior. Study 2 ($N = 929$) included a neutral control condition as well. Participants with a weak environmental attitude supported pro-environmental petitions less strongly after an environmentally unfriendly action. In neither study was a moderating effect on health-related behavior observed. In sum, Paper 4 provides only limited evidence for the moderating role of attitude strength on behavioral spillover. It does, however, provide compelling evidence for a *direct* effect of attitude: Across both contexts, environmental and health, a stronger attitude was associated with an increased likelihood of engaging in goal-conducive behaviors.

Discussion

The aim of this dissertation was to test the idea that an additional focus on superordinate goals and a combination of goals at different levels of abstraction fosters goal pursuit. The papers provide partial, preliminary evidence for the beneficial effect of combining goals at different levels of abstraction across several contexts. As noted, the contexts were New Year’s resolutions (Paper 1), cycling to work (Paper 2), and exercising (Paper 3); both field studies (Papers 1–3) and laboratory studies (Paper 4) were used; goals at different levels of abstraction were manipulated (Papers 1–3); superordinate goals were also measured (Paper 4). While the papers only partially support the idea that combining goals at different levels of abstraction fosters goal pursuit, they contribute to the existing literature on goal pursuit in a number of ways.

First, the four papers here are some of the first to investigate with experimental field studies how goals at different levels of abstraction affect goal pursuit. To date, studies on the role of goals at different levels of abstraction are scarce and predominantly correlational (Prestwich, Perugini, & Hurling, 2008) or laboratory studies (Fishbach, Dhar, & Zhang, 2006). This dissertation project helps to overcome the lack of experimental field research on how goals at different levels of abstraction affect goal pursuit, and as such we have the opportunity to refine existing theories (Gneezy, 2017).

Second, the papers shed light not only on the direct effects of goals at different levels of abstraction, but on their interaction. With the exception of research on proximal and distal goals, there is little research on how the interaction of goals influences long-term behavior (Fishbach & Dhar, 2007; Locke & Latham, 2013). With respect to proximal and distal goals, existing research tends to show that complementing distal goals by developing proximal ones facilitates performance (Latham & Seijts, 1999; Steel & König, 2006). The present work extends this approach to goals at different levels of abstraction by exploring how they may facilitate each other (Presseau, Sniehotta, Francis, & Gebhardt, 2010). There has been growing interest in studying multiple-goal pursuit; the view that understanding the effect of multiple goals as well as their dynamic interaction is an integral part of understanding how goals operate is gaining support (Locke & Latham, 2013). The present work contributes to this growing field of research, offering a springboard for future research on the study of the combined effect of goals at different levels of abstraction.

Third, the papers have applied a new way of manipulating and measuring superordinate goals (i.e., manipulation using the laddering technique; indirect measurement using inspection of behaviors). Thus, the approaches used here can provide a starting point for future research on the role of abstract, superordinate goals in goal pursuit.

Limitations

The studies in this dissertation have at least three limitations that should be addressed. First, field experiments allow only limited control over many contextual factors due to the dynamics inherent in any field setting, and are therefore susceptible to much uncontrolled variability (Gneezy, 2017). This is a limitation in the present research, and introduces challenges for data analysis and interpretation. An example of such a contextual factor that is likely to influence goal pursuit but is not captured by the present studies is time-related effects: Goal pursuit is often a long process consisting of several phases: from the initiation of a behavior, the transition of the initial

phase to the halfway point, to the advanced phase (e.g., action phase model; Heckhausen & Gollwitzer, 1987). Goals at different levels of abstraction might not be equally beneficial across all stages (Höchli et al., 2018). Depending on the stage, goals at different levels of abstraction can have different effects, both positive and negative. However, in the present studies we did not account for whether a person is in the pre-decisional phase, has already formed an intention to pursue the goal, or has even already started to pursue the goal before the start of the experiment. Especially in the context of New Year's resolutions (Paper 1), cycling to work (Paper 2), and exercising (Paper 3), where participants volunteered for the research, it can be assumed that the majority of participants considered the topic to be important, and may have already given much thought to it, or even taken previous initiatives to change their behavior in the desired direction.

A second limitation is that the present studies predominantly focus on self-reported or observed behavior as the main outcome variable, thus limiting the ability to investigate the psychological processes underlying the behavior and preventing a more detailed picture of the advantages and disadvantages of goals at different levels of abstraction. Goals at different levels of abstraction can trigger different processes by which they affect goal pursuit—both in a positive and negative way (Höchli et al., 2018). For example, subordinate goals may increase self-efficacy and as such positively influence goal pursuit (Bandura, 1997), but they also may promote premature disengagement. Superordinate goals may help sustain motivation but may be too vague to be helpful for action initiation (Locke & Latham, 2002). It is even possible that the aforementioned processes cancel each other out, so that no effect on behavior is observable.

A final limitation concerns goal manipulation. In the present research a new way of manipulating superordinate goals was tested. Although the manipulation task used to activate a superordinate goal did lead people to think of their goal as more abstract, three caveats must be mentioned, especially for studying broad, long-term goal pursuit.

First, goal manipulation may have been too weak. Participants completed the goal manipulation task in just a few minutes. It is conceivable that a goal formulated so quickly—even if a reminder is sent from time to time—does not remain active for several months. Future research could test more robust goal manipulation (e.g., over a longer period of time, with repeated manipulation tasks) to better study long-term goal pursuit.

Second, we cannot rule out that participants in the no-superordinate-goal condition may nevertheless have had a superordinate goal. Goals in a hierarchy are connected and can activate one another (Kruglanski et al., 2002); therefore activating a subordinate goal can lead to activation of a superordinate one even if the person did not engage in a corresponding manipulation task. Furthermore, research on unconscious goal pursuit suggests that goals can guide behavior outside a person's awareness, for example, by contextual stimuli (Aarts & Dijksterhuis, 2000; Fishbach et al., 2006). Such an unconscious goal activation might interfere with the goal manipulation in field experiments.

Third, the manipulation task allowed every participant to formulate their own superordinate goal. As the experimenter, I had no control over the content of the goal. To illustrate, the superordinate goal of a person trying to lose weight might have been “to be healthy,” but could just as easily have been “to be accepted by my peer group,” “to perform better in my job,” or “to find a romantic partner.” An alternative that allows more control over the manipulation would be to assign the same superordinate goal to all participants. This was deliberately not done in the present research, because superordinate goals are by definition intrinsically important and related to a person's ideal self (Boekaerts et al., 2006; Carver & Scheier, 2001). Thus, it is unlikely that a single, externally assigned goal will meet these criteria for a broad study sample.

Future Research

The results of the present research as well as its limitations provide a starting point for future work on how a combination of goals at different levels of abstraction might influence goal pursuit.

Five main directions for future research are outlined below.

First, it would be interesting to study the effect of goals at different levels on different outcome variables. Because goals at different levels of abstraction have different benefits for goal pursuit, it is conceivable that the benefits cannot all be captured equally well with the same outcome measure, such as the frequency with which a person engages in a focal behavior. This assumption is supported by the results of Paper 3, where the effect of goal manipulation varied depending on whether electronically measured or the self-reported exercise frequency is the dependent variable. Studies that investigate the effect of goals at different levels on outcomes other than frequency would deepen the understanding of the role of goals at different levels of abstraction on goal pursuit. Such additional outcome variables include well-being and enjoyment of goal pursuit, intensity or precision of behavior, establishment of new habits, resilience in the face of goal failures and setbacks, and the likelihood of engaging in unethical behavior.

Second, in order to provide insights about the underlying processes, it may be useful to converge the evidence from field studies with laboratory experiments. As part of the preparation for the present field studies, several laboratory studies were conducted. It turned out that the main dependent variable of interest—the long-term effect on the goal-relevant behavior—can be assessed only to a limited extent in short-term laboratory studies. For this reason, the present research focuses on long-term studies in the field. To explore underlying processes in future research, however, it would be interesting to return to laboratory studies, which would allow better control of the “noise” (Gneezy, 2017). Promising avenues include research on how a shift in reference points during goal pursuit (e.g., changing the reference point from the starting point to the desired end state) affects

motivation (Bonezzi et al., 2011), and to apply such a change in reference to goals at different levels of abstraction (e.g., changing the reference point from a goal at a low level of abstraction to a higher level). Similarly, experimental research on goals and mental accounting (e.g., how narrow vs. broad brackets affect behavioral regulation) could serve as a springboard for experiments on the effect of goals at different levels of abstraction on goal pursuit (Koch & Nafziger, 2017). As superordinate goals encompass several subordinate goals, they align with the distinction between broad and narrow brackets. An additional conceivable approach is experiments that do not measure goal pursuit over time, but rather look closely at a given point in time, where a change from a subordinate goal to a superordinate goal would be helpful from a theoretical point of view; for instance, at the time a subordinate goal is attained (Huang & Aaker, 2019).

Third, the boundary conditions of the effect of goals at different levels of abstraction on goal pursuit would be an interesting avenue for future research. Initial evidence suggests that situational factors such as stress, affect, and self-regulatory resources (Latham & Locke, 2007; Locke & Latham, 2006)—as well as more stable factors such as economic preferences (Becker, Deckers, Dohmen, Falk, & Kosse, 2012; Falk et al., 2018; Koch & Nafziger, 2011b), personality traits (Wiggins, 1996), and regulatory focus (Higgins, 1997, 1998)—influence goal pursuit. Singly or in interaction, each of these might interact positively or negatively with goals at different levels of abstraction to influence goal pursuit (Latham, Ganegoda, & Locke, 2011).

Fourth, future research could address limitations of experimental goal manipulation. Specifically, even without a manipulation task, people might focus independently and adaptively on goals at different levels of abstraction. Besides laboratory experiments that allow greater control (Bonezzi et al., 2011) we should investigate situations in which people are unlikely to already have existing superordinate goals; for example, when they are confronted with a completely new situation, such as after moving house, starting a family, or losing a job.

Finally, the question of how to measure goals at different levels of abstraction deserves more attention (Touré-Tillery & Fishbach, 2014). Paper 4 measures personal relevance with relatively stable behavioral dispositions. Superordinate goals are idealized conceptualizations of oneself (related concepts are values, attitudes, and identities; Höchli et al., 2018); superordinate goals could therefore be conceived as trait variables—in contrast to subordinate goals, conceived as state variables. The consideration of superordinate goals as traits and subordinate ones as states converges with research on how personal traits modulate the effects of subordinate goals on goal attainment (Latham et al., 2011), suggesting yet another approach to how goals at different levels of abstraction could be measured and how experiments could be designed.

Conclusion

Understanding the effect of multiple goals and their interaction is necessary for a full understanding of how goals operate. However, there is little research to date on how goals at different levels of abstraction facilitate one another and how their combination can influence long-term goal pursuit. The present dissertation addresses this gap and, despite several limitations, provides initial evidence that a combination of goals at different levels of abstraction fosters goal pursuit more effectively than goals at either one level or another. By investigating the idea both theoretically and experimentally, it is hoped that the dissertation provides a compelling impetus for future research.

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Paper 1

Making New Year's Resolutions that Stick: Exploring how Superordinate and Subordinate Goals Motivate Goal Pursuit

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Making New Year's Resolutions that Stick: Exploring how Superordinate and Subordinate Goals Motivate Goal Pursuit

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Background: New Year's Eve is a time when people make resolutions, but, more often than not, fail to achieve them. Previous research highlighted the positive effect of subordinate goals in goal pursuit. We argue that combining superordinate and subordinate goals contributes to successful goal pursuit, especially in the long run. We test whether a simultaneous focus on both goal types helps people to keep their resolutions. **Methods:** Using a 2×2 between-subjects design, participants ($N = 256$) formulated a resolution from which they derived either a superordinate (*yes/no*) or a subordinate goal (*yes/no*). The control group focused exclusively on a self-set resolution. Main outcome measures were *effort in goal pursuit* and *intentions to further pursue the goal* after 3 months. **Results:** Focusing on superordinate and subordinate goals increased the amount of effort invested in goal pursuit. A group difference was found only between the group focusing on both goal types and the group focusing on a superordinate goal. No statement could be made about intentions for further goal pursuit and processes by which goal type affects goal pursuit. **Conclusion:** The study provides preliminary insights into how combining superordinate and subordinate goals may be a helpful strategy to pursue long-term goals.

Keywords: behavioral change, field study, goal hierarchy, goal pursuit, motivation, new year's resolutions

INTRODUCTION

New Year's Eve is a time when people make resolutions to do better, to finish projects, and achieve goals. Motivation is high on the first day of January, but it tends to decrease over time and many, if not the majority of, New Year's resolutions are ultimately abandoned. By making a resolution, people are setting goals that they want to pursue. One line of research that fits the particulars of this process is goal-setting theory, which examines the way people set goals and the

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influence that the type of goal has on subsequent motivation and performance (Locke & Latham, 2002, 2013). Goal-setting theory proposes that, unlike abstract superordinate goals, setting specific goals (i.e. subordinate goals) boosts performance (Locke & Latham, 2002, 2013). From this perspective, the formulation of a New Year's resolution in the form of a subordinate goal should be a successful strategy.

Studies that highlight the advantages of subordinate goals predominantly examine the effect of a single goal on initiating a specific action or behavior during a limited time period (Locke & Latham, 2002; see also Presseau, Sniehotta, Francis, & Gebhardt, 2010). However, New Year's resolutions tend to have a broad focus and require long-term behavioral changes whereby, after first achieving the subordinate goal, people must also: continue to take goal-congruent actions, sustain motivation over the long term, resist the pull of competing goals and temptations, overcome compensation effects, and be resilient when faced with setbacks and failures (Rothman, Baldwin, Hertel, & Fuglestad, 2004). When addressing broad, long-term challenges, subordinate goals alone may not be a "silver bullet" (Ordóñez, Schweitzer, Galinsky, & Bazerman, 2009) and may even have detrimental effects on maintaining goal-congruent behavior beyond the first successful step (e.g. resting on laurels, Amir & Ariely, 2008; post-fulfillment inhibition, Förster, Liberman, & Higgins, 2005; Zeigarnik effect, Zeigarnik, 1927). This can limit or potentially reverse possible intervention effects. An example of this type of reversal is observed in dieters who successfully lose weight during the course of a diet but regain weight afterwards (e.g. Lowe, Miller-Kovach, & Phelan, 2001).

One approach that might help to improve the pursuit of New Year's resolutions over the course of the year and to manage the transition between behavior initiation and maintenance is to incorporate a focus on superordinate goals into the plan (Höchli, Brügger, & Messner, 2018).

Researchers generally agree that goals are hierarchically structured with abstract superordinate goals at the top and concrete subordinate goals at the bottom (Austin & Vancouver, 1996; Carver & Scheier, 2001), and that the goals within this hierarchy are interconnected and, as a consequence, can activate or inhibit each other (Kruglanski et al., 2002). While the motivational benefits of subordinate goals have been widely researched (Locke & Latham, 2002), relatively little is known about how superordinate goals influence goal pursuit and how they interact with subordinate goals (Day & Unsworth, 2013). We argue that although superordinate goals are by definition more abstract than subordinate goals, they represent or broadly define what people ultimately value and aspire to (Carver & Scheier, 2001; see also Schwartz et al., 2001) and that at least two characteristics of superordinate goals may confer several advantages for goal pursuit.

The first characteristic of superordinate goals that may confer an advantage is that they are fundamental to the overriding sense of self and intrinsically more

important than subordinate goals (Carver & Scheier, 2001). The heightened importance given to superordinate goals increases goal commitment (Bou-drenghien, Frenay, Bourgeois, Karabenick, & Eccles, 2013). This implies that people should be more motivated to carry out behaviors or subordinate goals to the extent to which they are linked to a person's superordinate goals (Day & Unsworth, 2013; Kruglanski et al., 2002; Shah, Friedman, & Kruglanski, 2002). In a similar vein, linking a behavior (or subordinate goal) to a superordinate goal that is important for one's sense of self can increase a person's anticipated regret (i.e. beliefs about whether or not feelings of regret will arise) from inaction, thus aiding successful goal pursuit (Prestwich, Perugini, & Hurling, 2008).

Furthermore, superordinate goals—and the corresponding, high level of commitment they promote—not only increase motivation, but also help to resolve goal conflicts and inhibit temptations. In situations where goal conflicts arise, focusing on superordinate goals can help one to prioritise, and inhibit alternative goals and temptations. Goals that are important to a person and to which the commitment is high—that is, superordinate goals—are more likely to be prioritised over subordinate goals lower on the level of importance and commitment (Sun & Frese, 2013). Superordinate goals can also help to inhibit alternative goals and temptations because the extent to which a person is able, or willing, to inhibit alternative goals depends on their commitment to the goal; and the stronger the commitment, the more its activation inhibits the accessibility of alternative goals (Shah et al., 2002). The inhibition effect of superordinate goals is further reinforced by the fact that temptations can activate superordinate goals, which in turn inhibits temptation and promotes further goal-congruent actions (Fishbach, Friedman, & Kruglanski, 2003).

A second characteristic of superordinate goals that fosters goal pursuit is its long-term nature. Superordinate goals (e.g. “to live a healthy life”) are often open-ended (i.e. without a clear end date) and cannot be achieved in a single first step. As a consequence, people experience a sense of discrepancy between their current situation (i.e. status quo) and their goal (Festinger, 1962), which signals (a) that the goal has not been achieved, (b) that the task has not been performed to their satisfaction, and/or (c) that there is a weakness in an area of personal importance (Fishbach & Dhar, 2007). Due to this discrepancy, even after achieving a first step, people focusing on superordinate goals do not feel that they have “done enough” and feel as though they should continue in their goal pursuit.

In the stages between setting and achieving a goal, focusing on a combination of these goals confers the advantages of both. Goals at the bottom of the goal hierarchy are very concrete and specific. These qualities facilitate self-efficacy beliefs (Bandura, 1997). When concrete subordinate goals are then combined with specific mental links between situational cues and anticipated goal-related actions, they are particularly effective at initiating goal-directed actions and overcoming situational obstacles (Gollwitzer, 1999). However, while subordinate goals promote the initiation of a specific action (Locke & Latham, 2002), they

also risk early disengagement from goal pursuit (Zeigarnik, 1927). In contrast, superordinate goals are less motivating when initiating behavior (Locke & Latham, 2002) but can be helpful in maintaining behavior over time (Höchli et al., 2018). We argue that focusing on both superordinate and subordinate goals confers respective advantages: People are more motivated to pursue subordinate goals that are associated with an intrinsically important superordinate goal, and they are better able to successfully deal with conflicting goals and temptations while still being motivated to initiate goal-oriented action. At the same time, the respective negative effects of both goal types are balanced out: People who focus on both superordinate and subordinate goals do not run the risk of early disengagement or lack of motivation due to an overly abstract goal disconnected from actual behavior and without enough information on how to attain the goal.

Although theory supports the idea that combining superordinate and subordinate goals may foster goal pursuit in the long run, and first correlative results support the hypothesis that both subordinate goals and superordinate goals may foster goal pursuit in a distinct or interactive way (Prestwich et al., 2008), experimental studies are scarce (e.g. Fishbach, Dhar, & Zhang, 2006; Höchli, Brügger, Abegglen, & Messner, 2019). In our study, in order to determine whether a combination of superordinate and subordinate goals would be more likely to help people keep their New Year's resolution, we asked participants to make a resolution from which they derived either (a) a superordinate goal, (b) a subordinate goal, (c) both a superordinate and a subordinate goal, or (d) no additional goal beyond the self-set New Year's resolution. Then, 3 months after New Year's Eve, we compared the effort invested in goal pursuit and intention to pursue the goal past the end of the 3-month study between the four goal conditions. Furthermore, we examined the effect of goal manipulation on participants' commitment to the goal, and the effect of perceived success in goal pursuit as a proxy for the discrepancy between the status quo and the desired end state to gain an initial insight into possible processes through which the additional focus on a superordinate goal can foster goal pursuit.

METHOD

Participants

Participants were recruited via an online advertisement in one of the largest Swiss daily newspapers to achieve a sample size as large and diverse as possible. The ad was run from 28 December 2016 until 8 January 2017 and included our eligibility requirement: participants must have made a New Year's resolution they want to achieve. As an incentive, participants were entered into a prize draw for four shopping vouchers (500 Swiss francs each). Due to the exploratory

character of the study, no a priori sample size was calculated. A total of 365 participants completed the starting questionnaire and thus were eligible for the study (i.e. they gave their email address so that their answers could be identified and the participants could be contacted again for the following parts of the survey). Of the 365 participants who completed the starting questionnaire, 271 completed the final questionnaire. To ensure good data quality, we only retained participants who (a) provided meaningful answers in the manipulation task and (b) did not fundamentally change their goal during the study (i.e. changed the level of abstraction of their goal). Based on these criteria, we excluded 15 participants; seven were excluded due to meaningless answers in the manipulation task and eight were excluded for fundamentally changing their goal. For more detail, see "Manipulation of goal focus" under "Measures and Materials". The final sample consisted of 256 participants (197 women, 59 men; $M_{\text{age}} = 35.01$ years, $SD_{\text{age}} = 14.81$ years; see Supplementary Material, Figure S1). For the drop-out analysis, see Supplementary Material, Table S1.

Design

We randomly assigned participants to one of four conditions using a 2 (superordinate goal: *yes/no*) by 2 (subordinate goal: *yes/no*) between-subjects design. The four different goal foci conditions included: (a) a superordinate goal focus ($n = 72$), (b) a subordinate goal focus ($n = 56$), (c) a superordinate and subordinate goal focus ($n = 59$), and (d) no focus beyond the self-set New Year's resolution ($n = 69$, see Supplementary Material, Figure S1). Three months after the start of the study, we collected participant data on dependent variables including: invested effort 3 months into the study, intent to pursue the goal further after the end of the 3-month study, commitment to the goal, and perceived success in goal pursuit.

Procedure

Participants completed an online survey consisting of seven parts: a starting questionnaire, five goal reminders during the 3 months of goal pursuit, and a concluding questionnaire. The starting questionnaire was completed around New Year's Eve. Consent for participating in the research was obtained by asking participants to only continue if they had read the instructions provided and agreed to them and if they were willing to participate in our study. Then, participants indicated their self-set New Year's resolution and underwent goal manipulation, a manipulation check, and control measures for age and gender. Two weeks later, participants were sent the first of five goal reminders with each new goal reminder (identical to the first) following every 2 weeks over the course of the 3-month study with the primary purpose of reminding the participant of the goal they set in the starting questionnaire. Three months after completing the starting

questionnaire, participants were sent a concluding questionnaire designed to assess their perceived success in goal pursuit during the last 3 months and assess their commitment to the goal at the end of the study. It also assessed whether they had completed or changed their goal, the effort invested in their goal pursuit at the moment, and their intentions for future goal pursuit. As this study looks at New Year's resolutions from a broad perspective, additional variables that are not a topic of this article (e.g. whether participants interpreted their behavior as progress or commitment) were assessed but not evaluated in the context of this paper. For an overview of all assessed variables, see Supplementary Material, Table S2. All survey elements were designed in Qualtrics and distributed via email.

Measures and Materials

Manipulation of Goal Focus. Participants in the *superordinate goal group* were asked to list three reasons *why* they want to pursue their self-set New Year's resolution. To illustrate, if a person who made it their New Year's resolution to play more sports were asked *why* they made that goal, answers may include a desire to live a healthier life, to look attractive, or to feel energetic. From this list, participants were then asked to choose the reason that was most important to them and, based on this reason, formulate a superordinate goal starting with "I want to be a person who..." (Based on the list above, a possible superordinate goal could be "I want to be a person who looks attractive.") In contrast, participants in the *subordinate goal group* were asked to list three concrete actions or steps describing *how* they want to pursue their self-set New Year's resolution. For example, if a participant in the subordinate goal group were asked how they intended to pursue a resolution to play more sports, answers may include jogging twice a week, cycling to work, or using the stairs instead of the elevator. Participants were then asked to choose the action that was most important to them, and formulate a subordinate goal based on this action such as "I want to jog twice a week" (for a similar approach see Taylor, Bagozzi, Gaither, & Jamerson, 2006). Participants in the third group, the *superordinate and subordinate goal group*, first derived a superordinate goal in the same way as the participants in the superordinate goal group. Then they were asked to list three concrete actions or steps describing how they would like to pursue their self-set New Year's resolution in the same way as the participants in the subordinate goal group. Participants in the fourth group focused on the self-set New Year's resolution that they indicated at the beginning of the start questionnaire; they did not formulate any additional goals based on their New Year's resolution.

Two members of the research team separately reviewed the formulated goals and assessed whether the manipulation instructions were followed as advised (i.e. confirmed that participants who had to formulate a superordinate goal

actually formulated a goal which starts with “I want to be a person who. . .” and that their goals were a meaningful response to *why* they were pursuing their resolution). They also each confirmed that participants who had to formulate a superordinate goal made meaningful goals that depicted *how* they were going to pursue their resolution. The two sets of analyses were then compared. If the assessments differed, discrepancies were discussed and resolved consensually.

Manipulation Check. To check whether the manipulation was successful in deriving the participant's goals, we used an adapted version of the self-report measure of abstraction (Burrus & Roese, 2006, Cronbach's $\alpha = 0.69$). Participants rated their goal on a 5-point scale for the following categories: from *side issue for my life as a whole* (1) to *central to my life as a whole* (5); *simple* (1) to *complicated* (5); *short-term goal* (1) to *long-term goal* (5); *small picture* (1) to *big picture* (5); *focus on “how” something gets done* (1) to *focus on “why” something gets done* (5); and *influences minor detours in life* (1) to *influences overall path of life* (5). On this 5-point scale, a rating of one corresponds to a concrete subordinate goal and five to an abstract superordinate goal. Abstraction scores were derived by taking the mean of the items.

Perceived Success in Goal Pursuit. Participants were asked how successful they perceived their goal pursuit to be over the last 3 months on a 7-point Likert scale (1 = *unsuccessful* to 7 = *successful*).

Commitment. Participants rated their commitment to their goal using Klein, Wesson, Hollenbeck, Wright, and DeShon's (2001) five-item scale (Cronbach's $\alpha = 0.62$) on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*).

Goal Completion. Participants indicated whether they had completed their goal at the end of the study (*yes/no*).

Goal Change. Participants indicated whether they had changed their goal since the start of the study (*yes/no*). Participants who changed their goal were asked to describe the change. The follow-up questions then related to the new goal. Two researchers reviewed the new goal and assessed whether it was at the same level of abstraction as the original goal (i.e. whether it still answered *why* or *how* to pursue the resolution) or had changed fundamentally (i.e. level of abstraction of the goal was changed). Each researcher completed their analyses separately and then they compared their conclusions. If their assessments differed, discrepancies were discussed and resolved consensually.

Effort Invested in Goal Pursuit. Participants answered “how strongly are you currently pursuing your goal?” using a 5-point Likert scale from 1 = *not at*

all to 5 = *very much* to assess how much effort participants had invested in goal pursuit after 3 months. Participants who had changed their goal were asked how strongly they were pursuing their new goal.

Intentions for Future Goal Pursuit. On a 5-point Likert scale, participants were asked to indicate the probability of pursuing their goal further after the end of the study (1 = *definitely not* to 5 = *definitely*) and how long they planned to pursue their goal (1 = *less than a week* to 7 = *indefinitely*). They were also asked to indicate how much effort they planned to invest in goal pursuit in the remaining time (1 = *none* to 5 = *very much*). Participants who changed their goal or set a new goal during the previous 3 months were asked the same questions regarding their new goal.

RESULTS

Manipulation Check

A two-way analysis of variance (ANOVA) showed a direct effect of superordinate condition on the self-reported measure of abstraction, $F(1, 252) = 2.32$, $p = .024$ (see Table 1). This indicates that participants who thought about *why* they wanted to pursue their New Year's resolution (superordinate condition, $M = 3.80$, $SD = 0.62$; superordinate and subordinate condition, $M = 3.79$, $SD = 0.62$) assessed their goal as more superordinate than participants who did not (subordinate condition, $M = 3.50$, $SD = 0.83$; control condition, $M = 3.69$, $SD = 0.61$, see Supplementary Material, Table S3). No significant direct effect of the subordinate condition nor an interaction effect was found, indicating that formulating *how* the New Year resolution should be pursued did not lead to more concrete formulation of one's goal.

Goal Changes and Completions: No Variation across Conditions

To verify that a change in the goal or completion of the goal during the study period was not dependent on the manipulation condition, two one-way ANOVAs were conducted. Forty-seven participants changed their goal during goal pursuit but their new goals did not change their level of abstraction, and they were kept in the sample. There was no significant difference in the number of participants who changed their goal across the four conditions, $\chi^2(3, N = 238) = 3.70$, $p = .296$. Similarly, repeating all the analyses of this study with an additional dummy variable to control for goal change did not change this study's results in direction and meaning (see Supplementary Material, Table S4).

TABLE 1
 Fixed Effects ANOVA Results Using the Manipulation Check, Effort in Goal Pursuit, Intention to Further Pursue the Goal, Intended Length of Further Goal Pursuit, Intended Effort in Further Goal Pursuit, Commitment, and Perceived Success as a Criterion

| | <i>Sum of squares</i> | <i>df</i> | <i>Mean Square</i> | <i>F</i> | <i>p</i> | <i>partial η²</i> | <i>partial η² 95% CI [LL, UL]</i> |
|---|-----------------------|-----------|--------------------|----------|----------|------------------------------|--|
| Rating of Goal Abstraction | | | | | | | |
| Superordinate Goal | 2.32 | 1 | 2.32 | 5.18 | .024 | 0.02 | |
| Subordinate Goal | 0.61 | 1 | 0.61 | 1.36 | .245 | 0.01 | [0.00, 0.04] |
| Superordinate × Subordinate Goal | 0.50 | 1 | 0.50 | 1.12 | .291 | 0.00 | [0.00, 0.03] |
| Error | 112.68 | 252 | 0.45 | | | | |
| Effort in Goal Pursuit | | | | | | | |
| Superordinate Goal | 0.44 | 1 | 0.44 | 0.67 | .414 | 0.00 | |
| Subordinate Goal | 1.98 | 1 | 1.98 | 2.99 | .085 | 0.01 | [0.00, 0.05] |
| Superordinate × Subordinate Goal | 4.57 | 1 | 4.57 | 6.88 | .009 | 0.03 | [0.00, 0.08] |
| Error | 155.47 | 234 | 0.66 | | | | |
| Intention to Further Pursue the Goal | | | | | | | |
| Superordinate Goal | 0.01 | 1 | 0.01 | 0.04 | .841 | 0.00 | |
| Subordinate Goal | 0.36 | 1 | 0.36 | 1.18 | .279 | 0.00 | [0.00, 0.04] |
| Superordinate × Subordinate Goal | 0.14 | 1 | 0.14 | 0.47 | .492 | 0.00 | [0.00, 0.03] |
| Error | 76.97 | 252 | 0.31 | | | | |
| Intended Length of Further Goal Pursuit | | | | | | | |
| Superordinate Goal | 10.75 | 1 | 10.75 | 8.92 | .003 | 0.03 | |
| Subordinate Goal | 0.02 | 1 | 0.02 | 0.01 | .906 | 0.00 | [0.00, 0.01] |
| Superordinate × Subordinate Goal | 0.12 | 1 | 0.12 | 0.10 | .748 | 0.00 | [0.00, 0.02] |
| Error | 303.70 | 252 | 1.21 | | | | |
| Intended Effort in Further Goal Pursuit | | | | | | | |
| Superordinate Goal | 0.00 | 1 | 0.00 | 0.00 | .991 | 0.00 | |
| Subordinate Goal | 0.38 | 1 | 0.38 | 0.77 | .382 | 0.00 | [0.00, 0.03] |
| Superordinate × Subordinate Goal | 0.34 | 1 | 0.34 | 0.69 | .408 | 0.00 | [0.00, 0.03] |
| Error | 123.66 | 252 | 0.49 | | | | |
| Commitment to the Goal at the End of the Study | | | | | | | |
| Superordinate Goal | 0.01 | 1 | 0.01 | 0.02 | .889 | 0.00 | |
| Subordinate Goal | 0.47 | 1 | 0.47 | 1.63 | .202 | 0.01 | [0.00, 0.04] |
| Commitment at Start | 7.12 | 1 | 7.12 | 24.80 | .000 | 0.09 | [0.03, 0.16] |
| Superordinate × Subordinate Goal | 0.00 | 1 | 0.00 | 0.00 | .952 | 0.00 | [0.00, 1.00] |
| Error | 72.07 | 251 | 0.29 | | | | |
| Perceived Success in Goal Pursuit | | | | | | | |
| Superordinate Goal | 0.84 | 1 | 0.84 | 1.11 | .293 | 0.00 | |
| Subordinate Goal | 3.22 | 1 | 3.22 | 4.26 | .040 | 0.02 | [0.00, 0.06] |

TABLE 1 (Continued)

| | <i>Sum of squares</i> | <i>df</i> | <i>Mean Square</i> | <i>F</i> | <i>p</i> | <i>partial η^2</i> | <i>partial η^2 95% CI [LL, UL]</i> |
|---|-----------------------|-----------|--------------------|----------|----------|------------------------------------|--|
| Superordinate \times Subordinate Goal | 0.87 | 1 | 0.87 | 1.15 | .285 | 0.00 | [0.00, 0.03] |
| Error | 190.64 | 252 | 0.76 | | | | |

Note: LL and UL represent the lower limit and upper limit of the partial η^2 confidence interval, respectively.

Eighteen participants had completed their goal by the end of the study, but there was no significant difference in the number of participants who completed their goal across the four conditions, $\chi^2(3, N = 256) = 2.78, p = .427$.

Long-Term Implications of Goal Focus on Effort in Goal Pursuit

We analyzed the amount of effort participants invested in goal pursuit 3 months after the start of the study. A two-way ANOVA confirmed our prediction that combining superordinate and subordinate goals motivated goal pursuit 3 months after the start of the study (see Table 1). There was a significant interaction effect between formulating a superordinate goal and formulating a subordinate goal on the amount of effort invested in goal pursuit after 3 months, $F(1, 234) = 4.57, p = .009, \eta_p^2 = 0.03$ (see Table 1 and Figure 1A). There was no main effect from formulating a superordinate or a subordinate goal alone. Examination of the means shows that focusing on both goal types ($M = 4.17, SD = 0.88$) fostered goal pursuit particularly well compared to focusing solely on a subordinate goal ($M = 3.94, SD = 0.73$) or solely a superordinate goal ($M = 3.71, SD = 0.84$), while focusing on no additional goal ($M = 4.05, SD = 0.79$) differed only slightly from focusing on both goals. However, a simple effects analysis shows that only the difference between participants focusing on both goal types and participants focusing solely on superordinate goals was statistically significant ($p = .004$).

A series of two-way ANOVAs was then run to test the effect of goal conditions on participant intentions to pursue their goal after the end of the study (see Table 1). There was no main or interaction effect of goal conditions on the probability of pursuing the goal further, $F(3, 252) = 0.56, p = .640$, but there was a main effect of superordinate goal formulation on the length of time participants intended to pursue their goal after the end of the study, $F(1, 252) = 10.75, p = .003, \eta_p^2 = 0.03$. Participants who focused on a superordinate goal intended to pursue their goal for a longer time than those who did not focus on a superordinate goal (see Figure 1B). However, we found that participants from all four

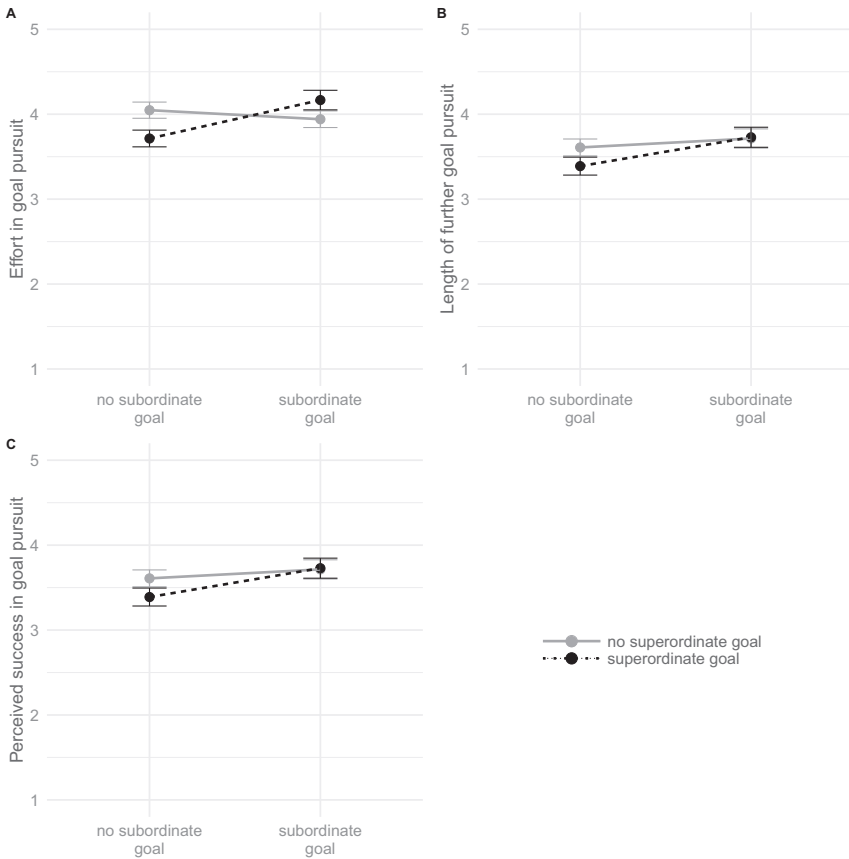


FIGURE 1. Effects of focusing on a superordinate goal, a subordinate goal and their interaction on effort in goal pursuit (A), length of further goal pursuit (B), and perceived success in goal pursuit (C).

goal conditions intended to pursue their goal for a long time in general ($M = 6.43$, $SD = 1.11$, on a scale from 1 = *less than a week* to 7 = *indefinite*). With regard to how much effort participants intended to invest in the remaining goal-pursuit time, no main effects nor interaction effects were found, $F(3, 252) = 0.49$, $p = .693$.

Initial Insights on Commitment and Perceived Success in Goal Pursuit

To gain initial insights on possible processes by which different goal foci may influence subsequent goal pursuit, we tested the effect of goal conditions on goal

commitment and perceived success at the end of the study. A two-way analysis of covariance (ANCOVA) showed a positive effect of commitment at the start of the study on commitment at the end of the study, $F(1, 251) = 7.12, p < .001, \eta_p^2 = 0.09$. No main or interaction effect of goal condition on commitment at the end of the study was found (all $p > .202$; see Table 1). This result was not in line with our expectation that a focus on superordinate goals would foster goal pursuit by enhancing commitment. However, this might indicate the possibility of a ceiling effect because participant commitment was high across all conditions at the beginning ($M = 4.32, SD = 0.58$ on a scale from 1 = *strongly disagree* to 5 = *strongly agree*).

We also ran a two-way ANOVA to assess the effects of goal conditions on perceived success in goal pursuit and found that there was a main effect of formulating a subordinate goal on perceived success of goal pursuit during the study, $F(1, 252) = 3.22, p = .040, \eta_p^2 = 0.02$. Participants who formulated a subordinate goal perceived their goal pursuit as more successful than participants who did not formulate a subordinate goal. This finding is in line with our expectation that the discrepancy between the status quo and the desired end state disappears when focusing on a subordinate goal but remains when focusing on a superordinate goal (see Figure 1C). Although the effect of the interaction term was not statistically significant, the results indicate that perceived success (as a proxy for the existing discrepancy) is salient when focusing solely on a superordinate goal and decreased when participants focused on both superordinate and subordinate goals.

DISCUSSION

Pursuing long-term goals is difficult and requires effort. This is demonstrated by the common perception that New Year's resolutions are difficult to maintain over longer periods of time. While goal-setting theory focuses primarily on the advantages of subordinate goals for successful goal pursuit, we argue that superordinate goals fulfill a crucial role in fostering successful goal pursuit, especially over the long run. As such, our study tested whether combining superordinate and subordinate goals would be more likely to help people keep their New Year's resolution.

We found a positive interaction effect between formulating a superordinate and formulating a subordinate goal on self-reported effort in goal pursuit 3 months into the study. Examination of the means showed that focusing on both goal types fostered goal pursuit particularly well compared to focusing solely on one goal type or the other, while focusing on no additional goal differed only slightly from focusing on both goals. A significant group difference was found only between the group focusing on both goal types and the group focusing solely on a superordinate goal. The probability of whether participants intended to further pursue their goal after the end of the study and how much

effort they intended to invest in this remaining time did not differ due to goal conditions, but focusing on a superordinate goal had a positive direct effect on the duration that the participants intended to pursue the goal further. While goal focus had no effect on commitment to the goal (commitment to goal pursuit was already high across all four groups at the beginning of the study), we found that participants focusing on a subordinate goal perceived their goal pursuit to be more successful than participants who did not focus on a subordinate goal.

Direct and Interactive Effects of Goals at Different Levels of Abstraction

These findings partially support our idea that combining superordinate and subordinate goals would help people successfully pursue their goals, especially in the long run. While this is one of the first studies to experimentally test the effect of a combination of superordinate and subordinate goals (compared to having a sole superordinate goal, a sole subordinate goal, or no additional goal) in the field, our results are in line with studies from other streams of research. Studies on proximal and distal goals show that people who have both goals perform better than those who have only distal goals (Latham & Seijts, 1999; Steel & König, 2006). This aligns with our idea that focusing on both superordinate and subordinate goals motivates goal pursuit more than focusing solely on superordinate goals. Further support for the beneficial effect of a combination of superordinate and subordinate goals for goal pursuit stems from a study by Fishbach et al. (2006), where four vignette experiments were used to determine how successfully achieving (versus failing to achieve) a subordinate goal can influence subsequent goal pursuit. Fishbach et al. found that participants who focused on successfully completing a single, subordinate goal were less likely to take additional goal-congruent action in comparison to those who also focused on a superordinate goal.

The advantage of a combination of superordinate and subordinate goals for goal pursuit is further reflected in the research on goal facilitation (e.g. Presseau, Tait, Johnston, Francis, & Sniehotta, 2013; Riediger & Freund, 2004). Intergoal facilitation occurs when the pursuit of one goal simultaneously increases the likelihood of success in reaching another goal. This can occur due to instrumental relations between goals, implying that progressing toward one goal also represents progressing toward another goal (Riediger & Freund, 2004). In the context of the goal hierarchy, a subordinate goal (e.g. jogging twice a week) connected to a more superordinate goal (e.g. leading a healthy life) can thus be seen as an instrumental means to facilitate the pursuit of a more superordinate goal. Furthermore, intergoal facilitation can occur due to overlapping goal attainment strategies, implying that one action is instrumental in the pursuit of more than one goal (Riediger & Freund, 2004); in the context of goal hierarchy, pursuing a certain goal (e.g. jogging twice a week) is likely to be effective for more than

one superordinate goal (e.g. to look attractive and to lead a healthy life). Inter-goal facilitation has been shown to increase engagement in goal-directed actions (Presseau et al., 2010, 2013). Importantly, a field study in the context of exercising showed that intergoal facilitation was associated with higher exercise adherence only in the fourth and fifth months of the study interval, indicating that intergoal facilitation particularly enhances long-term persistence in goal pursuit (Riediger & Freund, 2004; Study 2). As our study covered a period of only 3 months, it is possible that the impact of a combination of superordinate and subordinate goals had not yet fully unfolded—which may explain why our findings only partially support our hypotheses.

Finally, preliminary research on the positive direct effect, as well as the interactive effect of superordinate and subordinate goals, stems from research on goal desires (Prestwich et al., 2008). Goal desires—defined as the extent to which one wants to achieve a superordinate goal by performing a certain action—have been shown to moderate the effect of a behavioral intention on actual behavior. The results also show a direct effect of goal desires on behavior that further emphasises the importance of considering both goal desires and intentions in predicting behavior (Prestwich et al., 2008). Although the goal hierarchy does not deal with goal desires as such, goal desires might reflect the strength of the association between superordinate goals and subordinate goals, or act as a proxy for a focus on a connected superordinate goal while goal intentions (i.e. one's decision to try to perform a focal behavior) might reflect subordinate goals. Consequently, research on goal desires also provides preliminary evidence that both superordinate goals and subordinate goals should directly—and by interaction—predict goal-congruent behaviors.

Processes through which Superordinate and Subordinate Goals Affect Goal Pursuit

While the direct and interactive effects of focusing on superordinate and/or subordinate goals on engagement in goal pursuit align with the results of previous studies, less is known about the corresponding processes through which these effects occur. Our results show that goal foci had no significant effect on goal commitment. However, this should be treated with caution as the participants across all conditions in our study expressed very high commitment from the beginning. It can reasonably be assumed that this had a ceiling effect on the measure. Future research with a more diverse sample regarding initial commitment to the goal is necessary to clarify the role of goal commitment.

Furthermore, the results show that people who focused on a subordinate goal perceived more success in goal pursuit than participants who did not focus on a subordinate goal. We used this as a proxy to assess the discrepancy between participant perception of the status quo and a desired end state. This is partly in line with our expectation that when focusing on a superordinate goal, this

discrepancy would remain even after a first goal-congruent step is taken while the discrepancy would disappear when focusing on a subordinate goal. However, against our prediction, our results showed that focusing on both superordinate and subordinate goals did not decrease the participant's perception of success. We can imagine at least two possible reasons for this somewhat surprising result.

First, we hypothesise that when focusing on a superordinate goal, discrepancy between the status quo and the desired end state is maintained after a first goal-congruent action, which motivates the participant to continue the pursuit of the goal beyond a first step. Furthermore, an additional focus on subordinate goals allows people to track their progress in goal pursuit and evaluate whether they have made progress toward a superordinate goal at a rate that is less or greater than expected (Carver & Scheier, 2001). If the perceived rate of goal progress equals or exceeds the expected rate of goal progress, a person experiences no negative feelings even though a discrepancy exists (Watkins, 2011). This may explain why focusing solely on a superordinate goal results in lower perceived success, while this effect vanishes when combining a superordinate with subordinate goals. This also suggests that a combination of superordinate and subordinate goals would successfully bring out the respective benefits of both goal types.

Second, the discrepancy between the status quo and the desired end state was measured with a proxy—that is, the participant's perceived success in goal pursuit—but this interpretation of the proxy raises the question to what extent perceived success in goal pursuit provides suitable values for discrepancy. In other words, the validity of this proxy is in question. Another plausible interpretation would be that perceived success is a proxy for self-efficacy; that is, the belief that one is capable of carrying out the steps required to achieve the intended effect (Bandura, 1997). If people believe that they are capable of carrying out the required steps, they are likely to perceive their goal pursuit as successful. In contrast, if they do not believe that they are capable of carrying out the required steps, they are less likely to do so. From this perspective, participants indicating low perceived success in goal pursuit would indicate low self-efficacy. Subordinate goals can foster a sense of self-efficacy because it is easier to track progress for subordinate than superordinate goals (Bandura, 1997; Sun & Frese, 2013). This perspective would be in line with our results that focusing solely on superordinate goals negatively affected self-efficacy and would explain why the negative effects vanished when participants combined superordinate and subordinate goals. Again, this interpretation would indicate that a combination of superordinate and subordinate goals would lead to success. To draw meaningful conclusions about the processes by which a superordinate and subordinate goal focus influences goal pursuit, the processes should be examined over time. However, this was not possible with our study design because both the process and outcome variables were only measured at the end of the study.

This study adds to a growing body of literature on goal pursuit that expands the focus on the pursuit of a single subordinate goal over a limited time period (Fishbach & Dhar, 2007). It provides preliminary findings on how superordinate and subordinate goals influence goal pursuit, and interact with each other. Moreover, as our study took place over 3 months, we were able to account for the pursuit of multiple goals and multiple subsequent decisions over time.

Limitations

There are limitations to how much these results can be generalised. To begin with, the study design, which is based on individual New Year's resolutions, leads to at least five difficulties in interpreting the results.

First, all participants formulated a personal and thus different New Year's resolution. Basing our experiment on our subjects' personal New Year's resolutions was advantageous because it allowed us to research actual behavior (Emmons, 1989). However, negatively, this design meant that individuals started from different points and had different goals. Problematically, their resolutions spanned many behavioral domains (e.g. health, mindfulness, social relationships, environmental concerns) and differed in the initial level required for involvement. This personalised goal formulation may have resulted in different assessments of the question "how strongly are you currently pursuing your goal?" Goals that span a wide range of domains and actions can lead to different interpretations of how much a person has to do, how much time one has to invest, and/or how often goal-congruent actions are required to pursue the goal successfully. To illustrate, a goal of avoiding air travel during the holidays places a completely different set of demands on everyday life than, for example, exercising three times a week. It follows, then, that different interpretations of how much a person has to do to successfully pursue the goal affects the self-reported assessment of how strongly one currently pursues the goal. Future studies should consider designs that have all participants pursue the same goal (e.g. weight loss): This would reduce the problem that effort varies in relation to different individual goals which would then change interpretations of the required or achieved effort. In addition, a design in which all participants pursue the same goal offers the possibility of assessing effort and success based on a comparable measure (e.g. weight lost in kilograms). Objective measurement methods of effort in goal pursuit—by, for example, the use of a fitness tracker or an electronic login in gyms—would complement the available data and increase the accuracy of the measure further.

Second, initial resolutions differed in degree of superordinate/subordinate formulation, which could have undermined the effect of the goal manipulation. For example, a person with the original New Year's resolution to "lose 10 pounds" may have successfully gone through the manipulation and formulated the superordinate goal of "look attractive". However, this does not exclude the possibility that another person may have already set their original New Year's resolution as

“look attractive”. In other words, despite both participants correctly following the manipulation instructions, it is possible that the goals of both participants (one in the condition that did not formulate an additional goal and one in the superordinate condition) do not differ. This limitation deserves additional attention because our manipulation procedure cannot rule out the activation of additional goals at different hierarchical levels even if the person does not undergo the respective manipulation task. Goals are activated not only by conscious choice, but also unconsciously (for example, see bottom-up activation; Shah & Kruglanski, 2003). And since superordinate and subordinate goals are interconnected, it may be possible that merely focusing on goals at one level may automatically activate interconnected goals at another hierarchical level—outside one’s own consciousness—thereby obscuring the effect of the manipulation.

The third limitation is that the outcome might have been affected by other differences in goal properties, besides the level of abstraction of the manipulated goal. For example, goals may differ in whether they aim to achieve a certain level of performance or achieve the acquisition of a new skill, or by a focus on achieving success or avoiding failure (Fujita & McGregor, 2012). Focusing on arbitrary, individual New Year’s resolutions may have triggered processes that could not be assessed with our study design.

Aside from the manipulation itself, the manipulation check also leaves some questions unanswered—this is the fourth limitation. While the manipulation check showed that formulating a superordinate goal increased the perceived level of abstraction, the manipulation check could not account for any effect of subordinate goal manipulation. Thus, we cannot be certain whether or not the non-significant difference between the subordinate goal condition and the combined condition is also a result of a nonfunctioning manipulation. In future studies, additional manipulation checks would minimise the “noise” of other confounding variables while allowing researchers to assess the direct and interactive effect of the goal manipulation.

Finally, we could not control for the exact start date, which resulted in 42 people starting the study before New Year’s Day and 214 people starting afterwards. This meant that we could not exclude the possibility that some participants had started work on their New Year’s resolution before the beginning of the study. However, since we were particularly interested in how the participants would pursue their goal over time, rather than how they would behave when initiating a new action, the exact start date was not the focus of our research questions. In support of this view, repeating all the analyses of this study with an additional dummy variable to control whether a person started the study before or after New Year did not change the reported results in direction and meaning (see Supplementary Material, Table S5).

This inability to accurately control the effects of the manipulation may account for the unexpectedly successful goal pursuit of the group without an additional goal—another important point to bear in mind besides the difficulties

regarding the study design. While combining superordinate and subordinate goals increases invested effort in goal pursuit, focusing solely on a singular goal (subordinate or superordinate) resulted in less effort 3 months after the start of the study when compared to focusing on no additional goal (see Figure 1A). The unexpectedly successful goal pursuit of the group that focused on no additional goal may be linked to effects from the five goal reminders sent to the participants during the study. Evidence shows that simple reminders—analogue to those we sent—can increase performance over an extended period and even foster habit formation (Calzolari & Nardotto, 2017). It is plausible that these reminders promoted goal pursuit independent of the goal manipulation, which could have led to a suppression of the effect of the goal manipulation. Furthermore, it can be argued that participants may shift between superordinate and subordinate goals in response to circumstances in a functional, flexible, and adaptive way in the absence of any intervention (Watkins, 2011). Manipulation of the goal focus is therefore only meaningful if this natural regulation is impaired, for example, in the case of a psychological disorder (Watkins, 2011). In the present case, as a nonclinical sample, it can be assumed that this adaptive regulation was not impaired and that our results suggest that (in the case of adaptive regulation) the manipulation of the goal focus on (a) *only a subordinate goal* or (b) *only a superordinate goal* did not necessarily foster goal pursuit, and may even have detrimental effects such as causing systematic problems (for similar reasoning, see Ordóñez et al., 2009). Goals must thus be set and pursued with caution, and possible detrimental side effects have to be considered.

The positive effects of combining superordinate and subordinate goals were not found consistently across all dependent variables: Focusing on both superordinate and subordinate goals had a positive effect on actual participant effort, but not on participant intentions to pursue the goal further after the end of the study, nor on the amount of effort the participants intended to invest in further goal pursuit. This difference interestingly parallels the conceptual distinction between intentions and behavior, wherein actual effort corresponds to behavior and future plans correspond to intentions (i.e. the motivation or decision to perform a certain behavior; Prestwich et al., 2008). Although the chronological order of intention and behavior assessed in this study does not correspond to the usual order used to study the intention–behavior relationship (in the present study, the participants' behavior was first assessed and then they were asked about their intentions), the conceptual difference between intention and behavior offers a possible explanation as to why the manipulation of the goal focus in this study influenced participant behavior but not their intentions. In this study, there were no differences between the groups regarding intentions, which indicates that goals at all levels of abstraction are helpful in the formation of intentions for goal pursuit. However, not all goal types were equally helpful in terms of actual behavior. This can be interpreted in such a way that the advantage of focusing on both superordinate and subordinate goals emerges in the translation of

intentions into actual behavior, rather than in the formulation of intentions. This possible explanation aligns with other research on factors that foster the likelihood of turning an intention into behavior: For example, the more a person wants to achieve a superordinate goal by performing a certain action—referred to as goal desire—the stronger the effect of a behavioral intention on actual behavior (Prestwich et al., 2008). In a similar vein, a study by Sheeran and Orbell (2000) found that the degree to which a person's intention was relevant to their self-concept also moderated behavior: People who considered exercising to be an important part of their self-concept, were found to be more likely to actually exercise when they intended to do so.

Any inconsistency in our results can also be examined from a methodological perspective. Besides the previously mentioned limitations in this study (e.g. the noisiness of the data due to the experimental design, and the possible obscured effect of the manipulation), our measurement method may have contributed to some inconsistency in the results. For example, many of the concepts were measured with (a) self-report measures, which can lead to several known errors and biases such as social desirability bias, or an erroneous belief about one's own behavior, and (b) single-item measures, which can leave open questions about the reliability and validity of the measured constructs. And due to the explorative nature of this study, an a priori sample size was not calculated. To eliminate these shortcomings and to shed light on possible inconsistencies in our results, replications of the study should use validated multi-item measures and a priori sample size calculation based on the effect strengths observed in this study.

Future Research

Despite these limitations we believe our work could be a springboard for future field research in goal pursuit over time. More specifically, our work continues the study of the combined effect of superordinate and subordinate goals in broad, long-term goal pursuit. However, in order to substantiate our results, to shed light on the inconsistencies in the results, and to address the limitations of this study, we encourage further experimental field studies.

In addition to future research to address the limitations of this study, we see at least two sets of questions that could also be addressed. First, we encourage studies that would clarify the different processes triggered by a focus on superordinate and subordinate goals, alone or in interaction, and the resulting effect on long-term goal pursuit. While this study offers some preliminary insights into commitment and perceived success as possible moderators, the examination of other processes, such as the perception and resolution of temptation and goal conflict, promises to enrich the understanding of how goals operate. Another avenue for future research concerns factors that could foster understanding about the interplay between superordinate and subordinate goals within a person's goal

hierarchy. For example, the number of goals a person has, the strength and number of connections between these goals (Kruglanski et al., 2002), and the degree to which these goals facilitate or conflict with each other—both at the same and at different hierarchical levels (Presseau et al., 2010; Riediger & Freund, 2004)—could contribute to the extent to which the respective advantages of superordinate and subordinate goals come to the fore and/or balance out the respective disadvantages.

While preliminary, our results show that after 3 months, people invested more effort in pursuit of their goals if they focused on both superordinate and subordinate goals when compared to focusing solely on a superordinate goal, and that combining these goals may be a helpful strategy to effectively pursue long-term goals.

DATA AVAILABILITY STATEMENT

The dataset, R code, and codebook for this study can be found in the open science framework: https://osf.io/vrwzp/?view_only=fb0c5b5552fe43a382fbec5f987daff1.

ETHICS APPROVAL STATEMENT

This study was carried out as part of a larger research project in accordance with the recommendations of the Federal Act on Research Involving Human Beings of the Swiss Confederation. The research project was approved by the ethics committee of the canton of Bern, member of the Swiss Ethics Committee on research involving humans.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1. Fixed-Effects ANOVA Results Based on the Extended Sample.

Table S2. Overview of Additionally Assessed Variables and Scales Not Reported in the Manuscript.

Table S3. Means and Standard Deviations of the Manipulation Check as a Function of Both a Superordinate and Subordinate Goal Focus.

Table S4. Fixed-Effects ANCOVA Results Using a Dummy Variable As a Covariate For Goal Change.

Table S5. Fixed-Effects ANCOVA Results Using a Dummy Variable as a Covariate to Indicate Different Start Dates.

Figure S1. Flow Diagram.

Supplementary Material Paper 1

Making New Year's Resolutions that Stick: Exploring how Superordinate and Subordinate Goals Motivate Goal Pursuit

This is the supplementary material of the following article: Höchli, B., Brügger, A., & Messner, C. (2019). Making new year's resolutions that stick: Exploring how superordinate and subordinate goals motivate goal pursuit. *Applied Psychology: Health and Well-Being*. doi: 10.1111/aphw.12172.1016/j.appet.2015.09.034, which has been published in final form at https://onlinelibrary.wiley.com/doi/full/10.1111/aphw.12172?campaign=email_articlemetrics.

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Drop Out Analysis

Excluded from the study were 109 participants who either did not complete the final questionnaire (N = 94) or participated to the end, but were excluded to ensure good data quality. A comparison of the excluded participants and the 256 participants retained showed that the proportion of dropped participants was not associated with the experimental condition, $\chi^2(3, N = 365) = 3.38, p = .337$. Furthermore, we repeated all the analyses shown in the results section and took into account both the final sample (N = 256; see “Results” for analysis) and the dropped participants (N = 109). The results of the final sample (N = 256) did not significantly differ from the results of the extended sample (N = 365; see Table S1).

Table S1

Fixed-Effects ANOVA Results Based on the Extended Sample

| | Sum of Squares | <i>df</i> | Mean Square | <i>F</i> | <i>p</i> | partial η^2 | partial η^2 95% CI [LL, UL] |
|--|----------------------|-----------|----------------|----------|----------|------------------|--|
| Rating of Goal Abstraction | | | | | | | |
| Superordinate goal | 5.04 | 1 | 5.04 | 11.52 | .001 | .03 | |
| Subordinate goal | 0.06 | 1 | 0.06 | 0.14 | .704 | .00 | [.00, .01] |
| Superordinate x subordinate goal | 0.80 | 1 | 0.80 | 1.83 | .177 | .01 | [.00, .03] |
| Error | 158.02 | 361 | 0.44 | | | | |
| Effort in Goal Pursuit | | | | | | | |
| Superordinate goal | 0.31 | 1 | 0.31 | 0.47 | .495 | .00 | |
| Subordinate goal | 1.66 | 1 | 1.66 | 2.48 | .116 | .01 | [.00, .05] |
| Superordinate x subordinate goal | 6.44 | 1 | 6.44 | 9.66 | .002 | .04 | [.01, .09] |
| Error | 166.76 | 250 | 0.67 | | | | |
| Intention to Further Pursue the Goal | | | | | | | |
| Superordinate goal | 0.07 | 1 | 0.07 | 0.23 | .635 | .00 | |
| Subordinate goal | 0.16 | 1 | 0.16 | 0.51 | .476 | .00 | [.00, .03] |
| Superordinate x subordinate goal | 0.22 | 1 | 0.22 | 0.69 | .408 | .00 | [.00, .03] |
| Error | 85.84 | 270 | 0.32 | | | | |
| Intended Length of Further Goal Pursuit | | | | | | | |
| Superordinate goal | 9.18 | 1 | 9.18 | 7.74 | .006 | .03 | |
| Subordinate goal | 0.00 | 1 | 0.00 | 0.00 | .950 | .00 | [.00, 1.00] |
| Superordinate x subordinate goal | 0.13 | 1 | 0.13 | 0.11 | .744 | .00 | [.00, .02] |
| Error | 320.01 | 270 | 1.19 | | | | |

Intended Effort in Further Goal Pursuit

| | | | | | | | |
|----------------------------------|--------|-----|------|------|------|-----|------------|
| Superordinate goal | 0.00 | 1 | 0.00 | 0.01 | .920 | .00 | |
| Subordinate goal | 0.16 | 1 | 0.16 | 0.32 | .573 | .00 | [.00, .02] |
| Superordinate x subordinate goal | 0.69 | 1 | 0.69 | 1.39 | .239 | .01 | [.00, .03] |
| Error | 133.39 | 270 | 0.49 | | | | |

Commitment to the Goal at the End of the Study

| | | | | | | | |
|----------------------------------|-------|-----|-------|-------|------|-----|------------|
| Superordinate goal | 0.01 | 1 | 0.01 | 0.03 | .873 | .00 | |
| Subordinate goal | 0.31 | 1 | 0.31 | 1.06 | .304 | .00 | [.00, .03] |
| Commitment at start | 11.45 | 1 | 11.45 | 39.10 | .000 | .13 | [.06, .20] |
| Superordinate x subordinate goal | 0.01 | 1 | 0.01 | 0.04 | .842 | .00 | [.00, .01] |
| Error | 79.64 | 272 | 0.29 | | | | |

Perceived Success in Goal Pursuit

| | | | | | | | |
|----------------------------------|--------|-----|------|------|------|-----|------------|
| Superordinate goal | 0.48 | 1 | 0.48 | 0.61 | .436 | .00 | |
| Subordinate goal | 1.96 | 1 | 1.96 | 2.47 | .117 | .01 | [.00, .04] |
| Superordinate x subordinate goal | 1.70 | 1 | 1.70 | 2.14 | .144 | .01 | [.00, .04] |
| Error | 218.42 | 275 | 0.79 | | | | |

Note. LL and UL represent the lower-limit and upper-limit of the partial η^2 confidence interval, respectively.

Table S2*Overview of Additionally Assessed Variables and Scales Not Reported in the Manuscript*

| Additionally assessed constructs | Reason for inclusion in the study | Reference |
|--|--|---|
| Starting Questionnaire | | |
| Repetition: Have you already made this resolution once or several times in the past? | Control variable: If a person has set a specific resolution before, other processes might be at work compared to a person setting a resolution for the first time. | x |
| Frequency of required actions: Please indicate how regularly you would like to actively support this goal. | Control variable: If a person sets a resolution which requires action on very few occasions (e.g., I want to behave decently at family reunions), behavioral patterns might be different compared to resolutions that require actions on a daily basis. | x |
| Performance goal vs relaxation goal: Please indicate if your goal is more a performance goal or a relaxation goal | Exploratory question: An additional goal property that might may influence goal pursuit. | x |
| Brief Self-Control Scale (13 items) | Exploratory question: Self-control and grit are important determinants of success. While self-control refers to aligning action with the current goal despite temporarily tempting alternatives, grit refers to conscientiously pursuing and working on a superordinate goal over a longer period of time. Self-control can therefore be seen as particularly helpful in the pursuit of subordinate | Self-control scale: Tangney, Baumeister, & Boone, 2004 |
| Grit Scale (12 items) | | |

| | | |
|--|---|--|
| | goals, and grit as particularly helpful in the pursuit of superior goals (A. Duckworth & Gross, 2014). Can we observe this pattern in our data? And can our goal manipulation explain successful goal attainment beyond self-control and grit? | A. L. Duckworth, Peterson, Matthews, & Kelly, 2007 |
| Preference for Consistency Scale (selected items) | Exploratory question: Consistency theories attest that people wish to appear consistent and thus express a general tendency to make similar successive choices, which could foster the repetition of goal-congruent action, and thus foster goal pursuit. Can we observe this pattern in our data? And can our goal manipulation explain successful goal pursuit beyond a preference for consistency? | Cialdini, Trost, & Newsom, 1995 |
| Goal Reminders | | |
| Goal pursuit during previous week (3 items) | Exploratory question: Do we see any patterns in goal pursuit over time? | x |
| Progress vs commitment (6 items) | Exploratory question: Research on the dynamics of goal-based choices proposes that the decision to take additional goal-congruent actions depends on the extent to which one interprets their previous behavior as progress or as commitment. Since the focus is on the subgoal, progress in line with the subgoal signals that similar actions are redundant and hinders further goal pursuit. When the focus is on the superordinate goal, the same progress on a subgoal is perceived as relatively minor and a person is more likely to consider the commitment to the overall goal, thereby fostering further goal pursuit (Fishbach & Dhar, 2007). Can we find evidence in our study to support this proposal? | Fishbach, Dhar, & Zhang, 2006 |
| Compensatory behavior (6 items) | Exploratory question: People often make several potentially-related choices and hold multiple goals at any given time. Thus, for well-being and the attainment of | x |

| | | |
|-------------------------------------|--|--|
| | multiple goals it might be helpful to balance different goals (Fishbach & Dhar, 2007). Can we see patterns in the extent to which people consistently pursue their goals, and to what extent they compensate for their progress? Is this dependent on target manipulation? Does this have an influence on success in achieving the target? | |
| End Questionnaire | | |
| Satisfaction with goal pursuit | Exploratory question: Can the satisfaction with goal pursuit influence the motivation to further pursue the goal? For a similar reasoning see for example resting on laurels (Amir & Ariely, 2008). | x |
| Progress vs commitment (6 items) | See the explanation concerning the progress and commitment in “Goal Reminders.” | |
| Compensatory behavior (6 items) | See the explanation concerning the compensatory behavior in “Goal Reminders.” | |
| Preference for a specific goal type | Exploratory question: Is there an individual preference for the extent to which a person focuses on subordinate or superordinate goals? Could this preference moderate the effect of the goal manipulation on goal pursuit? | x |
| Thoughts on goals (12 items) | Exploratory question: Can goal focus (due to individual preferences or goal manipulation) be captured by asking how much a person consciously thinks about a specific type of goal during goal pursuit? | x |
| Happiness Scale (4 items) | Exploratory question: Is there a relationship between goal focus (due to individual preferences or goal manipulation) and happiness? | Lyubomirsky & Lepper, 1999; German version by Swami et al., 2009 |

Note. The complete codebook of all assessed variables is available under https://osf.io/vrwzp/?view_only=fb0c5b5552fe43a382fbec5f987daff1

Table S3

Means and Standard Deviations of the Manipulation Check as a Function of Both a Superordinate and Subordinate Goal Focus.

| | | Superordinate | | | |
|--|-----|---------------|-----------|----------|-----------|
| | | No | | Yes | |
| Subordinate | | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |
| Rating of Abstraction | | | | | |
| | No | 3.69 | 0.61 | 3.80 | 0.62 |
| | Yes | 3.50 | 0.83 | 3.79 | 0.62 |
| Effort in Goal Pursuit | | | | | |
| | No | 4.05 | 0.79 | 3.71 | 0.84 |
| | Yes | 3.94 | 0.73 | 4.17 | 0.88 |
| Intention to Further Pursue the Goal | | | | | |
| | No | 4.70 | 0.49 | 4.64 | 0.48 |
| | Yes | 4.57 | 0.60 | 4.61 | 0.64 |
| Intended Length of Further Goal Pursuit | | | | | |
| | No | 6.20 | 1.36 | 6.65 | 0.82 |
| | Yes | 6.23 | 1.24 | 6.59 | 0.89 |
| Intended Effort in Further Goal Pursuit | | | | | |
| | No | 3.88 | 0.70 | 3.82 | 0.64 |
| | Yes | 3.73 | 0.73 | 3.81 | 0.75 |
| Commitment | | | | | |
| | No | 4.28 | 0.55 | 4.28 | 0.61 |
| | Yes | 4.36 | 0.50 | 4.34 | 0.56 |
| Perceived Success | | | | | |
| | No | 3.61 | 0.83 | 3.39 | 0.90 |
| | Yes | 3.71 | 0.85 | 3.73 | 0.91 |

Note. *M* and *SD* represent mean and standard deviation, respectively.

Table S4*Fixed-Effects ANCOVA Results Using a Dummy Variable As a Covariate For Goal Change*

| | Sum of Squares | <i>df</i> | Mean Square | <i>F</i> | <i>p</i> | partial η^2 | partial η^2 95% CI [LL, UL] |
|---|----------------------|-----------|----------------|----------|----------|------------------|--|
| Effort in Goal Pursuit | | | | | | | |
| Superordinate goal | 0.33 | 1 | 0.33 | 0.50 | .479 | .00 | |
| Subordinate goal | 1.93 | 1 | 1.93 | 2.91 | .090 | .01 | [.00, .05] |
| Goal changed | 0.66 | 1 | 0.66 | 1.00 | .318 | .00 | [.00, .04] |
| Superordinate x subordinate goal | 4.70 | 1 | 4.70 | 7.08 | .008 | .03 | [.00, .08] |
| Error | 154.80 | 233 | 0.66 | | | | |
| Intention to Further Pursue the Goal | | | | | | | |
| Superordinate goal | 0.14 | 1 | 0.14 | 0.52 | .470 | .00 | |
| Subordinate goal | 0.04 | 1 | 0.04 | 0.14 | .710 | .00 | [.00, .02] |
| Goal changed | 0.37 | 1 | 0.37 | 1.34 | .249 | .01 | [.00, .04] |
| Superordinate x subordinate goal | 0.15 | 1 | 0.15 | 0.54 | .462 | .00 | [.00, .03] |
| Error | 63.77 | 233 | 0.27 | | | | |
| Intended Length of Further Goal Pursuit | | | | | | | |
| Superordinate goal | 10.04 | 1 | 10.04 | 9.47 | .002 | .04 | |
| Subordinate goal | 0.19 | 1 | 0.19 | 0.18 | .673 | .00 | [.00, .02] |
| Goal changed | 0.01 | 1 | 0.01 | 0.01 | .942 | .00 | [.00, .01] |
| Superordinate x subordinate goal | 0.03 | 1 | 0.03 | 0.02 | .876 | .00 | [.00, .01] |
| Error | 247.18 | 233 | 1.06 | | | | |
| Intended Effort in Further Goal Pursuit | | | | | | | |
| Superordinate goal | 0.00 | 1 | 0.00 | 0.01 | .919 | .00 | |
| Subordinate goal | 0.18 | 1 | 0.18 | 0.39 | .535 | .00 | [.00, .03] |
| Goal changed | 1.53 | 1 | 1.53 | 3.20 | .075 | .01 | [.00, .06] |
| Superordinate x subordinate goal | 0.34 | 1 | 0.34 | 0.70 | .403 | .00 | [.00, .03] |
| Error | 111.22 | 233 | 0.48 | | | | |
| Commitment to the Goal at the End of the Study | | | | | | | |
| Superordinate goal | 0.00 | 1 | 0.00 | 0.01 | .931 | .00 | |
| Subordinate goal | 0.21 | 1 | 0.21 | 0.76 | .385 | .00 | [.00, .03] |

| | | | | | | | |
|--|--------|-----|------|-------|------|-----|------------|
| Commitment at start | 8.63 | 1 | 8.63 | 30.76 | .000 | .12 | [.05, .20] |
| Goal changed | 0.01 | 1 | 0.01 | 0.04 | .850 | .00 | [.00, .02] |
| Superordinate x subordinate goal | 0.01 | 1 | 0.01 | 0.03 | .863 | .00 | [.00, .01] |
| Error | 65.09 | 232 | 0.28 | | | | |
| Perceived Success in Goal Pursuit | | | | | | | |
| Superordinate goal | 0.04 | 1 | 0.04 | 0.05 | .823 | .00 | |
| Subordinate goal | 3.46 | 1 | 3.46 | 4.93 | .027 | .02 | [.00, .07] |
| Goal changed | 0.68 | 1 | 0.68 | 0.96 | .328 | .00 | [.00, .04] |
| Superordinate x subordinate goal | 0.62 | 1 | 0.62 | 0.89 | .348 | .00 | [.00, .03] |
| Error | 163.54 | 233 | 0.70 | | | | |

Note. Dummy ‘Goal changed’: 1 = a goal change; 0 = no goal change. LL and UL represent the lower-limit and upper-limit of the partial η^2 confidence interval, respectively.

Table S5

Fixed-Effects ANCOVA Results Using a Dummy Variable as a Covariate to Indicate Different State Dates

| | Sum of Squares | <i>df</i> | Mean Square | <i>F</i> | <i>p</i> | partial η^2 | partial η^2 95% CI [LL, UL] |
|---|----------------------|-----------|----------------|----------|----------|------------------|--|
| Effort in Goal Pursuit | | | | | | | |
| Superordinate goal | 0.46 | 1 | 0.46 | 0.69 | .408 | .00 | |
| Subordinate goal | 1.97 | 1 | 1.97 | 2.95 | .087 | .01 | [.00, .05] |
| Start before New Year | 0.03 | 1 | 0.03 | 0.05 | .819 | .00 | [.00, .02] |
| Superordinate x subordinate goal | 4.57 | 1 | 4.57 | 6.84 | .009 | .03 | [.00, .08] |
| Error | 155.43 | 233 | 0.67 | | | | |
| Intention to Further Pursue the Goal | | | | | | | |
| Superordinate goal | 0.01 | 1 | 0.01 | 0.03 | .866 | .00 | |
| Subordinate goal | 0.35 | 1 | 0.35 | 1.14 | .287 | .00 | [.00, .03] |
| Start before New Year | 0.33 | 1 | 0.33 | 1.07 | .301 | .00 | [.00, .03] |
| Superordinate x subordinate goal | 0.15 | 1 | 0.15 | 0.51 | .477 | .00 | [.00, .03] |
| Error | 76.64 | 251 | 0.31 | | | | |
| Intended Length of Further Goal Pursuit | | | | | | | |
| Superordinate goal | 10.98 | 1 | 10.98 | 9.11 | .003 | .04 | |
| Subordinate goal | 0.01 | 1 | 0.01 | 0.01 | .921 | .00 | [.00, .01] |
| Start before New Year | 1.27 | 1 | 1.27 | 1.05 | .306 | .00 | [.00, .03] |
| Superordinate x subordinate goal | 0.11 | 1 | 0.11 | 0.09 | .767 | .00 | [.00, .02] |
| Error | 302.43 | 251 | 1.20 | | | | |
| Intended Effort in Further Goal Pursuit | | | | | | | |
| Superordinate goal | 0.00 | 1 | 0.00 | 0.00 | .969 | .00 | |
| Subordinate goal | 0.36 | 1 | 0.36 | 0.74 | .391 | .00 | [.00, .03] |
| Start before New Year | 0.40 | 1 | 0.40 | 0.81 | .370 | .00 | [.00, .03] |
| Superordinate x subordinate goal | 0.36 | 1 | 0.36 | 0.72 | .396 | .00 | [.00, .03] |
| Error | 123.26 | 251 | 0.49 | | | | |
| Commitment to the Goal at the End of the Study | | | | | | | |
| Superordinate goal | 0.00 | 1 | 0.00 | 0.01 | .911 | .00 | |

| | | | | | | | |
|----------------------------------|-------|-----|------|-------|------|-----|-------------|
| Subordinate goal | 0.48 | 1 | 0.48 | 1.67 | .198 | .01 | [.00, .04] |
| Commitment at start | 7.00 | 1 | 7.00 | 24.37 | .000 | .09 | [.03, .16] |
| Start before New Year | 0.24 | 1 | 0.24 | 0.83 | .365 | .00 | [.00, .03] |
| Superordinate x subordinate goal | 0.00 | 1 | 0.00 | 0.00 | .968 | .00 | [.00, 1.00] |
| Error | 71.84 | 250 | 0.29 | | | | |

Perceived Success in Goal Pursuit

| | | | | | | | |
|----------------------------------|--------|-----|------|------|------|-----|------------|
| Superordinate goal | 0.80 | 1 | 0.80 | 1.06 | .305 | .00 | |
| Subordinate goal | 3.27 | 1 | 3.27 | 4.31 | .039 | .02 | [.00, .06] |
| Start before New Year | 0.47 | 1 | 0.47 | 0.62 | .432 | .00 | [.00, .03] |
| Superordinate x subordinate goal | 0.90 | 1 | 0.90 | 1.19 | .277 | .00 | [.00, .04] |
| Error | 190.17 | 251 | 0.76 | | | | |

Note. Dummy ‘Start before New Year’: 1 = a start date before New Year’s Eve; 0 = a start date after New Year’s Eve. LL and UL represent the lower-limit and upper-limit of the partial η^2 confidence interval, respectively.

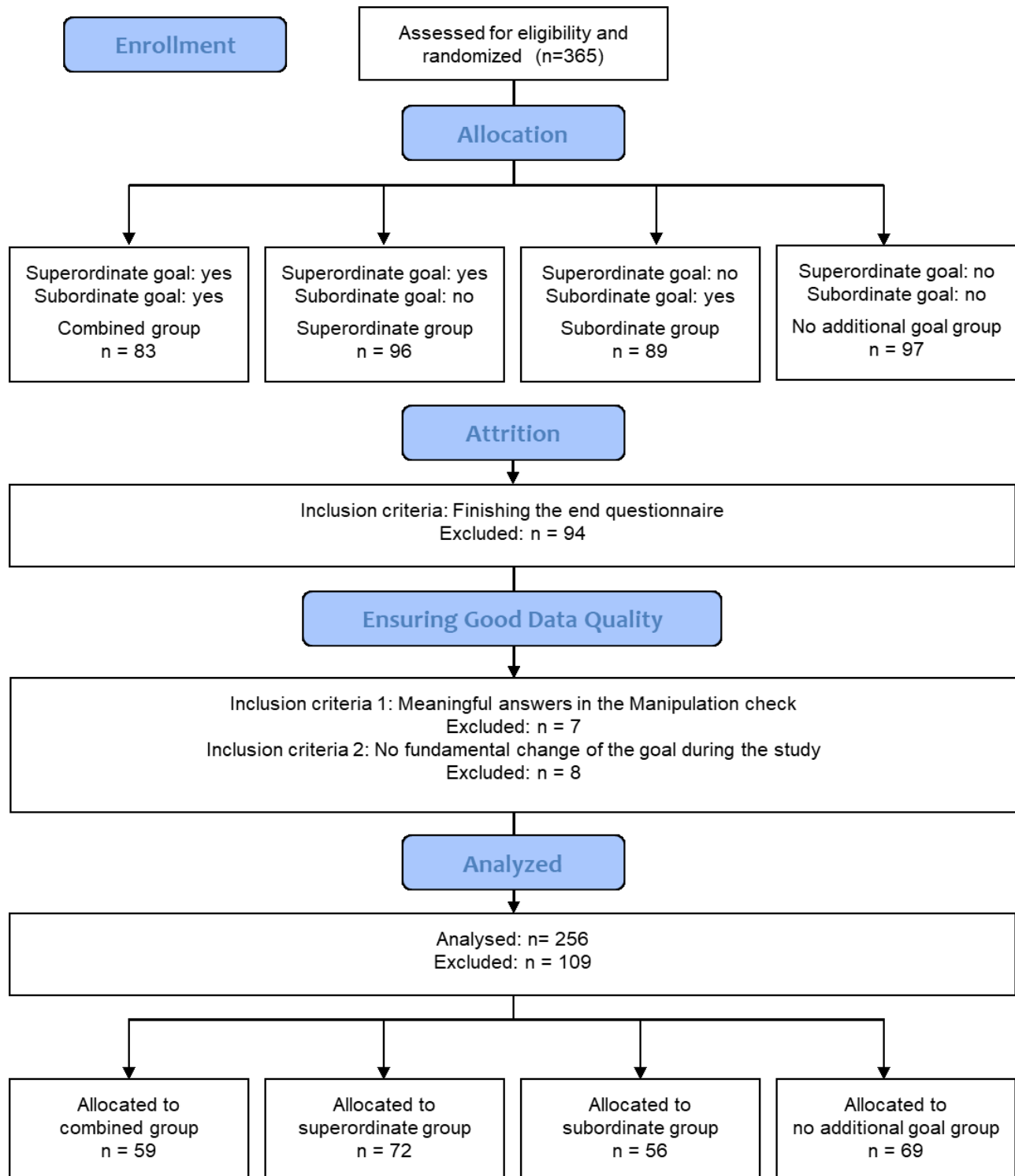


Figure S1. Flow Diagram.

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Paper 2

Using a Goal Theoretical Perspective to Reduce Negative and Promote Positive Spillover After a Bike-to-Work Campaign

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Using a Goal Theoretical Perspective to Reduce Negative and Promote Positive Spillover After a Bike-to-Work Campaign

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Behavioral change interventions often focus on a specific behavior over a limited time period; for example, a bike-to-work intervention that incentivizes cycling to work over 2 months. While such interventions can successfully initiate behavior, they run the risk of triggering negative spillover effects after completion: Reaching the end of an intervention could reduce the motivation to maintain the behavior; or an increase in the targeted behavior (e.g., cycling to work more often) could lead to negative spillover across behaviors (e.g., cycling less in leisure time). Using a goal theoretical perspective, we tested whether an intervention focusing on a specific behavior during a limited time period (a subordinate goal) triggers negative spillover, and whether superordinate goals and/or action steps reduce negative or promote positive spillover. We conducted an experimental field study ($N = 1,269$) in the context of a bike-to-work campaign with a longitudinal multilevel design. Participants across all four experimental conditions had the campaign goal of cycling to work for a maximum of 2 months (a subordinate goal). A quarter of the participants additionally generated superordinate goals, a quarter action steps and a quarter superordinate goals *and* action steps. The last quarter was a control condition which only set the subordinate campaign goal. Surprisingly, the intervention caused no negative and some positive spillover effects. Participants increased the frequency of cycling to work across all groups and the increase could be maintained up to 2 months after the campaign. An increase in cycling to work spilled over to an increase in cycling in leisure time and to an increase in eating fruits and vegetables. No spillover effects were found regarding exercising and eating sweets and snacks. Participants focusing additionally on a superordinate goal cycled to work more frequently at the end of the campaign than the control group. Contrary to our expectations, the maintenance of cycling to work over time and the positive spillover effects across behaviors did not differ due to the goal manipulation. These results reduce the concern that interventions focusing on a subordinate goal could trigger negative spillover effects and show the need for additional experimental field studies.

Keywords: goal hierarchy, goal pursuit, behavior change, long-term, spillover effect, intervention, longitudinal multilevel analysis

INTRODUCTION

Policy makers around the world are increasingly interested in how people's behavior can be changed (Frederiks et al., 2016). While regulatory mechanisms have traditionally been used to change behavior, campaign designers today increasingly rely on knowledge from behavioral research to motivate voluntary behavioral changes (Dolan and Galizzi, 2014; Moore and Boldero, 2017). In the environmental context, for example, there are numerous programs and interventions to encourage people to use less energy, focus more on renewable energy sources, produce less waste or switch to public transport, to name but a few (Abrahamse et al., 2005; for a review, see Osbaldiston and Schott, 2012; Abrahamse and Steg, 2013).

In order to be effective, behavior change interventions usually require people to adapt their behavior repeatedly over a long period of time and across different behavioral domains (Tiefenbeck et al., 2013; Moore and Boldero, 2017). To illustrate, one cannot lead a healthy life by exercising, or skipping dessert a single time. Thus, interventions aimed at changing behavior in the long-term and across behavioral domains have to consider not only the initiation of a targeted behavior, but also the long-term maintenance of an intervention effect, as well as possible effects that the change in the targeted behavior can have on other related behaviors. These effects are referred to as "spillover effects." These spillover effects are positive when a first behavior increases the likelihood of engaging in a second related behavior and are negative when they decrease the likelihood of engaging in a second related behavior (e.g., Poortinga et al., 2013; Truelove et al., 2014; Dolan and Galizzi, 2015; Nilsson et al., 2017). Spillover effects can occur over time (when conducting behavior X affects the probability of conducting behavior X later on); across socio-spatial contexts (when conducting behavior X in one context affects the probability of conducting behavior X in another context) or across behaviors (when conducting behavior X affects the probability of conducting behavior Y, either in the same or in a distinct behavioral domain) (Nilsson et al., 2017).

In the context of goal setting theory, interventions that focus on the pursuit of a single concrete goal that describes *what* a person is trying to achieve in the short run (i.e., subordinate goals) have proven to be successful in initiating behavioral change. The motivational benefit of focusing on subordinate goals has been widely researched and documented (Abrahamse et al., 2005; Locke and Latham, 2013). However, if their effect is considered in the context of broad, long-term challenges that include possible spillover effects, it is unclear whether pursuing subordinate goals is still the most effective way to change behavior. Subordinate goals should not be used as a panacea for changing behavior within the design of interventions (Ordóñez et al., 2009). Potential negative spillover effects of subordinate goals are increasingly discussed; for example, interventions that focus on a subordinate goal are constrained in time and often focus specifically on the intervention period. Thus, they run the risk that people stop pursuing the goal as soon as the intervention has finished (Jeffery et al., 2000; Geller, 2002; Lally and Gardner, 2013). This can limit or even reverse possible intervention effects. We argue that when addressing broad, long-term challenges

that require repeated behavior in the long-term and across different domains, superordinate goals fulfill a crucial role in motivating behavior, and a combination of both subordinate and superordinate is most effective (Höchli et al., 2018).

Using an experimental field study with a longitudinal multilevel design, the objective of this paper is to test whether (1) an intervention focusing on a subordinate goal gives rise to negative spillover effects over time and across behaviors, and whether (2) adding a superordinate goal can reduce negative and foster positive spillover effects over time and across behaviors. In order to better contextualize the results, a combination of a subordinate goal plus a concrete action step and a combination of all three—a subordinate goal, a superordinate goal and action steps—was tested.

USING A GOAL THEORETICAL PERSPECTIVE TO REDUCE NEGATIVE AND PROMOTE POSITIVE SPILLOVER

In recent years, policy makers have started to consider how to address behavioral spillover in their campaign strategies (Lanzini and Thøgersen, 2014; Moore and Boldero, 2017). However, it is difficult to draw unequivocal conclusions about the design of interventions from previous research on spillover effects. Existing research has reported both positive spillover effects that foster the intended intervention effect (e.g., Whitmarsh and O'Neill, 2010; Thøgersen and Noblet, 2012; Willis and Schor, 2012) but also negative spillover that could nullify or even reverse the intended intervention effect (e.g., Sorrell, 2007; Barr et al., 2010). To date, no general consensus exists about when and why positive or negative spillover effects occur (Truelove et al., 2014).

These inconsistent and contradictory theories and results show the need for a deeper understanding of why positive and negative spillover effects occur and what conditions increase or decrease their likelihood (Whitmarsh and O'Neill, 2010; Truelove et al., 2014).

We take a goal theoretical perspective to explain why negative spillover effects occur and to offer a strategy for how negative spillover effects can be reduced and positive spillover effects can be promoted.

Goal Hierarchy

When aiming to change behavior, the importance of planning and the usefulness of goals has been established (Carver and Scheier, 2001; Locke and Latham, 2013). Goals can differ in various characteristics, which can influence subsequent motivation and performance. To understand when positive and negative spillover effects occur, one characteristic of a goal is particularly relevant: the level of abstraction (Fujita and MacGregor, 2012). Concrete subordinate goals describe an action in detail: they convey exactly *what* action has to be done. As subordinate goals are constrained in time, and goal progress and achievement are easy to determine (e.g., Bandura, 1997), they can provide immediate incentives for performance and thus boost motivation. Abstract superordinate goals refer to idealized conceptualizations of one's self, one's relationships, or the society

one is part of, and are closely linked with values. Superordinate goals constitute the reasons or motives for goal striving and convey *why* an action is performed. They are, by definition, more vague than subordinate goals but may better represent people's ultimate wishes and aspirations (e.g., Carver and Scheier, 2001), and promote vision and guidance (Locke and Latham, 2013).

Goals at different levels of abstraction are interconnected: Superordinate goals (e.g., living a healthy life) determine subordinate goals (e.g., lose 10 pounds) which in turn give rise to more concrete goals, such as action steps, that describe *how* to behave in a specific situation (e.g., run for 30 min as soon as one gets home from work on Tuesdays). Goals at different levels of abstraction can be seen as hierarchically ordered, with superordinate goals at the top and concrete goals at the bottom (e.g., Carver and Scheier, 2001).

A Goal Theoretical Perspective and Negative Spillover

Focusing on subordinate goals has been shown to boost motivation and facilitate goal achievement. However, achieving a goal is not always an advantage. Achieving a goal can be negative because people stop working toward a goal when they perceive it to be completed (e.g., resting on laurels, Amir and Ariely, 2008; post-fulfillment inhibition, Förster et al., 2005; Zeigarnik effect, Zeigarnik, 1927). When pursuing a goal, the discrepancy between the status quo and the desired end-state results in an aversive and unpleasant tension (e.g., Carver and Scheier, 2001). In order to avoid this negative tension, people are motivated to decrease the discrepancy by acting in a goal-consistent way. Thus, the discrepancy encourages people to decrease the gap between their current state and their goal. Crucially, this also implies that once a goal is achieved, the discrepancy and the motivational impetus following from it will disappear. Goal achievement signals to people that they have done what is necessary and that they can stop pursuing that particular goal.

This tendency to relax one's efforts is unproblematic and even helpful if people really have achieved the goal they aspire to. However, many goals require continued effort over long periods of time. In addition, a goal is often only one of many steps that contribute to what is one's ultimate aspiration (i.e. their superordinate goal). Thus, achieving a subordinate goal (e.g., losing 10 pounds) will increase the tendency to relax efforts and may deter people from pursuing and achieving what they really want (e.g., living healthy life) and thus give rise to negative spillover over time. These arguments, which combine a goal theoretical perspective with negative spillover over time, are largely consistent with two other approaches explaining negative spillover effects: moral licensing and single-action bias (e.g., Truelove et al., 2014; Nilsson et al., 2017). *Moral licensing* occurs when a person who initially behaves in a moral way later on shows immoral, unethical or otherwise problematic behaviors (Mazar and Zhong, 2010; Merritt et al., 2010; Mullen and Monin, 2016). After doing good, a person thinks that she has done "enough" and allows herself to engage in less-moral behavior, believing she can balance out the prior moral and the latter less-moral behavior. *Single-action bias* occurs when a first action is perceived as a

big step toward tackling a challenge or solving a problem, when in reality it was only a small step. As an illustration, a person who has insulated their house feels that this one action reduces climate change and therefore no longer considers it necessary to take further steps to prevent climate change (Hansen et al., 2004; Girod and De Haan, 2009).

Designing a campaign around subordinate goals could hinder positive and give rise to negative spillover effects not only over time but also across socio-spatial contexts and across behavioral domains. Subordinate goals motivate behavior as they focus attention on the goal-relevant behavior, which is crucial for goal pursuit (Locke and Latham, 2002). However, this focus can be too narrow, as when people overlook other important tasks that serve the pursuit of the goal in a broader sense (Ordóñez et al., 2009). For example, a person might focus on the goal of buying ecologically produced food for environmental reasons, without realizing that flying to Bali for the holidays contradicts her first behavior. Designing a campaign with a narrow focus on a subordinate goal could thus undermine positive spillover effects and foster negative spillover effects—especially across behaviors that are not similar, for example across socio-spatial contexts or across different behavioral domains.

Taken together, interventions that focus on a specific behavior over a limited time period—that is, behavior that focuses on a subordinate goal—may be prone to negative spillover effects both over time and across behaviors.

A Goal Theoretical Perspective and Positive Spillover

One approach that might hinder negative spillover and foster positive spillover over time as well as across different behaviors is to design campaigns with a stronger focus on superordinate goals.

Superordinate goals can promote positive spillover effects over time as they often entail a long time span or do not have a clear end-state. In this case, achieving a subordinate goal or completing a campaign only signals partial fulfillment and the discrepancy between the status quo and the desired end-state is sustained. Because of this sustained discrepancy, people will not feel that they have "done enough," which should motivate them to carry out further goal-consistent activities (Fishbach et al., 2006). This argument overlaps with several consistency theories that explain positive spillover effects, such as the foot-in-the-door effect (Freedman and Fraser, 1966) or the cognitive dissonance theory (Festinger, 1962; for a review on consistency theories, see Gawronski and Strack, 2012). These theories suggest that a first behavior activates a positive self-image or social identity and people infer feelings of distressing dissonance when acting inconsistently (Festinger, 1962). As a person tries to avoid this dissonance, the likelihood of performing a subsequent behavior that is consistent with the activated identity or concept increases (Truelove et al., 2014).

Furthermore, superordinate goals may foster positive behavioral spillover across socio-spatial contexts and across domains, as they interconnect several behaviors. When focusing on a superordinate goal, it becomes apparent that there are

several means for pursuit (Kruglanski et al., 2002). For example, the goal of living a healthy life can be pursued by eating healthily, exercising regularly, and getting enough sleep. While these three distinct behaviors do not appear to be related in isolation, their interconnection becomes apparent when focusing on the common superordinate goal (Dolan and Galizzi, 2015). When a person focuses on a superordinate goal, engaging in a first goal-consistent action only signals partial completion, thereby motivating further actions. These further actions are not bound to the same or very similar repeated behavior, but can entail several distinct actions connected to the superordinate goal. For example, in order to progress toward a goal of “living a healthy life,” one could eat less convenience food, join a sports group, meditate, and get regular health checks. This also implies that, as long as the discrepancy between the status quo and the superordinate goal is sustained, a person will not engage in negative spillover behavior across other related contexts or behavioral domains, as the harmful effect of engaging in a behavior that contradicts the pursuit of the superordinate goal will be apparent.

Taken together, we argue that goals at all levels of abstraction have distinct advantages for the promotion of goal pursuit and work best when combined. Subordinate goals help to promote the initiation of a specific action, but they run the risk of triggering negative spillover effects. Superordinate goals are shown to be less motivating in initiating a behavior, but may be helpful to maintain a behavior over time as well as to foster positive spillover effects across other behaviors and domains. Thus, superordinate goals may help forestall negative spillover effects after reaching a first subordinate goal.

The Present Study

To complement existing research on spillover effects, this study focuses on the spillover effects of an existing behavior change intervention (a bike-to-work campaign in Switzerland) over time and across behaviors in different socio-spatial contexts (cycling to work and cycling in leisure time) and in different domains (exercising, eating) in an experimental field setting. By taking part in the existing bike-to-work campaign, all participants pursued a subordinate goal defining *what* had to be achieved (i.e., cycling to work on at least half of the working days during the intervention period). We investigate whether the bike-to-work campaign, which focuses on a specific behavior over a limited period of time, triggers negative spillover effects over time (research question 1) and whether the campaign triggers negative spillover effects across behavior (research question 2). Based on the assumption that superordinate goals sustain discrepancy between the status quo and the desired state and that superordinate goals highlight the relationship between distinct behaviors, for both research questions we analyze whether adding a superordinate goal can reduce negative spillover and foster positive spillover over time and across behaviors.

In addition to a condition that combined the subordinate bike-to-work goal (*what*) with a superordinate goal (*why*), we also investigated a condition that combined the bike-to-work goal with concrete action steps that must be completed in order to achieve the bike-to-work goal (*how*). Focusing on *how* to

achieve a goal has proven to be particularly helpful in the successful pursuit of goals when initiating a new behavior (see action phase model, Heckhausen and Gollwitzer, 1987) and when facing unfamiliar, complex situations (see control theory, Carver and Scheier, 1982; or action identification theory, Vallacher and Wegner, 1987). The advantage of action steps in goal pursuit is further reflected in the research on implementation intentions, which concentrates on *how* to achieve a goal and specifies in detail *when* and *where* this action will take place. In this way, implementation intentions link an intended action to a specific situation. Implementation intentions are shown to have a medium to large effect on promoting the initiation of an intended behavior (Gollwitzer and Sheeran, 2006) and are also helpful in maintaining a new behavior over time (Holland et al., 2006). Additionally, an experimental condition that references the empirically-supported, positive influence of action steps on goal achievement enables a better contextualization of the results (Watkins, 2011).

A combination of all three goal formulations is also examined as the final group of the study; this combination includes a subordinate goal (*what* do I pursue?), a superordinate goal (*why* do I pursue it?), and action steps (*how* do I pursue it?). It thus investigates how combining goals at different hierarchical levels could reap the benefits of superordinate goals, subordinate goals and action steps while canceling out the disadvantages (Höchli et al., 2018).

To summarize, the present study tests the following research questions.

Research question 1a: Does the effect of the bike-to-work campaign on cycling to work disappear at the end of the campaign and trigger negative spillover over time?

Research question 1b: Does formulating a superordinate goal and/or action steps in addition to the subordinate goal lead to a longer maintenance of the intervention effect on cycling to work, and therefore reduce negative and foster positive spillover effects over time?

Research question 2a: Does the effect of the bike-to-work campaign on cycling to work trigger negative spillover across behaviors?

Research question 2b: Does formulating a superordinate goal and/or action steps in addition to the subordinate goal reduce negative and foster positive spillover effects across behaviors?

METHODS

Participants

Participants were recruited via official emails from the bike-to-work organization in Switzerland that were sent to all participants in the bike-to-work campaign. As an incentive, participants who completed the study were entered in a prize draw for 5 wellness weekends each worth CHF 800. The registration questionnaire was started by 1,842 people; of these participants, 309 did not complete the registration questionnaire, meaning that they could not be contacted and were excluded from the sample. Of the 1,533 participants who registered, 1,377 began the starting questionnaire, and out of these, 1,285 finished it and underwent the manipulation, thus meeting the minimal criteria

to participate in this study. Within this sample, participants who changed their email address during the study and could no longer be uniquely identified were excluded from the study. Participants who were unable to provide meaningful answers regarding their cycling behavior (i.e., those who were injured or on holiday when they had to complete one of the questionnaires) were excluded from the corresponding questionnaire but remained in the sample for the remaining questionnaires. In addition, the study excluded responses regarding eating behaviors when the responses indicated that a person was consuming over 60 portions of fruit and vegetables per week (the total number of fruit and vegetable portions per week is determined by multiplying the number of days per week during which fruit or vegetables were eaten and the number of portions per day). Values above the mean at baseline plus six standard deviations, i.e., 60 portions per week, may indicate that those individuals have already indicated the number of portions per week rather than per day and were thus treated as inaccurate disclosures). But these participants were kept in the sample for the remaining questionnaires. Our final sample included 1,269 participants (746 women, 523 men, $M_{\text{age}} = 38.57$ years, $SD_{\text{age}} = 10.89$ years).

Design

Participants were randomly assigned to one of four conditions of a between-subjects design with repeated assessment of the outcome variable (e.g., frequency of cycling to work) within 7 months starting at the end of the bike-to-work campaign. By taking part in the bike-to-work campaign, all participants committed to pursue the goal of cycling to work on at least half of the working days for a maximum of 2 months. The control condition focused solely on this subordinate goal. In addition to the subordinate goal, the first intervention condition was asked to think about *why* they wanted to bike to work and, on this basis, formulate a superordinate goal (*superordinate* condition); a second intervention condition was asked to think about *how* to meet the target of the bike-to-work campaign and, on this basis, formulate concrete action steps (*action step* condition); and a third intervention condition was asked to formulate action steps as well as a superordinate goal (*combined goal hierarchy* condition). As outcome variables, we measured the frequency of cycling to work (spillover effect over time), the frequency of cycling during leisure time (spillover effect across socio-spatial contexts), the frequency of exercising, and the frequency of eating healthy and unhealthy foods (spillover across behavioral domains) at the end of the campaign and up to 7 months afterwards.

Procedure

Data were collected by the research team via seven online questionnaires: A registration questionnaire (1), an initial questionnaire at the start of the campaign (2), an end questionnaire at the end of the campaign (3), and three follow-up questionnaires (4–6). Additionally, a final follow-up questionnaire (7) was sent 7 months after the end of the campaign, in the winter, to all participants who had agreed to be contacted again. During the campaign, participants received a reminder message approximately every 2 weeks.

The registration questionnaire was sent 1 week before the start of the campaign. Consent for participating in the research was attained by asking participants to continue only if they had read the provided instructions, agreed to them, and were willing to participate in our study. To establish a baseline, we asked participants how frequently they cycled to work and during their leisure time, as well as about their exercising and eating behaviors. Furthermore, participants answered socio-demographic questions. The starting questionnaire was sent out the day that the campaign started. In the starting questionnaire, participants completed the goal manipulation and a manipulation check. To make sure that participants did not forget the details of the experimental condition they were assigned to, they received reminder messages approximately every 2 weeks during the campaign. On the last day of the campaign, participants received the end questionnaire. It assessed their frequency of cycling to work, cycling in their leisure time, and exercising, and also assessed their eating behaviors. Participants answered the same questions 2, 3, and 7 months after the end of the campaign (see **Figure 1**). All study elements were designed in Qualtrics and distributed via email.

Various additional variables were assessed which are not topic of this article (e.g., whether participants interpreted their behavior as progress or commitment, or the level of self-efficacy), and thus will not be described in the material and will not be evaluated in this context.

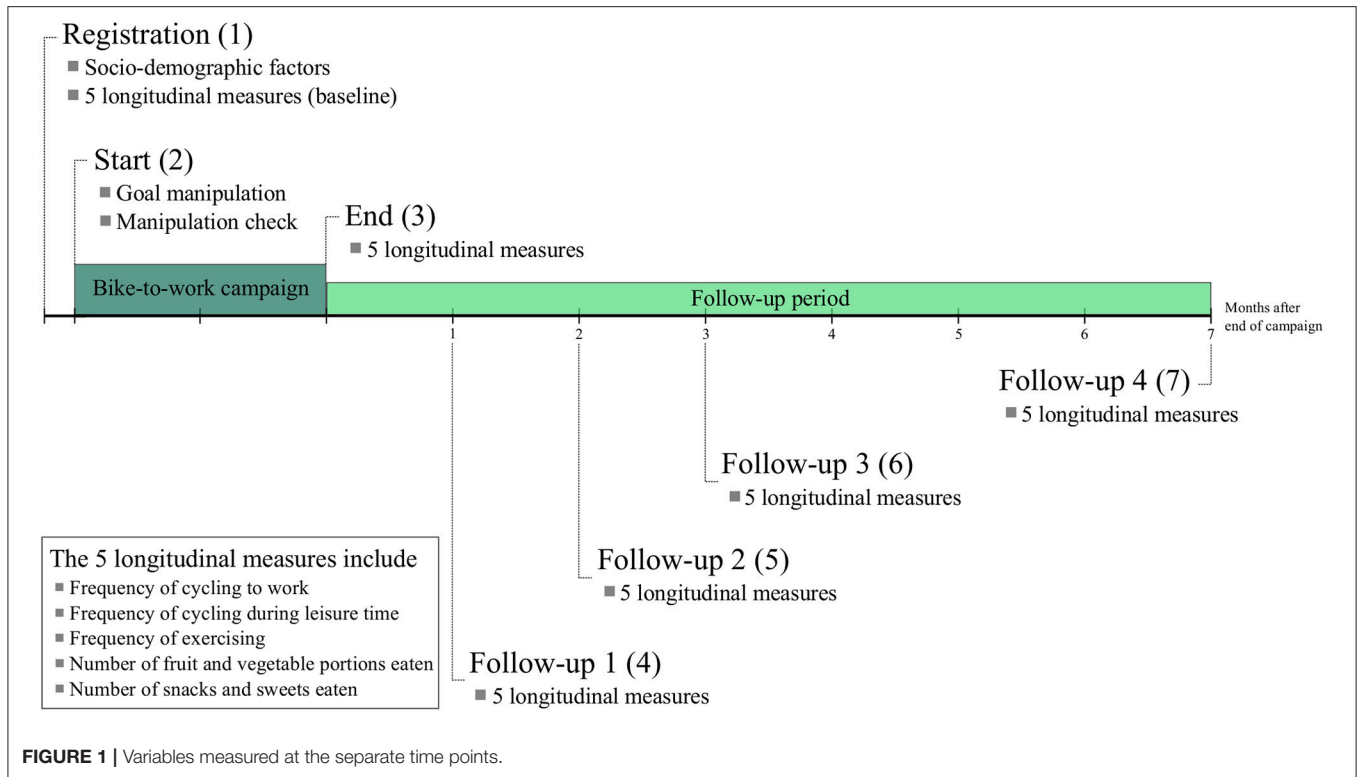
Measures and Materials

Goal Manipulation

The control condition ($N = 327$) focused only on the goal of the bike-to-work campaign: that is to cycle to work on at least half of the working days during the campaign.

The first intervention condition (superordinate goal, $N = 316$) was asked, in addition to the bike-to-work goal, to consider why they would like to pursue the bike-to-work campaign goal and write down their answer in their own words. Participants were then asked to address their answer and explain why it was important to them and again write down their answer. With these considerations in mind, participants were asked to consider which greater life goal the bike-to-work campaign and the desire to ride a bike more often is connected with, and to formulate a personal goal starting with “I want to be a person who...” (for a similar approach see laddering technique, e.g., Reynolds and Gutman, 1988).

The second intervention condition (action steps, $N = 311$) was asked, in addition to the bike-to-work goal, to write down three specific behaviors that will help them to achieve the bike-to-work campaign goal successfully. Participants were informed that ideally, these should be new behaviors that they have not yet implemented regularly and want to repeat. They were then asked to select the behavior that seemed to be the easiest and most effective to implement, and to formulate it as a personal goal. The third intervention group (combined goal hierarchy, $N = 315$) was asked, in addition to the bike-to-work goal, to formulate both action steps and a superordinate goal.



Manipulation Check

To measure the hierarchical level of abstraction of participants' goals, participants rated their goal on a 5-point scale using eight semantic differential items (adapted from Burrus, 2006, Cronbach's $\alpha = .78$): from *central to life as a whole* (=1) to *side issue for life as a whole* (=5), from *complicated* to *simple*, from *long-term goal* to *short-term goal*, from *concerns life as a whole* to *concerns a specific aspect of life*, from *focusing on why something gets done* to *focusing on how something gets done*, from *influences overall path of life* to *influences minor detours in life*, from *is strongly linked to personal values* to *is detached from personal values*, and from *important* to *not important*. For the control condition, this rating refers to the subordinate goal of the bike-to-work campaign; for the superordinate and combined goal hierarchy conditions to their self-formulated superordinate goal and for the action step condition to their self-formulated action step.

Longitudinal Measures

Five variables were measured on six separate time points: as baseline measurement just before the start of the campaign (baseline measurement), at the end of the campaign (end measurement), and after 1, 2, 3, and 7 months after the end of the campaign (4 follow-up measurements). **Figure 1** gives an overview of the variables measured at the separate time points.

Participants were asked on how many of the past 7 days they cycled to work, they cycled in their leisure time and they did strenuous and moderate physical activities. Furthermore, participants were asked on how many of the past 7 days

they have eaten vegetables and fruits as well as sweets and snacks, and the number of portions of each they ate on average per day. To compute the total number of fruit and vegetable portions as well as snacks and sweets eaten, the number of days was multiplied by the average number of portions of the respective food.

RESULTS

The results are presented in three parts. First, we report several data quality checks. Second, we describe the spillover effects of the intervention over time, both for the sample as a whole and separately for the four experimental conditions (research question 1). Third, we describe the spillover effects of the intervention across behaviors, again both for the sample as a whole and separately for the four experimental conditions (research question 2).

Data Quality Checks

Attrition Analysis

Among the participants who completed the start questionnaire, not all completed all five subsequent questionnaires (end questionnaire and four follow-up questionnaires, $M = 4.09$, $SD = 1.344$). To examine potential bias introduced by differential attrition between groups, we compared the number of completed questionnaires across groups but did not find any differences, [$F_{(3,1265)} = 0.69$, $p = 0.556$]. That is, there is no reason to assume that the conditions had an effect on the motivation to participate.

TABLE 1 | Kruskal–Dunn comparisons of self-reported hierarchical abstractions of participants' goals.

| Group | n | Mean | SD | Kruskal–Dunn comparisons (bonferroni) | | |
|-------------------------|-----|------|------|---------------------------------------|--------------------|--------------|
| | | | | Combined goal hierarchy | Superordinate goal | Action steps |
| Combined goal hierarchy | 315 | 2.42 | 0.51 | | | |
| Superordinate goal | 316 | 2.42 | 0.56 | 1.000 | | |
| Action step | 311 | 2.72 | 0.58 | <0.001 | <0.001 | |
| Control | 327 | 2.84 | 0.48 | <0.001 | <0.001 | 0.007 |

Manipulation Check

To test whether the goal manipulation had the intended effect, we measured the self-reported hierarchical abstraction of participants' goals. A Kruskal–Wallis test showed differences among the four goal conditions, $\chi^2(3) = 167.63$, $p < 0.001$. Follow-up tests were conducted to evaluate pairwise differences among the four groups, controlling for Type I error across tests by using the Bonferroni approach. A Kruskal–Dunn test indicated that participants who formulated a superordinate goal (superordinate goal condition and combined goal hierarchy condition) assessed their goal as more abstract than did the control condition and the action step condition (see **Table 1**), which indicates a successful manipulation.

Randomization Check

To check whether randomization was successful, a one-way multivariate analysis of variance (MANOVA) with baseline measures of cycling to work, cycling in leisure time, intensive physical activity, moderate physical activity, eating fruit and vegetables, and eating snacks and sweets as the dependent variables and condition (control vs. action step vs. superordinate goal vs. combined goal hierarchy) as the independent variable was performed. The MANOVA did not reveal a significant multivariate effect, [$F_{(3,1205)} = 1.32$, $p = 0.180$], and no significant univariate effects, indicating successful randomization (all $p > 0.153$).

Effects of the Bike-to-Work Campaign Over Time

To answer our first research question, the spillover effects are analyzed over time; first in relation to the overall intervention effect (research question 1a) and then in relation to the four experimental goal manipulation conditions (research question 1b).

Overall Effect of the Campaign on Cycling to Work Over Time: More Rides to Work Until Two Months After the Campaign

Our data—that is, repeated measurements on individuals—had a hierarchical structure with measures nested within persons. Accordingly, we analyzed the data by applying a hierarchical linear modeling approach using the R-package lme4 (Bates et al., 2014). The first level of analysis was at the repeated-measures level (i.e., respondents reported longitudinal measures on cycling to work at the six measurement points at the within-person level). The second level of analysis was at the level of

the individual respondent and captured changes in behavior between individuals.

In order to assess the overall effect of the campaign on cycling to work (research question 1a), we fitted a multivariate, multilevel model with random intercepts (for model specification see **Supplementary Model 1**). We examined the mean change of cycling to work at each of the five-measurement point compared to the baseline measure before the campaign and tested whether these means differed significantly. Results of this multivariate multilevel model are presented in **Table 2**.

At the end of the campaign, participants cycled to work on average almost 1 more day (0.88) per week than they did before the campaign, $b = 0.88$, $t = 17.51$, $p < 0.001$. This positive effect, when compared to baseline, was still present (although to lesser extents) 1 month, $b = 0.35$, $t = 6.75$, $p < 0.001$ and 2 months after the end of the campaign, $b = 0.27$, $t = 5.09$, $p < 0.001$. Three months after the end of the campaign, the positive effect on cycling to work was no longer discernable as the frequency of cycling to work was similar to baseline measurement, $b = 0.09$, $t = 1.70$, $p = 0.09$. Seven months after the end of the campaign—which corresponded to the winter season in Switzerland—participants cycled to work less often than they did at baseline, $b = -0.65$, $t = -11.14$, $p < 0.001$. In short, participants cycled more frequently during and up to 2 months after the campaign. Three months after the campaign, however, they returned to the same frequency as before the campaign, and in winter the frequency dropped below baseline levels (see **Figure 2**).

Effect of the Goal Type Manipulation on Cycling to Work Over Time: Superordinate Goals Show Some Positive Effects

To assess how cycling to work will develop after the end of the campaign and answer research question 1b, model 1 was slightly adapted. On the first level of analysis (the repeated-measures level within an individual), we included five measures per participant starting with the measurement at the end of the campaign where time was set to zero. The baseline measurement of cycling to work was included as a covariate at the between-person level. Furthermore, to assess whether formulating a superordinate goal and/or action steps in addition to the subordinate goal leads to longer maintenance of the intervention effect on cycling to work, we included goal type as a second-level (between persons) predictor. On this basis, we fit a multilevel growth model with random intercepts and random slopes as justified by the data (for model specifications see **Supplementary Model 2**). Results are presented in **Table 3**.

TABLE 2 | Application of a multivariate multilevel model for a within-subjects pre-/post-design with six fixed occasions.

| Predictor | Fixed | | | | | | Random | |
|---------------------------------|--------------|----------|------|---------|-----------|----------------|----------|------|
| | Coef. | <i>b</i> | SE | df | <i>t</i> | 95% CI | Coef. | SD |
| MODEL 1: CYCLING TO WORK | | | | | | | | |
| Intercept | β_{00} | 2.98 | 0.05 | 2589.45 | 54.87*** | 2.88 to 3.09 | r_{oi} | 1.49 |
| End | β_{10} | 0.88 | 0.05 | 5246.79 | 17.51*** | 0.79 to 0.98 | | |
| Follow-up 1 | β_{20} | 0.35 | 0.05 | 5264.59 | 6.75*** | 0.25 to 0.45 | | |
| Follow-up 2 | β_{30} | 0.27 | 0.05 | 5274.69 | 5.09*** | 0.16 to 0.37 | | |
| Follow-up 3 | β_{40} | 0.09 | 0.05 | 5277.66 | 1.70 | -0.01 to 0.19 | | |
| Follow-up 4 (winter) | β_{50} | -0.65 | 0.06 | 5304.74 | -11.14*** | -0.76 to -0.54 | | |

Coef. = Coefficient in corresponding model equation; *b* = unstandardized regression coefficient; $N_{occasions} = 6,459$, $N_{persons} = 1,269$. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

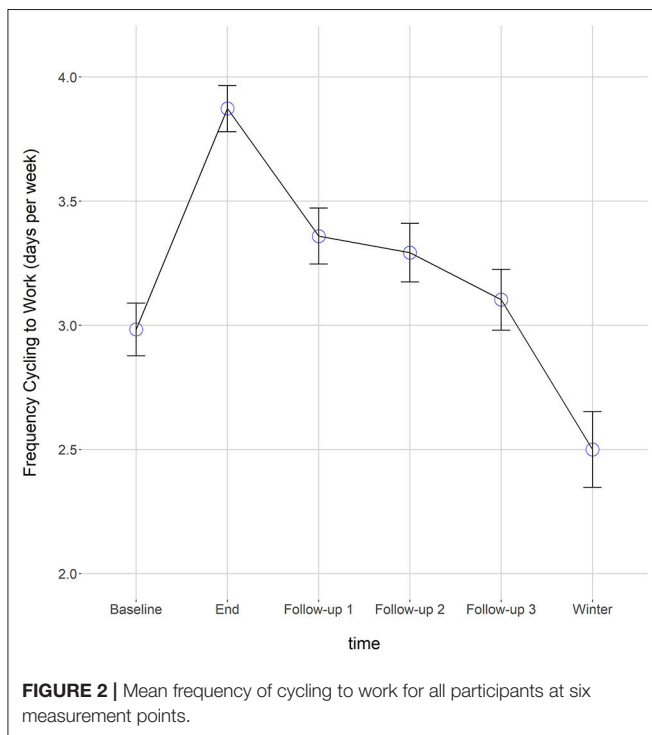


FIGURE 2 | Mean frequency of cycling to work for all participants at six measurement points.

The Intercept (β_{00}) shows that at the end of the campaign the control group cycled to work on average 3.61 days per week. At the between-person level, the frequency of cycling to work before the campaign (β_{01} , baseline) has a positive effect on cycling to work after the campaign across individuals, $b = 0.59$, $t = 35.53$, $p < 0.001$, indicating that people who cycled frequently before the start of the campaign were also more likely to cycle more frequently at the end of the campaign. The coefficients β_{02} – β_{04} shows the effect of the goal manipulation on cycling to work at the end of the campaign. For the group with an additional superordinate goal, a positive change in mean at the end of the campaign compared to the control group was observed, indicating that the campaign had a stronger effect for participants with a superordinate goal compared to the control

group, $b = 0.21$, $t = 2.03$, $p = 0.020$, Pseudo- $R^2 = 0.003^1$. No differences were observed between the combined goal hierarchy and the control condition or between the action steps and the control condition.

At the within-person level, time had a negative effect on cycling to work (β_{10}), indicating that the frequency of people riding their bike to work is declining after the end of the campaign, $b = -0.21$, $t = -11.00$, $p < 0.001$, Pseudo- $R^2 = 0.25$. This negative trend over time was observed for 87.13% of the sample (the percentage of individuals for whom the time slope was negative; see Hox et al., 2017). Thus, for the large majority of participants, the frequency of cycling to work decreased over time. This result is consistent with the results regarding the overall effect of the campaign: People maintained an increased level of cycling to work up to 2 months after the campaign. Three months after the intervention, the frequency of cycling to work did not differ from baseline, and 7 months after the campaign, during winter, a significant decrease compared to baseline was observed.

To test whether the goal manipulation had an effect on cycling to work over time—that is to see whether additionally formulating a superordinate goals and/or action steps could reduce or even dissolve this negative trend on cycling to work over time—the cross-level interaction between goal manipulation and time (β_{11} – β_{13}) is of interest. For the goal manipulation to be effective at fostering cycling to work in the long-run, we would expect β_{11} – β_{13} to be significantly larger than zero. The cross-level effects of all three goal manipulations \times time did not yield any significant effects. This indicates that complementing a subordinate goal with a superordinate goal and/or action steps did not lead to longer maintenance of the positive intervention effect, and thus did not mitigate the decrease of the target behavior over time.

Effects of the Bike-to-Work Campaign Across Behaviors

To answer our second research question, the spillover effects are analyzed over across behaviors; first in relation to an increase in

¹Pseudo- $R^2 = [(unrestricted\ error - restricted\ error)/unrestricted\ error]$ (Raudenbush and Bryk, 2002).

TABLE 3 | Application of a multilevel growth model examining the effect of goal type on cycling to work.

| Predictor | Fixed | | | | | | Random | | |
|---------------------------------|--------------|----------|------|---------|-----------|----------------|----------|------|------------|
| | Coef. | <i>b</i> | SE | df | <i>t</i> | 95% CI | Coef. | SD | Slopes < 0 |
| MODEL 2: CYCLING TO WORK | | | | | | | | | |
| Intercept | β_{00} | 3.61 | 0.07 | 1178.41 | 50.87*** | 3.47 to 3.74 | r_{0i} | 0.96 | |
| Baseline cycling to work (cgm) | β_{01} | 0.59 | 0.02 | 1203.68 | 35.53*** | 0.56 to 0.63 | | | |
| Combined goal hierarchy | β_{02} | 0.14 | 0.10 | 1170.97 | 1.39 | -0.05 to 0.34 | | | |
| Superordinate goal | β_{03} | 0.21 | 0.10 | 1180.74 | 2.03* | 0.01 to 0.41 | | | |
| Action step | β_{04} | 0.06 | 0.10 | 1172.84 | 0.62 | -0.13 to 0.26 | | | |
| Time | β_{10} | -0.21 | 0.02 | 930.26 | -11.00*** | -0.25 to -0.17 | r_{1i} | 0.19 | 87.13% |
| Combined goal hierarchy: time | β_{11} | -0.02 | 0.03 | 910.05 | -0.64 | -0.07 to 0.04 | | | |
| Superordinate goal: time | β_{12} | -0.01 | 0.03 | 920.15 | -0.33 | -0.06 to 0.04 | | | |
| Action step: time | β_{13} | 0.03 | 0.03 | 926.24 | 1.05 | -0.02 to 0.08 | | | |

Coef. = coefficient in corresponding model equation; *b* = unstandardized regression coefficient; slopes < 0 = percentage of random slopes that were estimated to be negative (calculated on the basis of the assumption of normally distributed random slopes; see Hox et al., 2017); $N_{occasions} = 5,190$, $N_{persons} = 1,269$. The baseline measure of cycling to work was centered at the grand mean. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

cycling to work (research question 2a), and then in relation to the goal manipulation (research question 2b).

Spillover Effects of the Campaign Across Socio-Spatial Contexts and Behavioral Domains: Partly Positive Effects From an Increase in Cycling to Work

The frequency of cycling to work increased on average across all participants as a result of the intervention. In the next step, to answer research question 2a (whether an increase in cycling to work could trigger negative spillover across behaviors), we investigated spillover effects from this change in cycling to work to cycling in leisure time, as well as across behavioral domains such as exercising and eating. We used a series of longitudinal multilevel models (**Supplementary Models 3–6**), to examine the effect of a change in cycling to work on the four possible spillover behaviors. The respective possible spillover behavior is the first-level outcome variable and cycling to work is the first-level predictor variable centered at the individuals mean; it is denoted by the suffix “cwc” (or “centered within clusters”; Enders and Tofighi, 2007). Additionally, we took the mean of all five measurements of cycling to work as a second-level predictor to control for the mean cycling frequency of each person. And finally, we included the baseline measure of cycling to work and the baseline measure of the respective possible spillover effect as a second-level predictor. All second-level predictors are denoted with the suffix “cgm” (or “centered at grand mean”; Enders and Tofighi, 2007). All models included random intercepts and random slopes as justified by the data (for model specifications, see **Supplementary Models 3–6**). Results of these multilevel models are presented in **Table 4**.

All baseline values of the behaviors that we tested for potential spillover effects had a positive effect on the respective potential spillover behavior in all four models (see **Table 4**). For example, participants who cycled more frequently in their leisure time before the campaign also cycled more frequently in their leisure time after the campaign. The baseline value of cycling to work

only showed a small negative effect on cycling in leisure time, $b = -0.06$, $t = -2.40$, $p = 0.017$, Pseudo- $R^2 = 0.004$.

At the between-person level, individual means of cycling to work predicted cycling in leisure time, $b = 0.28$, $t = 10.04$, $p < 0.001$, Pseudo- $R^2 = 0.10$, indicating that people who on average cycle more to work also cycle more in their leisure time.

To answer the research question whether an increase in cycling to work gives rise to spillover effects across behaviors, the within-person level is of importance. At the within-person level, cycling to work positively predicted cycling in leisure time, $b = 0.17$, $t = 10.40$, $p < 0.001$, Pseudo- $R^2 = 0.09$, and eating fruits and vegetables, $b = 0.31$, $t = 3.99$, $p < 0.001$, Pseudo- $R^2 = 0.005$ (see **Figures 3A,B**). No effect was found regarding exercising, and eating snacks and sweets.

The individual differences in cycling to work moderated the within-person slope for cycling to work regarding cycling in leisure time, $b = 0.03$, $t = 2.31$, $p = 0.021$, and exercising, $b = 0.08$, $t = 4.62$, $p < 0.001$. This indicates that participants with a higher level of individual means of cycling to work showed a larger positive spillover effect on cycling in leisure time and on exercising than participants with a lower level. In the case of exercise, even a change from a positive spillover for persons with a high person-mean to a negative spillover for persons with a low person-mean can be observed (see **Figures 3C,D**).

Spillover Effects of the Goal Type Manipulation Across Socio-Spatial Contexts and Across Behavioral Domains: No Effect of the Goal Manipulation

Although the goal manipulation did not have a consistent statistically significant impact on cycling to work, it is still possible that the goal manipulation affected other behaviors (Lanzini and Thøgersen, 2014). To answer research question 2b, whether goal manipulation can hinder negative and foster positive spillover effects across behavior, we tested whether there is a more positive change in cycling in leisure time, exercising and eating in the intervention groups than in the control group.

TABLE 4 | Application of multilevel models examining the relation between cycling to work and four possible spillover behaviors.

| Predictor | Fixed | | | | | | Random | | |
|--|--------------|----------|------|---------|----------|----------------|----------|------|------------|
| | Coef. | <i>b</i> | SE | df | <i>t</i> | 95% CI | Coef. | SD | Slopes < 0 |
| MODEL 3: LEISURE CYCLING | | | | | | | | | |
| Intercept | β_{00} | 1.97 | 0.03 | 1196.60 | 63.31*** | 1.91 to 2.03 | r_{oi} | 0.92 | |
| Baseline leisure cycling (cgm) | β_{01} | 0.58 | 0.02 | 1172.72 | 32.33*** | 0.54 to 0.61 | | | |
| Baseline cycling to work (cgm) | β_{02} | -0.06 | 0.02 | 1230.04 | -2.40* | -0.10 to -0.01 | | | |
| Person mean cycling to work (cgm) | β_{03} | 0.28 | 0.03 | 1248.54 | 10.04*** | 0.23 to 0.34 | | | |
| Cycling to work (cwc) | β_{10} | 0.17 | 0.02 | 625.99 | 10.40*** | 0.14 to 0.21 | r_{1i} | 0.21 | 79.9% |
| Person mean cycling to work (cgm): cycling to work (cwc) | β_{11} | 0.03 | 0.01 | 955.53 | 2.31* | 0.00 to 0.05 | | | |
| MODEL 4: EXERCISE | | | | | | | | | |
| Intercept | β_{00} | 3.50 | 0.05 | 1187.40 | 75.62*** | 3.42 to 3.60 | r_{oi} | 1.41 | |
| Baseline exercise (cgm) | β_{01} | 0.54 | 0.02 | 1190.41 | 28.14*** | 0.50 to 0.58 | | | |
| Baseline cycling to work (cgm) | β_{02} | 0.02 | 0.03 | 1227.99 | 0.48 | -0.05 to 0.09 | | | |
| Person mean cycling to work (cgm) | β_{03} | 0.05 | 0.04 | 1237.82 | 1.1 | -0.04 to 0.13 | | | |
| Cycling to work (cwc) | β_{10} | 0.04 | 0.02 | 511.78 | 1.82 | -0.01 to 0.09 | r_{1i} | 0.28 | 55.8% |
| Person mean cycling to work (cgm): cycling to work (cwc) | β_{11} | 0.08 | 0.02 | 795.05 | 4.62*** | 0.04 to 0.11 | | | |
| MODEL 5: FRUITS AND VEGETABLES | | | | | | | | | |
| Intercept | β_{00} | 21.25 | 0.23 | 1151.52 | 90.89*** | 20.80 to 21.72 | r_{oi} | 7.35 | |
| Baseline fruits and vegetables (cgm) | β_{01} | 0.47 | 0.02 | 1152.88 | 27.76*** | 0.44 to 0.51 | | | |
| Baseline cycling to work (cgm) | β_{02} | -0.04 | 0.17 | 1185.93 | -0.21 | -0.40 to 0.33 | | | |
| Person mean cycling to work (cgm) | β_{03} | 0.26 | 0.21 | 1195.22 | 1.23 | -0.15 to 0.67 | | | |
| Cycling to work (cwc) | β_{10} | 0.31 | 0.08 | 3731.46 | 3.99*** | 0.15 to 0.47 | r_{1i} | 0.09 | 99.9% |
| Person mean cycling to work (cgm): cycling to work (cwc) | β_{11} | -0.08 | 0.06 | 3741.39 | -1.39 | -0.20 to 0.03 | | | |
| MODEL 6: SNACKS AND SWEETS | | | | | | | | | |
| Intercept | β_{00} | 6.63 | 0.1 | 1192.13 | 65.04*** | 6.43 to 6.84 | r_{oi} | 3.05 | |
| Baseline snacks and sweets (cgm) | β_{01} | 0.51 | 0.02 | 1178.04 | 31.26*** | 0.48 to 0.54 | | | |
| Baseline cycling to work (cgm) | β_{02} | 0.11 | 0.08 | 1243.20 | 1.38 | -0.04 to 0.26 | | | |
| Person mean cycling to work (cgm) | β_{03} | 0.01 | 0.09 | 1248.65 | 0.16 | -0.17 to 0.20 | | | |
| Cycling to work (cwc) | β_{10} | 0.03 | 0.05 | 513.45 | 0.7 | -0.06 to 0.12 | r_{1i} | 0.39 | 53.3% |
| Person mean cycling to work (cgm): cycling to work (cwc) | β_{11} | 0.02 | 0.03 | 829.83 | 0.61 | -0.04 to 0.08 | | | |

Coef. = coefficient in corresponding model equation; *b* = unstandardized regression coefficient; slopes < 0 = percentage of random slopes that were estimated to be negative (calculated on the basis of the assumption of normally distributed random slopes; see Hox et al., 2017); $N_{occasions} = 5,190$, $N_{persons} = 1,269$. The baseline measure of cycling to work was centered at the grand mean. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

We repeated the statistical analyses in **Table 3** with the exception of the respective possible spillover behavior replacing cycling to work as the dependent variable and the baseline of the respective possible spillover behavior replacing the baseline of cycling to work (see **Supplementary Models 7–10**). All models included random intercepts and random slopes as justified by the data. The results are presented in **Table 5**.

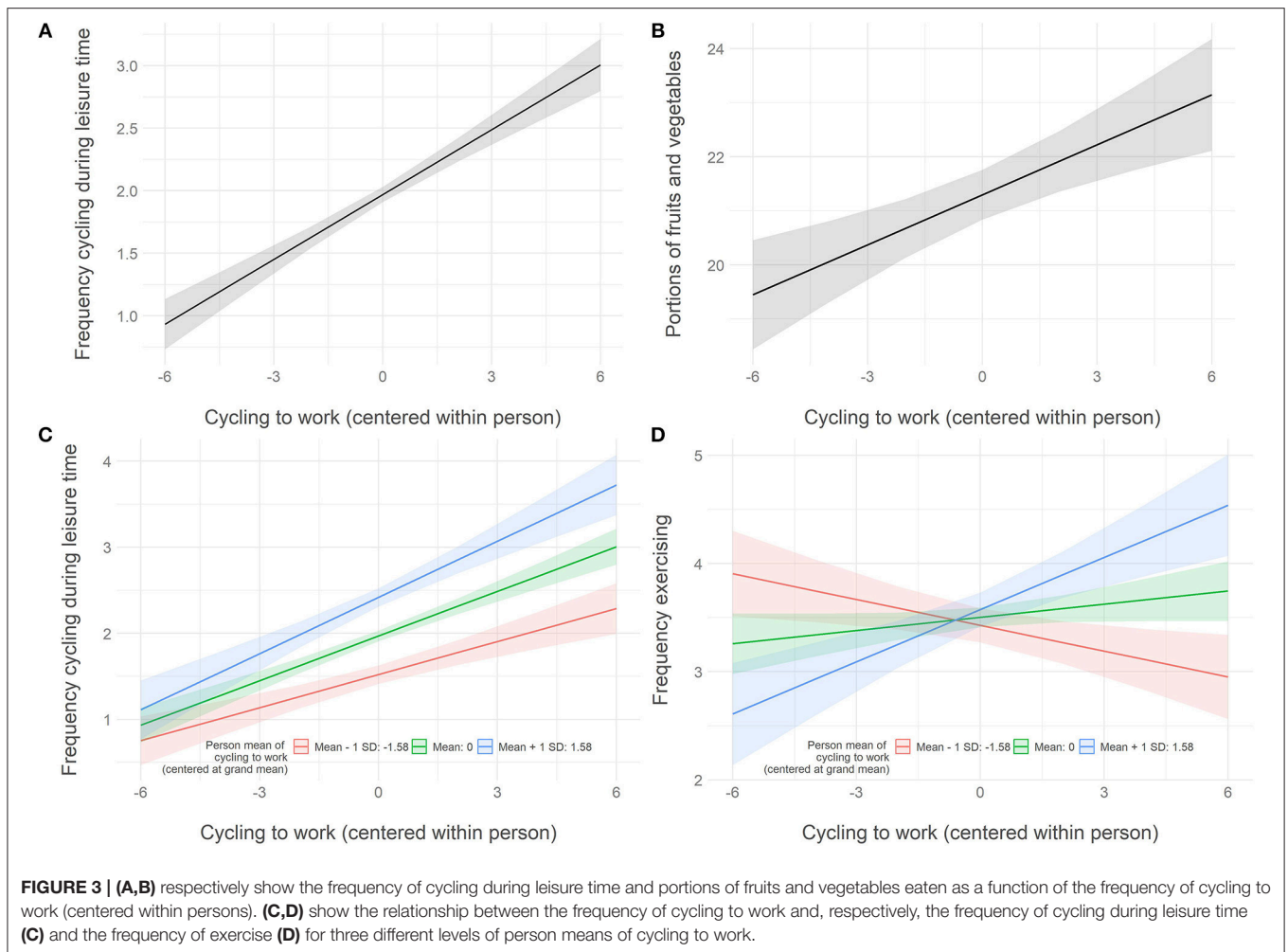
The baseline of the respective behavior had, in all models, a positive effect on the respective behavior (see **Table 5**). At the between-person level, goal manipulation had no effect on the four spillover behaviors. At the within-person level, time had a negative effect regarding cycling in leisure time, $b = -0.14$, $t = -8.56$, $p < 0.001$, Pseudo- $R^2 = 0.13$, and eating fruits and vegetables, $b = -0.21$, $t = -2.30$, $p = 0.022$, Pseudo- $R^2 = 0.07$.

To test research question 2b, whether goal manipulation can hinder negative (and foster positive) spillover effects across behaviors, the cross-level interaction between goal manipulation and time (β_{11} – β_{13}) is of importance. For the goal manipulation

to be effective at fostering the four spillover effects in the long-run, we would expect β_{11} – β_{13} to be significantly larger than zero. None of the three goal manipulations x time interactions yielded any significant effects, indicating that the goal manipulation did not affect the spillover behaviors over time.

DISCUSSION

Many individual and societal challenges require people to change their behavior over the long-term and across several behaviors. Thus, intervention designers have to take into account not only a specific, time-bound targeted behavior but also possible spillover effects of this targeted behavior, across time and across behaviors. However, no general consensus exists about the direction and size of possible spillover effects, nor about which factors can promote positive spillovers and reduce negative spillovers (Truelove et al., 2014). Furthermore, studies testing spillover effects experimentally in the field are still scarce and there is a need for more experimental research (Lanzini and Thøgersen, 2014). To contribute to this, based on a goal theoretical perspective, we



tested whether an intervention focusing on a specific behavior over a limited period of time (i.e., a subordinate goal) gives rise to negative spillover effects over time and across behaviors, and whether the formulation of a superordinate goal and/or action steps can hinder negative and foster positive spillover effects.

The campaign was successful in various aspects: Irrespective of the goal conditions, participants cycled to work more often at the end of the campaign than they did before the campaign. The increase in the cycling frequency was maintained up to 2 months after the campaign and thus the risk that the intervention effect will disappear immediately after the end of the intervention was not confirmed. While the results indicate that focusing on a superordinate goal increased the intervention effect measured at the end of the campaign, no effect of the goal manipulation was observed regarding the maintenance of the intervention effect over time. An increase in cycling to work spilled over across socio-spatial contexts to an increase in cycling in leisure time, and across behavioral domains to an increase in eating fruits and vegetables, which does not confirm the risk of negative spillover across behaviors. However, counter to our expectations, the goal manipulation did not yield any effect on the direction or size of the spillover effects across behaviors.

Spillover Effects in the Field

Embedding the present study in an existing large-scale campaign allows for an experimental design that enables the investigation of spillover effects in the field. Thus, the results of this study provide several insights on spillover effects across time and across behaviors in field settings. To start with, the overall increase in cycling to work compared to baseline for up to 2 months after the end of the campaign somewhat reduces the concern that the effect of a time-limited intervention will only last as long as the intervention itself (Jeffery et al., 2000; Geller, 2002; Lally and Gardner, 2013). Nevertheless, 2 months is a short period, and the decline in the intervention effect back to the initial level 3 months after the end of the campaign indicates that the participants did not change their behavior sustainably in the long-run (Lally and Gardner, 2013).

Furthermore, the evidence emerging from this study does not support the concern of negative spillover effect in field studies that could potentially nullify or even reverse the intervention effect on the targeted behavior, but corroborates earlier findings suggesting that behavior can, under certain circumstances, positively spill over from one behavior to other related behaviors (e.g., Lanzini and Thøgersen, 2014; Chatelain et al., 2018). The

TABLE 5 | Application of multilevel growth models examining the effect of goal type on several spillover behaviors.

| Predictor | Fixed | | | | | | Random | | |
|---------------------------------------|--------------|-------|------|---------|----------|----------------|----------|-------|------------|
| | Coef. | b | SE | df | t | 95% CI | Coef. | SD | Slopes < 0 |
| Model 7: LEISURE CYCLING | | | | | | | | | |
| Intercept | β_{00} | 2.24 | 0.08 | 1195.92 | 29.79*** | 2.10 to 2.38 | r_{0i} | 11.08 | |
| Baseline cycling leisure (cgm) | β_{01} | 0.63 | 0.02 | 1174.62 | 35.42*** | 0.60 to 0.67 | | | |
| Combined goal hierarchy | β_{02} | 0.02 | 0.11 | 1189.82 | 0.2 | -0.18 to 0.23 | | | |
| Superordinate goal | β_{03} | 0.02 | 0.11 | 1200.28 | 0.2 | -0.18 to 0.24 | | | |
| Action step | β_{04} | 0.00 | 0.11 | 1190.28 | 0.04 | -0.19 to 0.21 | | | |
| Time | β_{10} | -0.14 | 0.02 | 963.20 | -8.56*** | -0.17 to -0.11 | r_{1i} | 0.12 | 87.8% |
| Combined goal hierarchy: time | β_{11} | 0.00 | 0.02 | 944.15 | -0.1 | -0.05 to 0.04 | | | |
| Superordinate goal: time | β_{12} | 0.02 | 0.02 | 955.05 | 0.98 | -0.02 to 0.07 | | | |
| Action step: time | β_{13} | 0.01 | 0.02 | 957.81 | 0.42 | -0.03 to 0.06 | | | |
| MODEL 8: EXERCISE | | | | | | | | | |
| Intercept | β_{00} | 3.63 | 0.1 | 1203.59 | 34.95*** | 3.42 to 3.85 | r_{0i} | 1.50 | |
| Baseline exercise (cgm) | β_{01} | 0.54 | 0.02 | 1190.65 | 28.06*** | 0.50 to 0.58 | | | |
| Combined goal hierarchy | β_{02} | -0.09 | 0.15 | 1199.31 | -0.62 | -0.37 to 0.20 | | | |
| Superordinate goal | β_{03} | -0.12 | 0.15 | 1208.39 | -0.82 | -0.42 to 0.18 | | | |
| Action step | β_{04} | 0.16 | 0.15 | 1199.12 | 1.09 | -0.12 to 0.47 | | | |
| Time | β_{10} | -0.04 | 0.02 | 943.45 | -1.74 | -0.08 to -0.01 | r_{1i} | 0.15 | 60.3% |
| Combined goal hierarchy: time | β_{11} | 0.01 | 0.03 | 925.38 | 0.26 | -0.05 to 0.07 | | | |
| Superordinate goal: time | β_{12} | -0.03 | 0.03 | 935.85 | -0.81 | -0.09 to 0.03 | | | |
| Action step: time | β_{13} | -0.04 | 0.03 | 938.55 | -1.21 | -0.10 to 0.02 | | | |
| MODEL 9: FRUITS AND VEGETABLES | | | | | | | | | |
| Intercept | β_{00} | 21.81 | 0.51 | 1155.92 | 43.03*** | 20.75 to 22.89 | r_{0i} | 7.74 | |
| Baseline fruits and vegetables (cgm) | β_{01} | 0.48 | 0.02 | 1155.09 | 27.89*** | 0.44 to 0.51 | | | |
| Combined goal hierarchy | β_{02} | 0.09 | 0.73 | 1149.31 | 0.13 | -1.24 to 1.56 | | | |
| Superordinate goal | β_{03} | 0.61 | 0.73 | 1155.91 | 0.84 | -0.86 to 2.01 | | | |
| Action step | β_{04} | -0.51 | 0.73 | 1153.15 | -0.70 | -1.95 to 0.88 | | | |
| Time | β_{10} | -0.21 | 0.09 | 886.11 | -2.30* | -0.38 to -0.02 | r_{1i} | 0.63 | 62.9% |
| Combined goal hierarchy: time | β_{11} | -0.03 | 0.13 | 858.59 | -0.27 | -0.29 to 0.21 | | | |
| Superordinate goal: time | β_{12} | -0.12 | 0.13 | 867.12 | -0.94 | -0.35 to 0.13 | | | |
| Action step: time | β_{13} | -0.17 | 0.13 | 874.78 | -1.29 | -0.43 to 0.11 | | | |
| MODEL 10: SNACKS AND SWEETS | | | | | | | | | |
| Intercept | β_{00} | 3.07 | 0.26 | 1309.71 | 11.99*** | 2.55 to 3.58 | r_{0i} | 3.26 | |
| Baseline snacks and sweets (cgm) | β_{01} | 0.51 | 0.02 | 1175.19 | 31.10*** | 0.48 to 0.54 | | | |
| Combined goal hierarchy | β_{02} | -0.27 | 0.33 | 1197.31 | -0.81 | -0.92 to 0.41 | | | |
| Superordinate goal | β_{03} | 0.06 | 0.33 | 1204.77 | 0.19 | -0.61 to 0.70 | | | |
| Action step | β_{04} | -0.46 | 0.33 | 1201.48 | -1.40 | -1.13 to 0.22 | | | |
| Time | β_{10} | 0.03 | 0.05 | 930.61 | 0.64 | -0.06 to 0.13 | r_{1i} | 0.33 | 46.6% |
| Combined goal hierarchy: time | β_{11} | -0.13 | 0.07 | 907.91 | -1.93 | -0.27 to 0.00 | | | |
| Superordinate goal: time | β_{12} | -0.09 | 0.07 | 915.85 | -1.33 | -0.23 to 0.05 | | | |
| Action step: time | β_{13} | -0.02 | 0.07 | 921.19 | -0.33 | -0.16 to 0.11 | | | |

Coef. = coefficient in corresponding model equation; b = unstandardized regression coefficient; slopes < 0 = percentage of random slopes that were estimated to be negative (calculated on the basis of the assumption of normally distributed random slopes; see Hox, 2010, p. 19); $N_{occasions} = 6345$, $N_{persons} = 1269$. All baseline measurements as well as the person means of cycling to work were centered at the grand mean. $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

observed spillover effects are not very strong, although small effect sizes are not unusual in the context of spillover (see Blanken et al., 2015). However, the results show no consistent positive spillover effect across all observed behaviors, suggesting that the occurrence of spillover effects depends on certain attributes of the observed behaviors. There are at least two relevant attributes

in this respect: similarity between and cost of the behaviors. Spillover effects—negative and positive—are more likely to occur between similar behaviors (Truelove et al., 2014). Similarity may be with respect to the behavioral domain but also to the cost and effort or frequency of performance, to the symbolic meaning of the behavior, or to how the behavior is performed (Lanzini and

Thøgersen, 2014). This is consistent with our finding that an increase in cycling to work positively spills over to an increase in cycling in leisure time. Furthermore, earlier findings suggest that individuals are more likely to adopt new behaviors that are not costly, and spillover is more likely to impact low-cost than high-cost behavior, where cost in the broad sense can refer to any kind of expenditure (e.g., money, time, physical strength, attention) (Lanzini and Thøgersen, 2014). This line of research may explain why, in the present study, an increase in cycling to work positively spilled over to healthy eating but not to unhealthy eating and exercising. It can be hypothesized that the costliness and effort of the specific spillover accounts for the observed effects: Performing an additional workout requires more time and physical effort than eating an additional apple. As spillover is more likely to impact low-cost than high-cost behavior, an increase in cycling to work is more likely to spillover to eating more fruits and vegetables, which requires relatively low effort, and less likely to spillover to exercising, which requires relatively high effort. Furthermore, a decrease in eating sweets and snacks can be seen as resisting a temptation. Temptations offer an immediate outcome which exerts a strong motivational pull (Fishbach et al., 2003) and thus often stand in conflict with goals that are higher in importance but whose outcomes are less salient and further away (Cavallo and Fitzsimons, 2012). Resisting temptation is difficult and requires high effort and willpower (Gollwitzer et al., 2010). If eating sweets and snacks is considered a temptation, observing no spillover effect is consistent with earlier results suggesting that spillover is less likely to impact high effort behaviors.

Finally, the results show the relevant role of moderating variables in the occurrence of spillover effects—namely, the average frequency of conducting the targeted behavior. While the positive spillover effect of *cycling to work* to *cycling in leisure time* was greater for people who, on average, cycled more frequently to work, the spillover effect on exercising was even reversed depending on the average frequency of cycling to work. Alternatively, the spillover effect was positive for those who, on average, cycled more frequently to work, and it was negative for those who cycled less often to work. This gives us the first indication of the possible risk of compensatory behavior: for people who conduct a target behavior infrequently, an increase in the target behavior could lead to a reduction in the associated behavior (for a similar reasoning, see Brügger and Höchli, submitted).

The Role of a Goal Theoretical Perspective in Spillover Effects

While some results indicate that focusing on a superordinate goal as well as a subordinate goal reinforces the positive intervention effect, there was no consistent positive impact of the goal manipulation—both superordinate goals and/or action steps—on spillover effects.

The lack of effect of action steps on cycling to work does not support previous results. The effect of action steps has been widely studied and shows positive effects on goal pursuit across various domains (see for example research on implementation intentions, Gollwitzer and Sheeran, 2006). While the focus of this technique is mainly on initiating behaviors

(e.g., Gollwitzer, 1999; Brandstätter et al., 2001), there are also some studies that highlight the advantage of implementation intentions for maintaining behavior over time, especially in combination with further self-regulatory measures such as mental contrasting (e.g., Stadler et al., 2010; Oettingen, 2012; Duckworth et al., 2013). However, our results show no effect of formulating action steps on cycling to work during the bike-to-work campaign as well as up to 7 months after the campaign. We can speculate that many people participating in the bike-to-work campaign already cycled before the campaign started and some of them may have already developed the habit of cycling to work. Some evidence for this explanation comes from research on implementation intentions: Implementation intentions are shown to have a strong effect on adopting a new behavior (Gollwitzer and Sheeran, 2006) or breaking old unwanted habits and developing new ones (Adriaanse et al., 2010; Osbaldiston and Schott, 2012). However, the effect of implementation intentions to reinforce or strengthen an already existing habit might be much smaller and could explain the lack of effect of implementation intentions on cycling to work.

Focusing on a superordinate goal in addition to the subordinate goal also did not show any effect on cycling to work. Based on a goal theoretical perspective, we expected that adding a superordinate goal would foster cycling to work over time as well as generate positive spillover effects across socio-spatial contexts (cycling in leisure time) and across different behavioral domains (exercising and eating). Compared to action steps and implementation intentions, very little research has dealt with the idea that focusing on superordinate goals could maintain the motivation to work toward a goal. To our knowledge, only one study has empirically tested the effect of focusing on superordinate goals when faced with repeated goal-relevant decisions (Fishbach et al., 2006). Thereby, four studies revealed a consistent pattern showing that activating a superordinate goal increased the tendency to act goal-consistent; that is, to make two decisions that both contribute to achieving the shared superordinate goal. These results indicate that focusing on a superordinate goal leads to a longer maintenance of the positive intervention effect, which is not consistent with our results. Importantly, though, whereas Fishbach's study was conducted in a laboratory setting, our study was a large field study. As such, the present findings complement previous research and show the need for further research highlighting possible mechanisms that could lead to the expected effect in a laboratory setting but not in a field study.

Furthermore, adding a focus on a superordinate goal did not influence spillover effects across behaviors. This result also does not support earlier results from similar streams of research, such as research on the effect of social identity on spillover effects. In the environmental domain for example, focusing on or highlighting a pro-environmental identity increases the likelihood of acting in a pro-environmental way and fosters positive spillover effects across different pro-environmental behaviors (Cornelissen et al., 2013; Van der Werff et al., 2014). In the present study, participants who formulated a superordinate goal were asked to think about why cycling to work is important

to them and to derive a personal goal starting with “I want to be a person who...” which highlights the proximity and conceptual similarity of a superordinate goal and social identities (Oyserman and James, 2011; Van der Werff et al., 2014) and would suggest a positive effect of superordinate goals on spillover effects that was not observed. However, it cannot be ruled out that people in the control condition or in the action step condition may not think of a superordinate goal on their own. Goals at different hierarchical levels are associated with each other (Kruglanski et al., 2002). Depending on the association strength, the activation of a subordinate goal can activate an associated superordinate goal. By thinking about the subordinate goal of cycling to work, a connected superordinate may become accessible, without deliberately undergoing a goal manipulation and explicitly activating it. This assumption is further corroborated by a more recent stream of research that states that goals can guide behavior outside of a person’s awareness (e.g., Custers et al., 2012). Contextual stimuli such as priming are shown to activate goals unconsciously and guide behavior (Aarts and Dijksterhuis, 2000; Fishbach et al., 2006). Thus, cycling to work or reporting one’s cycling effort could unconsciously activate related superordinate goals. The impossibility of experimentally excluding the activation of superordinate goals in the control condition or action step condition may be one reason why no differences between the four conditions on cycling to work and possible spillover effects could be observed.

The lack of the expected spillover effects over time and across behaviors through the goal formulation—action steps, superordinate goals and the combination of them—could further indicate that the present experimental design is only partially suitable for demonstrating the effects of the goal manipulation. First, no negative spillover effects and even positive spillover effects in some behaviors were observed across all experimental groups. This shows that the original campaign has already succeeded in bringing about a positive change in behavior without any additional interventions. While these results shed a good light on the campaign, however, it is a difficult starting point for identifying possible effects of additional intervention groups, which are expected to prevent negative spillover effects and foster positive spillover effects. Second, the goal formulation might have been too weak. The bike-to-work campaign is well-known in Switzerland and the goal of the campaign—to cycle to work at least half of the working days—is in the foreground of the campaign.² It can be hypothesized that an additional superordinate goal or action steps might therefore have little influence in the context of the existing campaign. This assumption is supported by the self-perception theory (Bem, 1972), according to which people infer attitudes from observing their own behavior which then affects their behavior. Participants of the bike-to-work campaign were advised to report their cycling every day during the campaign. This means that the participants considered their cycling behavior on a daily basis. According to the self-perception theory, this promotes cycling behavior independent of the goal manipulation, which could lead to a suppression of the effect of the goal manipulation

and thus explain the lack thereof. Finally, it cannot be ruled out that different processes influence the effect on cycling to work and on related behaviors, with different goals triggering different processes (Höchli et al., 2018). For example, subordinate goals may increase self-efficacy which fosters goal pursuit (Bandura, 1997) but run the risk of decreased motivation after achieving a first subordinate goals (Amir and Ariely, 2008), while superordinate goals may increase commitment (Boudreghien et al., 2013) but may be too vague to be motivating in the moment (Locke and Latham, 2002). It is possible that these processes contradict each other and cancel each other out, and therefore no direct effect of the goal manipulation is visible.

Limitations

This study has a number of limitations that should be addressed. First, the sample of the study might be biased due to self-selection. Voluntary participation in the bike-to-work campaign already indicates an affinity for cycling compared to the total population. The willingness of the participants to participate in the present study, in addition to taking part in the bike-to-work campaign, results in a sample with highly motivated participants who likely show higher commitment and willingness to cycle to work compared to the other participants in the bike-to-work campaign who did not take part in the present study, and to the general population. However, in this study, it was not possible to compare commitment or behavior to a control group that did not participate in the campaign, as the sample consists exclusively of participants in the bike-to-work campaign. To assess the effect of the campaign more comprehensively, it would be necessary to both (1) look at within-person variance comparing the frequency of cycling to work of a person to his or her baseline level and (2) compared it to a control group not taking part in the campaign.

A second limitation of this study is that self-reporting behaviors leads to several known errors and biases, such as erroneous beliefs about one’s behavior or social desirability bias (e.g., Chao and Lam, 2011; Kormos and Gifford, 2014). This shows the need to replicate the results in additional studies that are not based on self-reports. In addition, several longitudinal measurements (the self-reported frequency of cycling to work, cycling in leisure time, and exercising) in this study consisted of single item indicators (frequency of activity per week). It is generally accepted that, in many cases, short measurement instruments are inferior to multi-item measurement instruments, especially as there is no easy statistical way to determine (and report on) their reliability (Diamantopoulos et al., 2012; Postmes et al., 2013). Nevertheless, in this study we deliberately opted for single item measurements for the longitudinal frequency measurements. First, we made this decision for pragmatic reasons: Due to the high number of repeated measurements in this study, we have kept the number of questions as low as possible in order to keep the participant effort at an acceptable level throughout the study (Robins et al., 2001). Secondly, we also opted for single item measurements from a conceptual point of view: Single item measures and short scales can achieve a satisfactory level of reliability when they evaluate homogeneous and clearly defined concepts (Loo and Kelts, 1998; Postmes et al., 2013). The measurement of the frequency of

²<https://www.biketowork.ch/en/>

the performance of an activity in a given limited time period seems to be sufficiently homogeneous to be operationalized with a single element. The use of single item measures is further supported by encouraging results from recent research that investigated the comparative reliability and validity of individual items and multi-item measures (Gogol et al., 2014). Having said this, we encourage further research into the behavior of interest using reliable and valid multi-item measurements to identify and complement any weaknesses in the measurement. When undergoing the goal manipulation, the participants of this study formulated their own superordinate goals; this could be seen as a third limitation because it does not allow control over the exact content and behavioral context of the goals. According to the goal systems theory, a superordinate goal is interconnected with several distinct behaviors and vice versa: a behavior can be interconnected with multiple superordinate goals (Kruglanski et al., 2002). Cycling to work, for example, could be connected to the superordinate goal of living a healthy life, but could also be connected to an environmental goal (e.g., leading an environmentally friendly life) or social goal (e.g., being a person who cultivates social contacts). For this reason, it is difficult to make clear predictions as to what extent different behaviors or subordinate goals are related to each other and thus between which behaviors spillover effects are most likely to be expected. When a person focuses on a superordinate goal in the health domain, a spillover effect on healthy eating requires a different interpretation than when a person focuses on a superordinate goal in the environmental domain. In order to avoid this uncertainty, it would be possible to avoid individual formulations of superordinate goals by the participants by setting the same superordinate goal for all participants in the design of the study. But we decided against this course of action due to the personal nature of superordinate goals; these goals describes who a person is trying to be and thus is a central aspect of a person's identity (e.g., Emmons, 1989, 2005; Carver and Scheier, 2001). And as such, it is highly unlikely that a superordinate goal imposed by the intervention design would meet these criteria for all participants.

Finally, no special attention was paid to seasonal effects on the study even though it is colder, rainier, and snowier in Switzerland during the winter. That said, this seasonal change occurs across Switzerland during the winter, and weather and road conditions varied in a similar way for all participants. This is clearly visible in that the entire sample, regardless of the condition, cycled to work significantly less frequently in winter than they did in the baseline measurement in spring. Because data from the different experimental conditions were examined in parallel, it is unlikely that the seasonal variations differentially affected our central research questions. However, when it comes to investigating the main reasons and obstacles which encourage or hinder cycling, weather and seasonal effects as well as conditions for adapting bicycle use, such as road conditions, the presence of cycle paths, distance to the workplace or elevation of terrain, must certainly be considered. Furthermore, in order to investigate the influence of different goal formulations on behavior over time, it would be interesting to observe how cycling behavior develops in the spring and summer following the study. More specifically, it would be interesting to investigate whether the goal manipulation

affects the time, extent and intensity that participants start cycling after a winter break.

Future Research

While the present study sheds light on the effect of interventions in the field over time and across behaviors, most research on spillover effects is still based on correlational studies or laboratory studies with small sample sizes. This makes it difficult to draw causal inferences regarding the effect of an intervention over time and across different behaviors and thus to derive relevant implications for the design of environmental policy. We therefore encourage further experimental field studies (e.g., randomized controlled trials) to achieve a comprehensive understanding of the net effect of an intervention in the field after accounting for possible spillover effects.

The observed positive spillover effects on some behaviors, but not on others, lead to the same conclusion as the inconsistent results on the direction and size of spillover effects from earlier research: In order to understand spillover effects, it is indispensable to examine processes and boundary conditions regarding the effects studied. This concerns both the behavior targeted by an intervention and the behaviors to which a change in the targeted behavior could spill over. More research is needed to understand why spillover effects are more or less likely to occur across some behaviors than others, and to understand the types of behaviors that may be valuable targets for policy interventions after accounting for spillover effects (Dietz et al., 2009; Truelove et al., 2014). The similarity between behaviors and the effort and cost necessary to perform the behavior, or the interconnection with an underlying superordinate goal that relates different behaviors to each other, are promising starting points to shed light on this matter.

Furthermore, our results show that participants with a higher level of individual means of cycling to work showed a slightly larger spillover effect on cycling in leisure time and on exercising than participants with a lower level. This suggests that the existence and size of spillover effects may depend on the frequency or intensity of the targeted behavior prior to intervention. We suggest further research that looks at different levels of expertise, frequency of performance or existing habits regarding the behavior targeted by the intervention. Since many large-scale interventions, such as the bike-to-work campaign, are aimed at a wide range of participants with different starting situations, we expect such insights to be of great practical relevance for policy makers and intervention designers.

Finally, this study shows some evidence that focusing on a superordinate goal in addition to a subordinate goal can increase the positive intervention effect. This suggests that, despite the lack of a clear positive effect in the present studies, a goal theoretical perspective could be a valuable approach to increasing the effectiveness of future interventions. Due to several limitations of the present study—for example, that the control group also participated in the campaign, and that the goal manipulation was carried out within the framework of a campaign with a prevailing and widely known campaign goal—we recommend further experimental studies that highlight the role of superordinate goals and action steps in interventions.

CONCLUSION

The present experimental field study reduces the concern that an intervention focusing on a specific behavior over a limited period of time (i.e., a subordinate goal) gives rise to negative spillover effects over time and across behaviors that could nullify or even reverse the intended intervention effect. In addition, the study shows that positive spillover over time and across behaviors is possible, but does not occur consistently, indicating that several additional factors such as the similarity or cost of a behavior or the pre-intervention behavior also affect the presence and size of spillover effects. Although the observed positive spillover effects over time and across behavior cannot be traced back to the goal manipulation, the results give first indications that an additional focus on a superordinate goal can reinforce the intervention effect.

The results show the need for further experimental field research to shed light on the boundary conditions and processes by which positive spillover effects occur, and on the role of a goal theoretical perspective to increase the effectiveness of behavioral change interventions.

DATA AVAILABILITY

The dataset and R code for this study can be found in the open science framework: https://osf.io/rx9bu/?view_only=e0daebafb5d44418891216488b3e446.

ETHICS STATEMENT

This study was carried out as part of a larger research project in accordance with the recommendations of the Federal

Act on Research Involving Human Beings (Human Research Act, HRA) of the Swiss Confederation. The research project was approved by the ethics committee of the canton of Bern, member of the Swiss Ethics Committee on research involving humans.

AUTHOR CONTRIBUTIONS

BH, AB, and CM jointly developed the ideas in the paper. BH collected the data. RA merged and prepared the data set. BH and RA analyzed the data. BH wrote the paper. AB and CM read the paper and provided feedback on several drafts of the paper.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2019.00433/full#supplementary-material>

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Supplementary Material Paper 2

Using a Goal Theoretical Perspective to Reduce Negative and Promote Positive Spillover After a Bike-to-Work Campaign

Supplementary Model 1.

Multivariate multilevel model: Effects of the Bike-to-Work Campaign Over Time

This multivariate multilevel model captures the mean difference in the frequency of cycling to work between fixed occasions. To model the differences between the means at the different time points and the mean at baseline we included five dummy variables, each of which contrasts one of the five measurements after the campaign with the baseline measurement before the campaign (Lischetzke, Reis, & Arndt, 2015). Thus, we included six measures per participant ($n = 1269$) for a total of 7614 data points.

The intercept, π_{0i} , represents individuals baseline measure of cycling to work before the intervention takes place. We did allow for variance regarding the intercept. The mean difference of cycling to work between two time points is captured by the individual difference scores ($\pi_{1i} - \pi_{5i}$) which depicts the non-reference score minus the reference score of cycling to work of an individual. The difference between two time points is significantly different from zero if the test of the level 2 fixed effects is significant ($\beta_{00} - \beta_{50}$, the mean difference between two time points across individuals). In order to assess the effect of the campaign across all participants, we did not allow for variance in the slope (no error term $r_{1i} - r_{5i}$) which means that the slope is the same for all participants and the individuals' difference scores equal the mean difference score).

Model 1: Multivariate multilevel model for within-subjects pre- and /post-design with six fixed occasions.

$$\text{Level 1 (measures):} \quad \text{Cycling to work}_{ti} = \pi_{0i} + \pi_{1i}\text{Post} + \pi_{2i}\text{Follow-up 1} + \pi_{3i}\text{Follow-up 2} + \pi_{4i}\text{Follow-up 3} + \pi_{5i}\text{Follow-up 4}$$

$$\begin{aligned} \text{Level 2 (persons):} \quad \pi_{0i} &= \beta_{00} + r_{0i} \\ \pi_{1i} &= \beta_{10} \\ \pi_{2i} &= \beta_{20} \\ \pi_{3i} &= \beta_{30} \\ \pi_{4i} &= \beta_{40} \\ \pi_{5i} &= \beta_{50} \end{aligned}$$

Supplementary Model 2.

Multilevel growth model: Effects of goal type on cycling to work

In order to make statements about how cycling to work will develop after the end of the campaign, model 1 was slightly adapted. The adapted model, model 2, included the baseline measurement of cycling to work as a covariate. The first level of analysis is again at the repeated-measures level—that is, respondents' reported longitudinal measures—but with five measures per participants for a total of 6345 data points; time is set to zero at the time of the end questionnaire (end questionnaire = time 0), to 1 at the time of the follow-up measurement 1 month after the end of the campaign, to 2 at the time of the follow-up measurement 2 months after the campaign, to 3 at the time of the follow-up measurement 3 months after the campaign, and to 7 at the time of the follow-up questionnaire in winter, 7 months after the end of the campaign. The second level of analysis is again at the level of the individual respondent, with $n = 1269$.

We specified and estimated a linear growth model for cycling to work that allowed each participant to have her own initial level of cycling to work (= time point 0 at the end of the campaign) and rate of change in cycling to work. Model comparisons via deviance tests (e.g., Snijders & Bosker, 2012) showed that the random effects had a variance that was significantly larger than zero. The model included the maximal random effects structure justified by the data.

To assess the effect of the goal manipulation on cycling to work over time, cycling to work is the first-level outcome variable and goal type is a second-level, or between-individuals, predictor. Because participants were randomized to treatment and control conditions, we hypothesized no group differences in average baseline measures of cycling to work and included it as a second-level covariate, centered at the grand mean (henceforth denoted with the suffix “.cgm”, see Enders and Tofighi, 2007).

Model 2: Multilevel growth model examining the effect of goal type on cycling to work

Level 1 (measures): $\text{Cycling to work}_{ti} = \pi_{0i} + \pi_{1i} * \text{time} + e_{ti}$

Level 2 (persons): $\pi_{0i} = \beta_{00} + \beta_{01} * \text{baseline cycling.cgm} + \beta_{02} * \text{goal type} + r_{0i}$

$\pi_{1i} = \beta_{10} + \beta_{11} * \text{goal type} + r_{1i}$

If there is substantial within-person variability, a multilevel analysis is essential to answering the research question. In order to examine this prerequisite for the present analysis, we first estimated unconditional means models to partition the variance in cycling to work across both levels of analysis and then calculated the intraclass correlation (ICC, proportion of variance that is due to the person level). An ICC of .53 for cycling to work demonstrated substantial within-person variability.

Supplementary Models 3-6.

Spillover effects of the campaign across socio-spatial contexts and across behavioral domains

To assess the effects of cycling to work for four possible spillover behaviors, spillover behavior is taken to be a first-level outcome variable while cycling to work is a first-level predictor variable. In the models described below, the first-level predictor (cycling to work) change is of primary substantive interest. However, without any centering or with only grand-mean centering of a first-level predictor, the slope contains both within- and between-person variation, resulting in a mix of the Level 1 and Level 2 association between the independent and the dependent variables (Enders & Tofighi, 2007). To get a “pure” estimate of the within-person effect, cycling to work was group-mean centered (i.e., centered at the individuals’ mean, see Enders & Tofighi, 2007). For simplicity, the person mean-centered variables are henceforth denoted with the suffix “.cwc” (centered within clusters, see Enders & Tofighi, 2007; Raudenbush & Bryk, 2002). As group-mean centering of the level 1 variables removes between-person information, we additionally averaged cycling to work within each individual across all measurement points. We entered these person-means as a second-level predictor in the analysis, in order to test whether cycling to work has a differential effect between persons than within persons on other behaviors (Enders & Tofighi, 2007). Furthermore, we included the cross-level interaction between the first-level predictor *cycling to work* and the second-level predictor *person-means of cycling to work* in order to test for a moderation effect, such that the association between cycling to work and cycling in leisure time is stronger for people who cycle to work more often. Baseline measures of the respective behavior and of cycling to work are included as second-level covariates. In the models below, all second level predictors are centered at the grand mean; for simplicity, the grand mean-centered variables are henceforth denoted with the suffix “.cgm” (Enders & Tofighi, 2007).

Models 3-6: Multilevel models examining the relation between cycling to work and four possible spillover behaviors.

Level 1 (measures):
$$\text{possible spillover behavior}_{ti} = \pi_{0i} + \pi_{1i} * \text{cycling to work.cwc} + e_{ii}$$

Level 2 (persons):
$$\pi_{0i} = \beta_{00} + \beta_{01} * \text{baseline cycling.cgm} + \beta_{02} * \text{baseline possible spillover behavior.cgm} + \beta_{03} * \text{person means cycling to work.cgm} + r_{0i}$$

$$\pi_{1i} = \beta_{10} + \beta_{11} * \text{person means cycling to work.cgm} + r_{1i}$$

We included random effects for the intercept terms and for the slope terms in all models. Model comparisons via deviance tests (e.g., Snijders & Bosker, 2012) showed that all the random effects had a variance that was significantly larger than zero.

An ICC of .61 for cycling in leisure time, .59 for exercising, .71 for eating fruits and vegetables and .62 for eating sweets and snacks demonstrated substantial within-person variability, suggesting that a multilevel analysis is essential to address the research question.

Supplementary Models 7-10.

Spillover effects of the goal-type manipulation across socio-spatial contexts and across behavioral domains

Models 7–10 are based on model 2 with the exception that the spillover behavior replaced cycling to work as the dependent variable, and the baseline of the respective spillover behavior replaced the baseline of cycling to work.

Models 7-10: Multilevel growth model examining the effect of goal type on cycling to work

Level 1 (measures): $\text{possible spillover behavior}_{ti} = \pi_{0i} + \pi_{1i} * \text{time} + e_{ti}$

Level 2 (persons): $\pi_{0i} = \beta_{00} + \beta_{01} * \text{baseline possible spillover behavior.cgm} +$

$\beta_{02} * \text{goal type} + r_{0i}$

$\pi_{1i} = \beta_{10} + \beta_{11} * \text{goal type} + r_{1i}$

Model comparisons via deviance tests (e.g., Snijders & Bosker, 2012) showed that all the random effects had a variance that was significantly larger than zero. Thus, the models 7–10 contain both fixed effects and all possible random effects. An ICC of 0.47 for cycling in leisure time, 0.48 for exercising, 0.62 for eating fruits and vegetables and 0.49 for eating sweets and snacks demonstrated substantial within-person variability, suggesting that a multilevel analysis is essential to address the research question.

(Dietz, Gardner, Gilligan, Stern, & Vandenberg, 2009)

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Paper 3

Exploring the Influence of Goals at Different Levels of Abstraction on Self-Reported and Electronically Measured Exercise Frequency: An Experimental Field Study

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Manuscript

EXPLORING THE ROLE OF GOALS ON EXERCISE FREQUENCY

Exploring the Influence of Goals at Different Levels of Abstraction on Self-Reported and
Electronically Measured Exercise Frequency: An Experimental Field Study

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EXPLORING THE ROLE OF GOALS ON EXERCISE FREQUENCY

Abstract

Although regular physical activity is associated with numerous health benefits, many people are not sufficiently active. Interventions that aim to increase physical activity rely mainly on concrete, “subordinate” goals. Based on a goal-theoretical perspective, I argue that combining goals at different levels of abstraction may foster successful goal pursuit, particularly in the long run. In the present study, all participants committed to the subordinate goal of exercising three times per week for three weeks. A 2×2 between-subjects design was used to assign participants to an additional superordinate goal, concrete action steps, or both; a control group focused solely on the subordinate goal. The main outcome was exercise frequency, which was measured (a) in the short term, i.e., during the three-week intervention period, using self-reports and electronic data; and (b) in the long term, i.e., during a six-month follow-up period, using electronic data. For the self-reported frequency in the short term, the results show an interaction between a superordinate goal and action steps: In the absence of action steps, a superordinate goal had a negative effect, but this negative effect dissolved when action steps were present. Similarly, action steps exerted a positive effect in the presence of a superordinate goal, but this effect dissolved in the absence of a superordinate goal. When considering goal achievement (i.e., nine completed training sessions), the beneficial effect of a combination of superordinate goals and action steps and detrimental effect of focusing only on a superordinate goal or action steps was even more pronounced. Goal manipulation had no significant influence either in the short or long term for electronically measured exercise frequency. Possible explanations for the observed effects and the differences between self-reported and electronically measured exercise frequencies are discussed.

Exploring the Influence of Goals at Different Levels of Abstraction on Self-Reported and Electronically Measured Exercise Frequency: An Experimental Field Study

Although it is well known that regular physical activity (PA) is associated with many health benefits, a large proportion of people in all population groups are currently not sufficiently concerned with PA (World Health Organization, 2010). Insufficient PA is a major behavioral risk factor for noncommunicable diseases (NCDs) such as cardiovascular disease, diabetes, stroke, obesity, and multiple cancers (World Health Organization, 2017). This suggests that people at risk can prevent, mitigate, or treat many of the deadliest and most widespread diseases by changing their own behavior (World Health Organization, 2017). Interventions that promote PA and health behavior in general are seen as promising for the prevention of NCDs (McEwan et al., 2016; World Health Organization, 2017).

In the context of behavior change interventions, the beneficial role of goals has been highlighted (Locke & Latham, 2013; Michie et al., 2013). Goals are mental representations of desired outcomes to which people are committed (Fishbach & Ferguson, 2007; Fujita & MacGregor, 2012). Goals are powerful in changing a behavior, as setting a goal creates a sense of urgency that motivates people to direct attention and to make an effort to reduce the discrepancy between the current state and a desired state (Carver & Scheier, 2001; McEwan et al., 2016). Because of the powerful function of goals to direct behaviors, goal setting is one of the most widely applied and universally accepted strategies to foster PA (Glanz & Bishop, 2010; Swann et al., 2019). For example, in a recent review of interventions and behavioral change techniques to foster PA in healthy, inactive adults, goal setting was the strategy of choice in 22 of 26 studies (Howlett, Trivedi, Troop, & Chater, 2019).

Research on goal setting has emphasized that goals are particularly useful when formulated in a concrete manner. Across hundreds of studies, it has been shown that challenging,

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specific, and concrete (i.e., “subordinate”) goals—in contrast to vague and abstract (i.e., “superordinate”) goals—are powerful motivators and boost success in initiating an action and pursuing a goal (e.g., Locke & Latham, 1990, 2002, 2013). This insight is not only reflected in research but is widely applied in practice: Common guidelines for PA focus mainly on concrete goals such as 150 minutes of medium intensity PA per week (World Health Organization, 2017) or 10,000 steps per day (Guertler, Vandelanotte, Kirwan, & Duncan, 2015). The focus on subordinate goals is receiving additional impetus from the current popularity of wearables (e.g., Fitbit), which predominantly focus on the attainment of subordinate goals and make it fun and socially engaging (Swann & Rosenbaum, 2018).

The Problem: Detrimental Side Effects of Subordinate Goals

Although goal-setting interventions with subordinate goals are effective for behavioral change, critical voices have been raised questioning whether attention solely to subordinate goals is the best strategy in the case of multiple, complex, or long-term goals (Beauchamp, Crawford, & Jackson, 2019; McEwan et al., 2016; Ordóñez, Schweitzer, Galinsky, & Bazerman, 2009; Swann et al., 2019). In such cases, it is not only a matter of initiating a single, time-limited goal; it is also a matter of maintaining behavior over the longer term, sustaining motivation after a first successful step, and resisting the temptations afforded by conflicting, competing goals (Rothman, Baldwin, Hertel, & Fuglestad, 2004).

Attention solely to subordinate goals may even have detrimental effects (Ordóñez et al., 2009). One such potential effect is premature goal disengagement. The reasoning here depends on the understanding that goals motivate behavior through discrepancy: People monitor where they stand in relation to their goal (Carver & Scheier, 2001). In the case of a discrepancy between the current and desired state, they experience an unpleasant tension, a negative feeling such as anger, sadness, or fear. Because it is unpleasant, the tension motivates responses to

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decrease the discrepancy (Carver & Scheier, 2001; Fishbach & Finkelstein, 2012). In short, discrepancy is the engine of motivation to decrease the gap between the current and goal state.

This also implies, however, that once a goal is achieved, the discrepancy disappears, and with it the motivational impetus. Although there are benefits in some situations—the person now has resources to pursue other goals—it can be detrimental, especially when pursuing broad, long-term goals that cannot be achieved by a single action, such as “being healthy.” In that case, disengaging from a behavior after achieving a first subordinate goal runs against a person’s long-term best interests. (Thus, for example, dieters who have successfully lost weight often regain it once the dieting period is over.) Interventions that focus on a single subordinate goal run the risk that people will stop pursuing the behavior after the end of the intervention, and thus fail to achieve long lasting effects (Geller, Lippke, & Nigg, 2017). The dilemma then is how to tackle long-term, broad challenges—such as being healthy—and how the tendency to disengage too early from goals can be stopped or at least mitigated.

The Solution: Combining Goals at Different Levels of Abstraction

I propose that attending to superordinate *as well as* subordinate goals would motivate people to work toward their goal over the long run and would reduce the tendency to abandon it after some initial goal-consistent actions. Superordinate goals are abstract goals that refer to idealized conceptualizations, for example, of one’s self, one’s relationships, or the society one is part of. Such superordinate goals provide a general orientation as to what is (and is not) important to a person (Boekaerts, de Koning, & Vedder, 2006; see also Schwartz et al., 2001). Compared to subordinate goals, superordinate goals do not entail a specific end-state. To illustrate, it is easy to determine when a person has achieved the goal of exercising three times a week, but not so easy to determine when they have achieved the goal of living a healthy life. It is even questionable whether goals at this high level of abstraction can ever be fully attained

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(Wicklund & Gollwitzer, 1982). It follows that when superordinate goals are activated, on achieving a first step—a subordinate goal—a person does *not* get a feeling of having done enough or having achieved the goal. Thus the discrepancy between the present and the desired end-state remains, and so does the motivational impetus. Whereas, from a goal-setting perspective, the lack of a concrete endpoint is detrimental to the initiation of behavior (Locke & Latham, 2002), I argue that it is precisely this open endpoint that can be conducive to long-term goal pursuit. Thus, I hypothesize that focusing on a superordinate goal is likely to foster goal pursuit in the long run.

There is little research to date on combining subordinate and superordinate goals. There is, however, a good deal of research on combining subordinate goals and concrete action steps, which specify how to pursue a goal. Thinking about action steps is useful because abstract and generic intentions are translated into simple, executable actions (Bayuk, 2015; Gollwitzer, 1993; Masicampo & Baumeister, 2012). Action steps are particularly helpful when initiating a new behavior (action phase model, Heckhausen & Gollwitzer, 1987) and when facing unfamiliar, complex situations (control theory, Carver & Scheier, 2001; action identification theory, Vallacher & Wegner, 1987).

The usefulness of action steps in goal pursuit is also reflected in research on implementation intentions (Gollwitzer & Brandstätter, 1997), which are if-then statements that specify when, where, and how a goal intention is to be implemented. Thus implementation intentions link an intended action to a specific situation (e.g., “If I encounter situation X, then I will engage in action Y,” Gollwitzer & Brandstätter, 1997). Implementation intentions are helpful at different stages of goal pursuit: both in initiating a behavior and also in maintaining it over time (Gollwitzer & Sheeran, 2006; Holland, Aarts, & Langendam, 2006). Of course, implementation intentions and action steps need to be aligned with a goal the person is

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committed to (Adriaanse et al., 2010). I expect that combining action steps with a higher-order goal will motivate goal pursuit both in the short and the long term.

Goals at different levels of abstraction might not be equally helpful across all the stages of goal pursuit. In particular, it is worth keeping in mind that different principles may be involved for behavior initiation vs. behavior maintenance (Höchli, Brügger, & Messner, 2018; Mann, De Ridder, & Fujita, 2013; Rothman et al., 2004). Thus, reliance on any single strategy may render one vulnerable to failure, whereas a combination of different strategies is more likely to be effective.

Initial laboratory (Fishbach, Dhar, & Zhang, 2006) and field (Höchli, Brügger, Abegglen, & Messner, 2019) experiments provide preliminary support for the benefits of combining goals at different levels of abstraction. A limitation of these experiments, however, is that the outcome was measured solely using self-reports. Self-report is a common method to measure behavior but should be used with great caution as the measurement method can have a significant impact on what is observed. Self-reports of PA can be both higher and lower than directly measured PA, posing a problem for research studies that rely on it exclusively (Dyrstad, Hansen, Holme, & Anderssen, 2014; Prince et al., 2008).

The Present Study

The present study asks whether focusing on goals at different levels of abstraction affects exercise frequency in the short or long term. All participants committed to the subordinate goal of exercising in the gym three times per week for three weeks. Except for participants in the control group, participants additionally committed to a superordinate goal, actions steps, or both. Exercise frequency was measured during (a) the short term, the intervention period of three weeks, and (b) the long term, a follow-up period up to six months after the end of the

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intervention. Exercise frequency was measured by both self-report and electronic login data in the intervention period, and by electronic login data in the follow-up period.

In addition to the subordinate goal of exercising three times per week, a focus on action steps is predicted to have a positive effect on exercise frequency in the short term. In the long term, however, I hypothesize that an additional focus both on action steps and a superordinate goal will have a positive effect on exercise frequency.

Method

Participants

Participants were recruited across eight gyms in the canton of Bern, Switzerland, by means of flyers posted during four weeks in October and November 2017. The flyer listed the eligibility requirements: participants must have trained less than three times a week on average and must want to increase their training. As incentives, participants who completed the study received a voucher from their gym worth CHF 30 and were entered in a draw for a wellness weekend worth CHF 750. The aim was to recruit 240 participants (calculations to determine required sample size for a small-to-medium effect with 90% power at the 5% level were made with GPower Analysis Version 3.1, Faul, Erdfelder, Lang, & Buchner, 2007). Some 201 participants signed up for the study; 2 participants did not complete the start questionnaire and 48 did not complete the end questionnaire. Participants who did not attend the appointment for the end questionnaire were reminded several times by email and by phone by members of the research team. Unfortunately, 48 did not respond to repeated attempts to make an appointment. No self-reported or electronic data were collected for a further 19 persons and thus were excluded from the study. The lack of self-reported data is due to the fact that participants lost their manual exercise plan during the study. Reasons for the lack of electronic data were, for example, that the badge for the electronic login did not work during the intervention and follow-

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up period or that their gym subscription did not require an electronic login. The final sample consisted of 132 participants (100 women, 32 men, $M_{\text{age}} = 36.27$ years, $SD_{\text{age}} = 13.26$ years).

(Insert Figure 1 here)

Design

Participants were randomly assigned to one of four conditions using a 2 (superordinate goal: yes/no) \times 2 (action steps: yes/no) between-subjects design. All participants committed to the subordinate goal of exercising in the gym three times a week for three weeks. The control group focused solely on this goal, whereas the intervention groups were asked to think additionally on goals at different levels of abstraction. The first intervention group was asked to think about *why* they want exercise more, and on this basis to formulate a *superordinate* goal. A second intervention group was asked to think about *how* to pursue the exercise goal, and on this basis to formulate *action steps*. A third intervention group formulated both a superordinate goal and action steps. The main outcome measure was the frequency of exercising during the three study weeks and up to six months after the end of the study.

Measures

Goal manipulation. The control group ($n = 38$) focused only on the goal of exercising three times a week for three weeks.

The first intervention group (superordinate goal, $n = 35$) was asked to consider why they would like to exercise more and to write down the answer. Next, they were asked why their answer was important to them, and again to write it down. With these considerations in mind, participants were asked to consider which greater life goal the exercise goal is connected with, and to formulate a personal goal starting with “I want to be a person who...” (a similar approach is the “laddering” technique, Reynolds & Gutman, 1988).

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The second intervention group (action steps, $n = 29$) was asked, in addition to the exercise goal, to consider how they could integrate the three weekly training sessions in their everyday life, and were asked to write down three specific situations or “time windows” in which they planned to exercise.

The third intervention group ($n = 30$) was asked to formulate both a superordinate goal and action steps.

Exercise frequency (electronic). Frequency of training sessions was recorded electronically via the badge system of the participants’ gym. Frequency was determined for three phases: (a) baseline: the seven days before the start of the intervention; (b) intervention: the three-week intervention period; and (c) follow-up: the six months after the intervention.

Exercise frequency (self-report). Exercise frequency during the intervention period was additionally recorded as a self-report using the participants’ manual exercise plan, on which participants reported the dates they exercised.

Goal achievement. For each type of measurement (electronic and self-report), it was determined (yes/no) whether a person achieved the exercise goal of training three times per week for three weeks (i.e., completed at least nine training sessions).

Commitment. Participants rated their commitment to their exercise goal at the start of the study using Klein, Wesson, Hollenbeck, Wright, and Deshon’s (2001) five-item scale (Cronbach’s $\alpha = 0.56$) using a 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree).

Procedure

Interested persons filled out a paper-and-pencil “start” questionnaire in their gym. There were four versions of the start questionnaire, corresponding to experimental condition. Participants were randomly assigned to one of three intervention groups or the control group by virtue of the questionnaires’ being distributed at randomly. The start questionnaire included a

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consent form (consent to participate in the study and to pursue the goal of exercising three times a week for three weeks), the manipulation task, and some demographic questions. Additionally, participants were given a printed exercise plan. They were asked to enter their goal(s) formulated during the goal manipulation as a reminder, and to note down their exercise sessions during the three weeks of intervention. After fixing a date for the “end” questionnaire, participants began their intervention period.

Ten days after the start, participants were sent an email reminding them of their goal formulation and the date for their end questionnaire. After the three weeks, they were given the end questionnaire to fill out and the fitness voucher as a thank you. In the end questionnaire, participants indicated whether something unusual had happened during the course of the study (e.g., an injury, illness, or prolonged absence for some other reason). Additional variables that are not relevant for this article were also assessed.

Results

Drop-out Analysis

Excluded from the study were 69 participants who did not complete the start questionnaire ($n = 2$), the end questionnaire ($n = 48$), or had missing data on exercise frequency ($n = 19$). A comparison of the dropped participants and the 132 participants retained showed that the proportion of dropped participants was not associated with experimental condition, $\chi^2(3, N = 201) = 6.13, p = .106$. Furthermore, all the analyses reported in the Results section were repeated with the extended sample ($N = 201$) that included the 69 dropped participants. The results were the same regardless of sample type (see Supplementary Material, Tables 1-3).

Descriptive Statistics

On average, participants exercised 1.14 times the week before the study started (electronically measured frequency). During the intervention period, the average number of

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exercise sessions was 7.66 according to self-reports and 6.28 according to electronically measured frequencies. However, achieving the subordinate exercise goal required a total of nine sessions. According to self-assessment, 46.21% of the participants achieved the goal; according to electronic assessment, 27.27% achieved it.

Randomization Check

A one-way multivariate analysis of variance with goal condition as the independent variable and age, the baseline measure of frequency, and commitment to the pursuit of the exercise goal as the dependent variables was performed to check whether randomization was successful. The MANOVA revealed no significant effects (all $ps > .379$), indicating successful randomization.

Manipulation Check

Two members of the research team separately reviewed the formulated goals to assess whether the instructions had been followed. They assessed whether participants asked to formulate a superordinate goal actually formulated a goal that started with “I want to be a person who...” and that their goals were a meaningful response to *why* they wanted to exercise more. The researchers also assessed whether participants asked to formulate action steps described *how* they were going to pursue the exercise goal. The researchers agreed that all participants performed the assigned task as intended.

Goal Focus Influences Self-reported but not Electronically Measured Exercise Frequency

During the Intervention Period

I analyzed the effect of goal condition (superordinate goal, action steps, or both) and baseline exercise frequency on exercise frequency during the three-week intervention period both with self-report and electronic measures of frequency. As the dependent variables are count data—i.e., discrete data with non-negative integer values—and in order to account for under- or

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overdispersion respectively, I used a quasi-Poisson regression (Bilder & Loughin, 2014; Hoef & Boveng, 2007).

With respect to self-reported frequency (see Table 1, Model A), there was a significant interaction between a superordinate goal and action steps, indicating that focusing on a superordinate goal had a negative effect on exercise frequency in the absence of action steps, but this negative effect dissolved when action steps were present. In a similar vein, when a superordinate goal was present, focusing on action steps had a positive effect on exercise frequency, but this effect dissolved when no superordinate goal was present (see Figure 2A). Interestingly, no effect of the goal manipulation could be observed when using electronic measures of exercise frequency as dependent variable (see Table 1, Model B and Figure 2B). Baseline exercise frequency had no effect on exercise frequency during the study period with respect to self-reported data, but a positive effect with respect to electronically measured data.

(Insert Table 1 and Figure 2 here)

The difference between self-reported and electronically measured exercise frequency is also reflected when looking at whether a person achieved the subordinate goal of exercising three times a week during the three weeks. A binomial logistic regression with self-reported goal achievement as the dependent variable shows a significant interaction effect of focusing on a superordinate goal and focusing on action steps. This indicates that focusing on a superordinate goal had a negative effect on goal achievement in the absence of action steps, but a positive effect when action steps are present. Similarly, when a superordinate goal is present, focusing on action steps had a positive effect on exercise frequency, but a negative effect when no superordinate goal is present (see Table 2, Model A). Again, goal focus had no effect on goal achievement when using electronically measured data as the dependent variable (see Table 2, Model B).

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(Insert Table 2 here)

No Effect of Goal Focus on Exercise Frequency up to Six Months after the Study

Next, I analyzed the effect of goal condition (superordinate goal, action steps, and their interaction) and baseline exercise frequency on exercise frequency during the six-month follow-up period using electronic measures of exercise frequency. A quasi-Poisson regression showed a positive effect of the baseline exercise frequency but no effect of goal manipulation on the frequency of exercising up to six months after the end of the study (see Table 3).

(Insert Table 3 here)

Discussion

Using a 2×2 design, the present study investigated whether focusing on goals at different levels of abstraction affected the exercise frequency in a gym during (a) a three-week intervention period with a specified exercise frequency to be achieved (training three times a week) and (b) six-month follow-up period without an externally specified exercise frequency to be achieved. The exercise frequency during the three-week intervention period was measured both with electronic login data as well as self-reported exercise frequencies. The exercise frequency during the follow-up period was measured by electronic login data only.

During the intervention period, the goal manipulation affected the self-reported exercise frequency. I found an interaction effect between formulating a superordinate goal and formulating action steps. In the absence of action steps, a superordinate goal had a negative effect, but this negative effect dissolved when action steps were present. Similarly, action steps exerted a positive effect in the presence of a superordinate goal, but this effect dissolved in the absence of a superordinate goal. When considering goal achievement instead of frequency, the beneficial effect of a combination of superordinate goals and action steps and detrimental effect of focusing only on a superordinate goal or action steps becomes even more pronounced. In

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contrast, with respect to the electronically measured exercise frequency, goal manipulation did not affect exercise frequency or goal achievement either during the intervention period or the follow-up period. Thus, no support was found for the hypothesis that during the intervention period, an additional focus on action steps positively affects exercise frequency. Similarly, no support was found for the hypothesis that during the follow-up period, an additional focus on a superordinate goal and action steps would be effective.

Three points stand out in particular and will be discussed in more detail: first, the interaction effect of focusing on a superordinate goal or action steps with respect to self-reported exercise frequency and goal achievement; second, the difference between self-reported and electronically measured exercise frequencies during the intervention period and, third, the lack of effect of the goal manipulation in the follow-up period.

Focusing on a Superordinate Goal or Action Steps May Hinder Goal Pursuit

With regard to the self-reported frequency, it can be seen that focusing on a superordinate goal has a negative influence on goal pursuit in the absence of action steps, but this negative effect dissolves when action steps are also present. Likewise, focusing on action steps only has a positive influence on goal pursuit in the presence of a superordinate goal but does not foster goal pursuit in the absence of a superordinate goal. While focusing on a superordinate goal *and* action steps is beneficial compared to focusing on a superordinate goal *or* action steps, it does not lead to more successful goal pursuit than in the control group. This result is in line with research on goal pursuit and psychological disorders. It states that people change functionally, flexibly and adaptably between superordinate goals, subordinate goals and action steps in response to circumstances (Watkins, 2011). Manipulating the goal focus therefore only makes sense if this natural regulation is impaired, e.g. in the case of psychological disorders (Watkins, 2011). In the present case, it can be assumed that this natural regulation was not impaired. The results thus

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suggest that a goal manipulation that shifts focus on only a superordinate goal or only on action steps may impair this natural regulation. In contrast, focusing on a superordinate goals *and* action steps may activate the entire goal hierarchy and thus enable a natural regulation of goals at all levels of abstraction. In other words, relying on any single strategy may render one vulnerable to failure, whereas a combination of different strategies is more likely to be effective. This interpretation of the results raises the question of whether manipulating the goal focus is helpful for non-clinical samples at all, and stresses that goals must be set and pursued with caution and taking into account possible negative side effects.

Difference Between Self-Reported and Electronically Measured Exercise Frequencies

A second point that stands out in the results is that the effect of the goal manipulation differed between self-reported exercise frequency and electronically measured exercise frequency. This suggests that the difference between self-report and electronic measures cannot only be explained by some well-known errors and biases regarding self-reported behavior (e.g., erroneous beliefs about one's behavior, difficulty with recalling information, social desirability bias; Cerin et al., 2016; Kormos & Gifford, 2014), or technical difficulties regarding the electronically measured data, as these errors, biases and difficulties would affect the whole study sample (Dyrstad et al., 2014; Prince et al., 2008). Rather, it may indicate that the difference between self-reported and electronically measured exercise frequencies depends on the goal manipulation.

A possible explanation for why the goal manipulation affected self-reported exercise frequency differently than electronically measured exercise frequency is that the electronic data reflect the actual training behavior of the participants, while the self-reported data allows participants to deliberately misrepresent (i.e. overstate) their exercise frequency. This is consistent with the fact that the self-reported frequencies ($M = 7.66$, $SD = 2.33$) are on average

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higher than the electronically measured frequencies ($M = 6.28$, $SD = 3.31$). From this perspective, the results indicate that focusing additionally on a superordinate goal in the absence of action steps or focusing on action steps in the absence of a superordinate goal would hinder people to overstate their exercise frequency. However, if a participant focuses on a superordinate goal *and* action steps, this hindering effect is no longer visible.

Hindering effect of superordinate goals on overstating one's behavior. The hindering effect of superordinate goals on overstating one's behavior aligns with research on goal setting and unethical behavior that explores how the type and structure of goals can influence the resulting potential for unethical behavior (Ordóñez & Welsh, 2015). Goal setting theory assumes a positive linear relationship between how challenging a goal is and how much effort a person invests in goal pursuit (Locke & Latham, 2002). However, goals can also be too challenging and thus induce detrimental side effects such as unethical behavior (Ordóñez et al., 2009; Schweitzer, Ordóñez, & Douma, 2004). A reason for such unethical behavior is that goal failure is connected to psychological costs (Heath, Larrick, & Wu, 1999; Ordóñez & Welsh, 2015; Schweitzer et al., 2004). The more challenging a goal is, the higher the risk of goal failure. In the case that a person who falls short of a goal and has the opportunity to behave unethically (e.g., to overstate one's behavior) and thereby to achieve the goal (or appear to achieve it), it offers a possibility to eliminate the costs of falling short of the goal. If the costs of not achieving the goal outweigh the psychological costs of behaving unethically, people would have an incentive to engage in unethical behavior (Schweitzer, Ordóñez, & Douma, 2002; Schweitzer et al., 2004).

In the present study, focusing on a superordinate goals hinders overstating one's behavior. This might be explained by the fact that people are more likely to incur psychological costs when they focus on a single subordinate goal than when additionally focusing on a superordinate goal. When focusing on a subordinate goal, the achievement (or non-achievement)

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is easy to determine. If a person did not exercise nine times in three weeks, they incur the psychological cost associated with goal failure. This creates an incentive to overstate the behavior and thereby eliminate the costs of failure. When focusing on a superordinate goal, however, goal achievement is much more difficult or even impossible to assess, and thus leaves reasonable doubt as to whether a person actually failed to achieve the goal. This line of reasoning would explain why there might be less incentive to overstate behavior when focusing on a superordinate goal than when not focusing on a superordinate goal.

Hindering effect of action steps on overstating one's behavior. The hindering effect of action steps on overstating one's behavior aligns with research on self-image. Because people strive to maintain a positive self-image (Allport, 1955; Rosenberg, 1979), they avoid lying "too much," as dishonest behavior threatens their self-image (Mazar & Zhong, 2010; Sachdeva, Iliev, & Medin, 2009; Welsh & Ordóñez, 2013). That is why people behave dishonestly only to a certain extent—in this way, they can profit from their misconduct and still feel honest. In order to maintain a certain misconduct with the self-image of being an honest person, people use justifications (Shalvi, Gino, Barkan, & Ayal, 2015). Such justifications occur more frequently when the behavior in question permits certain ambiguities, for example, when there are gray areas or when they can assure themselves or others that they can no longer remember exactly whether they have behaved in a certain way (Pittarello, Rubaltelli, & Rumiati, 2013; Schweitzer & Hsee, 2002). Applied to the present study, the more precisely the exercise sessions are planned, the more clearly is it defined what the person should do, when, and where, and the clearer it becomes if the person does not carry out the planned behavior. In other words, the level of detail of a plan allows a more precise evaluation and verification of the corresponding behavior. This reduces the ambiguity and the scope for interpretation, which could facilitate the misrepresentation of one's behavior (Pittarello et al., 2013). This could explain why

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people who formulate concrete action steps self-report lower goal achievement than people who do not formulate action steps.

However, this line of reasoning does not explain the interaction effect of focusing on a superordinate goal and action steps on self-reported exercise frequency and goal achievement. All in all, related research helps shed some light on the observed effects, but cannot give a clear answer how goals at different levels of abstraction influence exercise frequency. I can only hypothesize which boundary conditions and mechanisms also affect exercise behavior and could account for the (partly inconsistent) results.

No Effect of Goal Focus on Exercise Frequency in the Long Term

A third point that stands out in the results is that, contrary to my hypothesis, goal manipulation had no influence on exercise frequency during the follow-up period. Another point that bears discussion is that with electronically measured data, the effect of goal manipulation is absent in both the long and the short term.

No effect of superordinate goals on exercise frequency in the long run. The expected effect of superordinate goals in the long term was not observed. On the one hand, this contradicts previous experimental research in the lab. Fishbach et al. (2006) conducted four studies in which participants made two successive hypothetical decisions, both representing a subordinate goal (e.g., wearing a sun hat, applying sunscreen) pertaining to the same superordinate goal (preventing sun damage). Participants exposed to contextual cues making the superordinate goal salient were more likely to be goal-consistent than those without a superordinate goal.

On the other hand, the absence of an effect of goal manipulation on long-term exercise frequency is consistent with a recent field experiment on the effect of a bike-to-work campaign. Focusing on a superordinate goal increased cycling behavior during the time of the campaign but

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not over the long term (Höchli et al., 2019). What stands out here is the difference between lab experiments and field experiments: Initial results from the laboratory, based on hypothetical and short-term behavior, show a positive effect of superordinate goals, whereas this is not the case for more ecologically valid situations and in particular not over the long run.

A possible explanation is that laboratory experiments allow control over the experimental procedure, but do not represent real-world situations (Gneezy, 2017). A hypothetical question about the behavior of a person in an experimental task differs from the requirement to exercise three times a week for three weeks in one's everyday life. Whether a person actually exercises in real life depends on many factors other than the goal (e.g., whether he has a strenuous time at work, his child is ill, old friends are in town, etc.). In the lab, these influences are averaged out, but they may directly influence behavior in a field study, and may indeed have overridden any effects of goal manipulation.

Furthermore, note that goal pursuit was operationalized as exercise frequency. However, other aspects of exercise—type, duration, intensity—are also relevant, and could potentially be used for operationalization (Kelly, Fitzsimons, & Baker, 2016). Different operationalizations of behavior may correspond to different dimensions of motivation (Touré-Tillery & Fishbach, 2014). In particular, the distinction between outcome-focused and process-focused motivation can contribute to the interpretation of the results (e.g., Touré-Tillery & Fishbach, 2014). Outcome-focused motivation refers to the desire to achieve a certain result, for example, to complete a certain number of repetitions. Process-oriented motivation refers to elements related to goal pursuit, such as executing the target behavior as precisely as possible or with high concentration, learning or enjoying the goal-related behaviors—the outcome itself plays a less important role (Touré-Tillery & Fishbach, 2011, 2014). In the present study, with its emphasis on exercise frequency, the focus is on outcome-related motivation. However, having a superordinate

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goal is likely to influence also process-related motivation such as intrinsic importance, meaning, or enjoyment, which cannot be captured by the present study design (Höchli et al., 2018).

No effect of action steps on exercise frequency in the long term. The expected effect of action steps was not observed. Action steps—or similar approaches, such as implementation intentions—have repeatedly led to positive effects in goal pursuit, both in the short and long term (e.g., Gollwitzer & Sheeran, 2006). Implementation intentions have proven to be particularly effective when combined with other self-regulatory measures such as mental contrasting (Duckworth, Kirby, Gollwitzer, & Oettingen, 2013; Oettingen, 2012; Stadler, Oettingen, & Gollwitzer, 2010). One possibility for the lack of an action steps effect here could be that, from the participants' point of view, the study was effectively finished after the three intervention weeks. It is known that goal attainment can lead to disengagement with goal-related behaviors (Förster, Liberman, & Higgins, 2005; Liberman & Förster, 2000; Zeigarnik, 1927), attaining the study goal might have weakened such further self-regulatory measures which in turn also could have reduced the effect of action steps.

No effect of goal manipulation on electronically measured exercise frequency in the short and long run. When exercise frequency was measured electronically, goal manipulation showed no significant effects in either the short or long term. This may indicate that the manipulation was too weak to influence behavior or that the study was under-powered to find a significant relationship. These concerns are discussed further below.

Limitations

The first limitation of the study is sample size. Although I attempted to recruit 240 participants, the final sample consisted of 132. The sample size is likely to be too small to have adequate power to detect the hypothesized effect. Future studies with an appropriate sample size are necessary in order to shed more light on the research questions dealt with here.

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A second limitation is the lack of a control group with no goal. The present experiment was designed to show potential differences between subordinate goals, action steps, superordinate goals, and their interactions, but it cannot show whether the focus on goals at different levels of abstraction is better, worse, or as effective as no goal at all. This makes it difficult to compare the observed effect sizes with other goal-setting interventions (e.g., McEwan et al., 2016).

It should also be noted that all participants were paid for their participation; there was no unpaid control group. Financial incentives have been shown to influence gym attendance both during and after the short-term intervention period. This effect on long-term behavioral change has been particularly evident in people who have not trained frequently before the intervention (Charness & Gneezy, 2009). It is possible that financial incentives promoted exercise independent of goal manipulation, perhaps even overriding goal manipulation.

All participants had the same goal: To exercise three times a week for three weeks. The downside is that this goal is not equally challenging for all people. Training three times a week was undoubtedly easier for some than for others—due to physical fitness, travel arrangements, family constellation, etc. As a result, the goal may have been too challenging for some and too easy for others. However, subjective challenge affects motivation and performance (Locke & Latham, 2013), and depending on how challenging a task is, goals at different levels of abstraction can be more or less helpful (Swann & Rosenbaum, 2018). Thus subjective challenge could have interfered with the effect of the goal manipulation.

Another limitation of this study is the potentially weak manipulation effect, especially over the long term. Participants underwent the goal manipulation in the context of the start questionnaire, which took only a few minutes. Although participants were reminded of their

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goals during the intervention period, no reminder was available after that time. It is conceivable that participants forgot the goals they had formulated over the following six months.

Future Research

In order to substantiate the results and better place them in the context of existing research, I encourage replications of the present study with appropriate no-goal and no-pay control groups and sufficient sample size.

Future research could test more systematically the effectiveness of goal types and shed light on their boundary conditions. This should be carried out, firstly, over various stages of PA adoption (setting, achieving, maintaining behavior). Goals at different levels of abstraction may not be equally beneficial over all stages. More specifically, several psychological models of behavioral change conceptualize goal pursuit and behavioral change as a process with different phases—from the formation of a goal, to the initiation of an action, to the maintenance of long-term behavior (e.g., Bamberg, 2013; Heckhausen & Gollwitzer, 1987; Prochaska & Velicer, 1997). Future research could address the role that superordinate and subordinate goals, action steps, and their interaction play across the various phases of goal pursuit. Future investigations could explore the ways that switching between goals at different levels of abstraction could facilitate goal pursuit, especially in the long term. Secondly, future research could explore systematically the effectiveness of different goal types for specific populations, such as the initial level of PA. The initial PA level of a person could influence the effectiveness of a given goal (Latham & Locke, 1991). For example, a challenging subordinate goal may motivate a person who already exercises twice a week to increase to three, but may be less effective for an inactive person who is just starting to exercise (Swann & Rosenbaum, 2018).

Future research could also examine outcome variables other than exercise frequency. This study focused on frequency but neglected other variables that could illuminate the role of goals

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at different levels of abstraction. Measuring aspects of PA such as duration or intensity would allow researchers to more systematically explore the effects of the goal manipulation on different facets of motivation (e.g., outcome-focused vs. process-focused motivation). Assessing psychological factors that influence long-term maintenance of PA—factors such as affect and self-efficacy, as well as processes to cope with setbacks, goal adjustment, and habit formation—would allow greater understanding of the benefits of goals at different levels of abstraction for pursuit of various types of goals (Swann & Rosenbaum, 2018; Touré-Tillery & Fishbach, 2014).

With respect to outcome measures, it would also be interesting to examine differences between self-reported and electronically measured exercise frequency more systematically. In the present study, results from the two methods differed. Both for the interpretation of scientific research on goals (which is often based on self-reports) and for the resulting recommendations for interventions to increase PA, a more detailed investigation of the factors and mechanisms leading to potential misreporting would be of great relevance.

Finally, the present study used aggregate data and measured mean changes in conditions—not individual responses. However, goal pursuit might differ according to individual and situational characteristics, so it would be interesting to use other designs (e.g., qualitative or longitudinal n-of-1 designs) to assess setting the right goal, at the right time, for the right person (McDonald et al., 2017).

Conclusion

With respect to self-reported frequency in the short term, the results show an interaction between a superordinate goal and action steps: In the absence of action steps, a superordinate goal had a negative effect, but this negative effect dissolved when action steps were present. Similarly, action steps exerted a positive effect in the presence of a superordinate goal, but this effect dissolved in the absence of a superordinate goal. When considering goal achievement (i.e.,

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nine completed training sessions), the beneficial effect of a combination of superordinate goals and action steps and detrimental effect of focusing only on a superordinate goal or action steps was even more pronounced. With respect to electronically measured frequency, goal manipulation had no significant influence either in the short or long term. The results show the need for further experimental research to explore the role of goals at different levels of abstraction on short- and long-term goal pursuit, as well as their effect on the differences between self-reported and objectively measured behavior.

Data availability statement

The dataset, R code, and codebook for this study can be found in the open science framework: https://osf.io/da2mn/?view_only=f642e330c8e84ff5964d2809e572ade2

Ethics approval statement

This study was carried out as part of a larger research project in accordance with the recommendations of the Federal Act on Research involving Human Beings of the Swiss Confederation. The research project was approved by the ethics committee of the canton of Bern, member of the Swiss Ethics Committee on research involving humans.

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EXPLORING THE ROLE OF GOALS ON EXERCISE FREQUENCY

Table 1

Exercise Frequency as a Function of Goal Manipulation and Baseline Measure

| | Model A Self-reported exercise frequency | Model B Electronically measured exercise frequency |
|--------------------------------------|--|--|
| Superordinate goal | -0.259*** (-0.401, -0.117) t = -3.584 | -0.239 (-0.491, 0.014) t = -1.853 |
| Action steps | -0.117 (-0.258, 0.025) t = -1.611 | -0.040 (-0.284, 0.203) t = -0.325 |
| Baseline | 0.014 (-0.032, 0.060) t = 0.585 | 0.140*** (0.062, 0.218) t = 3.517 |
| Superordinate goal × Action steps | 0.359*** (0.153, 0.565) t = 3.412 | 0.149 (-0.217, 0.516) t = 0.798 |
| Constant | 2.112*** (2.003, 2.222) t = 37.904 | 1.760*** (1.561, 1.959) t = 17.327 |
| Observations | 132 | 132 |

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. As quasi models are only characterized by their mean and variance, they do not necessarily have a distributional form; therefore AIC and log likelihood are not reported (e.g., Bilder & Loughin, 2014; Hoef & Boveng, 2007).

EXPLORING THE ROLE OF GOALS ON EXERCISE FREQUENCY

Table 2

Goal Achievement as a Function of Goal Manipulation and Baseline Measure

| | Model A Self-reported goal achievement | Model B Electronically measured goal achievement |
|--------------------------------------|--|--|
| Superordinate goal | -1.827*** (-2.871, -0.783) t = -3.431 | -0.817 (-1.939, 0.305) t = -1.427 |
| Action steps | -1.289* (-2.309, -0.270) t = -2.479 | -0.119 (-1.162, 0.924) t = -0.223 |
| Baseline | 0.106 (-0.233, 0.445) t = 0.614 | 0.230 (-0.118, 0.578) t = 1.295 |
| Superordinate goal × Action steps | 2.878*** (1.392, 4.364) t = 3.797 | 0.604 (-0.993, 2.201) t = 0.742 |
| Constant | 0.517 (-0.279, 1.313) t = 1.274 | -0.969* (-1.807, -0.131) t = -2.267 |
| Observations | 132 | 132 |
| Log Likelihood | -81.908 | -74.966 |
| Akaike Inf. Crit. | 173.816 | 159.932 |

Note: *p<0.05; **p<0.01; ***p<0.001

EXPLORING THE ROLE OF GOALS ON EXERCISE FREQUENCY

Table 3

Exercise Frequency up to Six Months after the End of the Study as a Function of Goal

Manipulation and Baseline Measure

| | |
|-----------------------------------|--|
| Superordinate goal | -0.333 (-0.812, 0.146) t = -1.364 |
| Action steps | 0.130 (-0.293, 0.553) t = 0.603 |
| Baseline | 0.226** (0.090, 0.361) t = 3.265 |
| Superordinate goal × Action steps | 0.166 (-0.494, 0.827) t = 0.494 |
| Constant | 3.367*** (2.999, 3.736) t = 17.912 |
| Observations | 132 |

Note: *p<0.05; **p<0.01; ***p<0.001. As quasi models are only characterized by their mean and variance, they do not necessarily have a distributional form; therefore AIC and Log Likelihood are not reported (e.g., Bilder & Loughin, 2014; Hoef & Boveng, 2007).

EXPLORING THE ROLE OF GOALS ON EXERCISE FREQUENCY

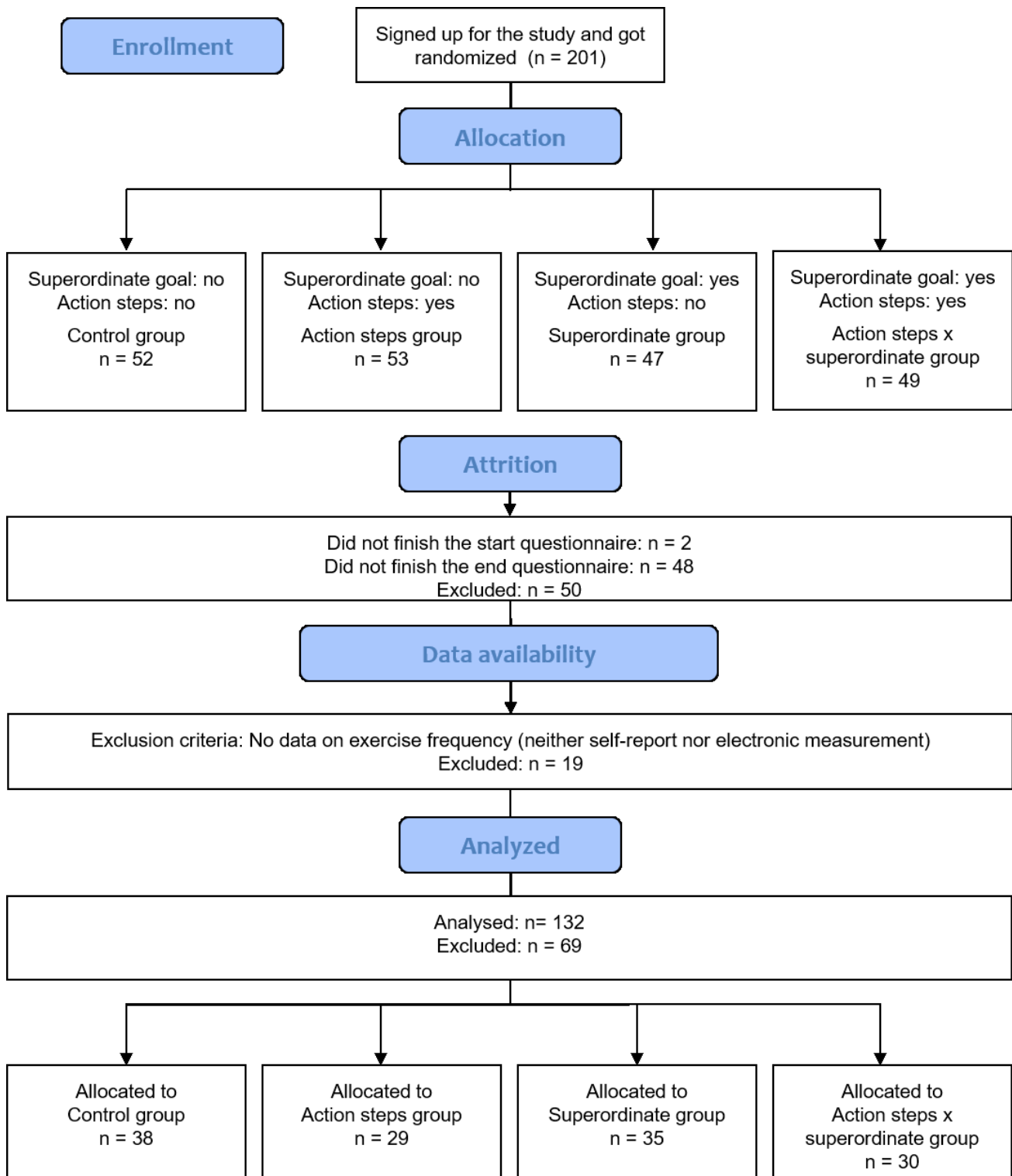


Figure 1. Flow Diagram.

EXPLORING THE ROLE OF GOALS ON EXERCISE FREQUENCY

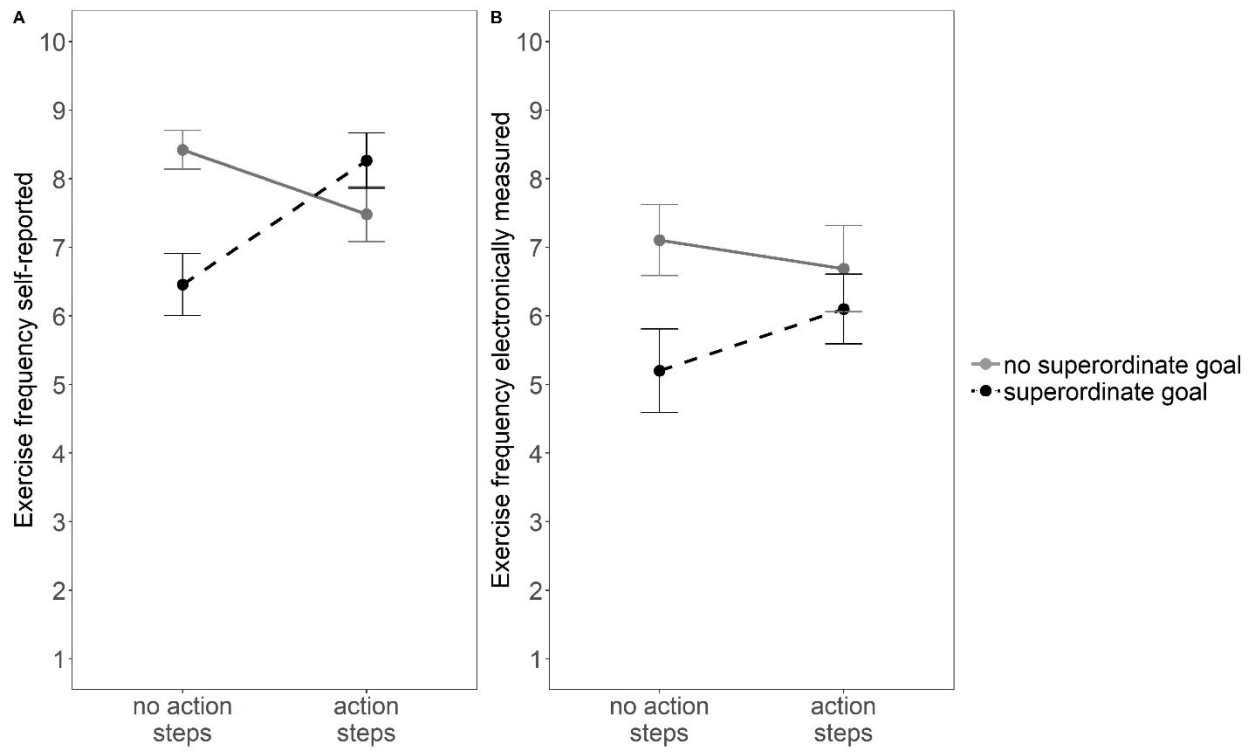


Figure 2. Intervention period: Effects of a superordinate goal and action steps on exercise frequency measured by (A) self-reports and (B) electronic login data from the gym.

Supplementary Material Paper 3

**Exploring the Influence of Goals at Different Levels of Abstraction on Self-
Reported and Electronically Measured Exercise Frequency:
An Experimental Field Study**

Supplementary Table 1

Exercise Frequency as a Function of Goal Manipulation and Baseline Measure

| | Model A Self-reported exercise frequency | Model B Electronically measured exercise frequency |
|--------------------------------------|--|--|
| Superordinate goal | -0.241** (-0.391, -0.091) t = -3.147 | -0.031 (-0.392, 0.330) t = -0.167 |
| Action steps | -0.152* (-0.303, -0.002) t = -1.981 | -0.168 (-0.523, 0.187) t = -0.926 |
| Baseline | 0.028 (-0.021, 0.076) t = 1.115 | 0.399*** (0.299, 0.498) t = 7.840 |
| Superordinate goal × Action steps | 0.346** (0.128, 0.565) t = 3.103 | 0.019 (-0.508, 0.546) t = 0.070 |
| Constant | 2.094*** (1.977, 2.211) t = 35.095 | 1.117*** (0.831, 1.404) t = 7.640 |
| Observations | 136 | 200 |

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. As quasi models are only characterized by their mean and variance, they do not necessarily have a distributional form; therefore AIC and log likelihood are not reported (e.g., Bilder & Loughin, 2014; Hoef & Boveng, 2007).

Supplementary Table 2

Goal Achievement as a Function of Goal Manipulation and Baseline Measure

| | Model A Self-reported goal achievement | Model B Electronically measured goal achievement |
|--------------------------------------|--|--|
| Superordinate goal | -1.699** (-2.717, -0.680) t = -3.270 | -0.438 (-1.498, 0.622) t = -0.810 |
| Action steps | -1.380** (-2.391, -0.369) t = -2.676 | -0.304 (-1.305, 0.697) t = -0.595 |
| Baseline | 0.126 (-0.207, 0.460) t = 0.743 | 0.571*** (0.247, 0.895) t = 3.454 |
| Superordinate goal × Action steps | 2.767*** (1.313, 4.221) t = 3.729 | 0.332 (-1.182, 1.846) t = 0.430 |
| Constant | 0.492 (-0.299, 1.282) t = 1.220 | -1.751*** (-2.534, -0.969) t = -4.387 |
| Observations | 136 | 200 |
| Log Likelihood | -84.953 | -88.675 |
| Akaike Inf. Crit. | 179.906 | 187.35 |

Note: *p<0.05; **p<0.01; ***p<0.001

Supplementary Table 3

Exercise Frequency up to Six Months after the End of the Study as a Function of Goal Manipulation and Baseline Measure

| | |
|-----------------------------------|--|
| Superordinate goal | -0.106 (-0.655, 0.443) t = -0.379 |
| Action steps | 0.027 (-0.469, 0.522) t = 0.106 |
| Baseline | 0.470*** (0.331, 0.610) t = 6.622 |
| Superordinate goal × Action steps | 0.015 (-0.746, 0.775) t = 0.038 |
| Constant | 2.733*** (2.307, 3.159) t = 12.569 |

| | |
|--------------|-----|
| Observations | 200 |
|--------------|-----|

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. As quasi models are only characterized by their mean and variance, they do not necessarily have a distributional form; therefore AIC and Log Likelihood are not reported (e.g., Bilder & Loughin, 2014; Hoef & Boveng, 2007).

Paper 4

The Role of Attitude Strength in Behavioral Spillover: Attitude Matters—But Not Necessarily as a Moderator

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The Role of Attitude Strength in Behavioral Spillover: Attitude Matters—But Not Necessarily as a Moderator

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Studies on how one behavior affects subsequent behaviors find evidence for two opposite trends: Sometimes a first behavior increases the likelihood of engaging in additional behaviors that contribute to the same goal (positive behavioral spillover), and at other times a first behavior decreases this likelihood (negative spillover). A factor that may explain both patterns is attitude strength. A stronger (more favorable) attitude toward an issue may make the connections between related behaviors more salient and increase the motivation to work toward the underlying goal. We predicted that people with a stronger (more favorable) attitude are more likely to engage in subsequent behaviors that address an issue they care about. Two experiments tested the prediction in the contexts of pro-environmental and health behavior. Study 1 ($N = 378$) provided some support for the predicted moderating role of attitude toward the environment when participants recalled either an environmentally friendly or unfriendly action: A strong attitude increased the likelihood, whereas a weak attitude decreased the likelihood of carrying out successive goal-conducive behaviors. When compared to a neutral control condition in Study 2 ($N = 929$), participants with a weak environmental attitude supported pro-environmental petitions less strongly after an environmentally harmful action. Support for such petitions did not waver, however, among participants with a strong environmental attitude: They consistently acted environmentally friendly. Contrary to the hypothesis, in neither study did strength of attitude toward personal health moderate the effect of an initial behavior in the expected direction. In sum, the two studies provided only limited evidence for behavioral spillover: Participants mostly acted in accordance with their attitude but were hardly affected by recalling previous actions. When behavioral spillover did occur, however, a strong environmental attitude tended to increase the likelihood of acting in an environmentally friendly way, whereas the behavior of those with a weak attitude was less predictable. This research contributes to a more nuanced theoretical understanding of the role of attitude in spillover, but provides only limited evidence for its role as a moderator.

Keywords: pro-environmental behavior, health behavior, environmental attitude, health attitude, spillover, moral licensing, moral cleansing

INTRODUCTION

Many personal and societal goals can be achieved only if people repeatedly work toward them. For example, to lead a healthy life, it is not enough to eat a single healthy meal. People need to repeatedly make healthy food choices and also do other things that benefit their health, like get enough sleep and exercise regularly. Similarly, if people want to reduce their environmental footprint, they need to do more than recycle one glass bottle; they need to repeatedly recycle different types of things and engage in additional behaviors, such as using energy-efficient appliances and modes of transport. In short, in many contexts people need to engage in several successive actions to achieve their goals.

Despite the need for such consistent behavior, we know relatively little about when an action that helps achieve a goal affects subsequent actions that contribute to the same goal. In accordance with previous research, we refer to relationships between initial and subsequent behaviors as “spillover.” *Positive* spillover refers to situations where a first behavior increases the likelihood of a different second behavior (i.e., spillover across behaviors), or the same behavior again across time (i.e., spillover across time) or in a different context (i.e., spillover across contexts) that contributes to the same goal as the first (Truelove et al., 2014; Dolan and Galizzi, 2015; Nilsson et al., 2017; Carrico et al., 2018). By contrast, *negative* spillover describes situations in which a first goal-conductive behavior *reduces* the likelihood of engaging in other, similar behaviors or the same behavior across time or contexts (or in which a first, goal-inconsistent behavior increases this likelihood, see **Figure 1** for all the variations).

The literature provides compelling theoretical explanations and empirical evidence for both types of spillover (Dolan and Galizzi, 2015). On the one hand, research in the context of moral behavior shows that after performing a first moral behavior, individuals feel that they have earned the moral entitlement to reward themselves by refraining from further moral behavior (Monin and Miller, 2001; Merritt et al., 2010). To illustrate, individuals who recalled a moral behavior were more likely to cheat on a math task (Jordan et al., 2011) and donated less money to charity (Sachdeva et al., 2009). Other research corroborates the idea that an initial behavior can induce the feeling that a person has “done enough” and that no further behavior along the same lines is necessary, which fosters negative spillover effects (variously termed resting on one’s laurels, Amir and Ariely, 2008; goal attainment, Longoni et al., 2014; single-action bias, Weber, 1997a).

On the other hand, other perspectives such as cognitive dissonance theory (Festinger, 1957), self-perception theory (Bem, 1972), and the foot-in-the-door effect (Freedman and Fraser, 1966) suggest that individuals have a strong urge for consistency and tend to act in a way that is consistent with previous actions and existing beliefs, which should lead to positive spillover (Albarracín and Wyer, 2000; Gawronski and Strack, 2012).

A crucial question that arises from these two contradictory patterns of spillover concerns why a first goal-conductive behavior sometimes increases the likelihood of further similar behaviors and why it sometimes reduces it. One explanation is that additional psychological processes may be at work (Truelove

| | Initial positive (goal-conductive) behavior | Initial negative (not goal-conductive) behavior |
|---------------------------------------|---|---|
| Positive Spillover (consistency) | Behavior 1 + Behavior 2 + | Behavior 1 - Behavior 2 - |
| Negative Spillover (inconsistency) | Behavior 1 + Behavior 2 - | Behavior 1 - Behavior 2 + |

FIGURE 1 | Overview of how the valence and (in)consistency of successive behaviors lead to positive and negative spillover (adopted from Dolan and Galizzi, 2015).

et al., 2014; Mullen and Monin, 2016). For example, it is possible that the extent to which a behavior and its broader context matter to a person influences which psychological processes are triggered and whether they result in positive or negative spillover (Effron et al., 2009; Meijers, 2014; Nilsson et al., 2017). Our research builds on this idea: We argue that the more a person cares about an issue such as the environment or personal health – the strength of their attitude – the more likely they are to engage in multiple behaviors conducive to the underlying goal (positive spillover). By contrast, when people engage in behaviors to do with issues they do not care strongly about, they feel they have done enough (Weber, 1997b; Amir and Ariely, 2008), and use their limited resources (e.g., attention, physical strength, time, money) to pursue other goals (Moskowitz, 2012).

Previous spillover research focused on behaviors with obvious links to morality, and often relied on moral processes to explain spillover effects (including behaviors connected to environmental protection, which has clear moral connotations; Monin and Miller, 2001; Effron et al., 2009; Mazar and Zhong, 2010; Merritt et al., 2010; Meijers, 2014). We tie in to this research tradition by using an established experimental paradigm (Sachdeva et al., 2009), examining the predicted moderating influence of attitude strength on spillover in the context of environmental protection, which is often strongly morally connoted (e.g., Feinberg and Willer, 2013). We extend the scope of previous research by testing assumptions in two different contexts: environmental protection and health. As a result, we explore whether spillover processes are restricted to behaviors related to morality or whether they also occur in domains less morally charged.

Personal Relevance as a Moderator of Behavioral Spillover

The idea that personal relevance could influence the extent and type of behavioral spillover is supported by different theoretical perspectives and some empirical evidence. We take a goal-theoretical perspective to reconcile different streams of research into conceptually similar constructs (e.g., superordinate goals or identity). The central hypothesis is that the more relevant an issue is to a person, the more an initial goal-conductive act should decrease negative spillover and promote positive spillover (see Höchli et al., 2018).

According to goal-theoretical perspectives, people pursue goals that are related to each other but vary in level of abstraction (Vallacher and Wegner, 1987; Carver and Scheier, 2001). For

example, “be healthy” is a relatively abstract and broad health goal at the top of the hierarchy, whereas “do 40 push-ups on Wednesday afternoon” is a specific health goal at the bottom (Carver and Scheier, 2001; Kruglanski et al., 2002). The most concrete goals (sub-goals) correspond to specific, single actions.

More abstract goals are often referred to as “superordinate” (Carver and Scheier, 2001). These broad representations determine what people ultimately value and aspire to; they provide a general orientation as to what is important to a person (Carver and Scheier, 2001; Schwartz et al., 2001; Boekaerts et al., 2006).

This understanding of superordinate goals points to similarities with functionally and conceptually related concepts. For instance, goals are often equated with values (e.g., Schwartz, 1992). Further, superordinate goals are described as “be” goals – that is, the kind of self one aspires to be (Carver and Scheier, 2001). This links superordinate goals closely to theoretical concepts such as “self-identity” and “possible selves,” which are as well representations of the self that motivate behavior (Hoyle and Sherrill, 2006; Oyserman and James, 2011; Van der Werff et al., 2013). Although superordinate goals, values, identity, and possible selves are theoretically distinct concepts, the terms are often used interchangeably (Schwartz, 1992; Masuda et al., 2010).

There are at least two characteristics of superordinate goals that point to their possible role as moderators of spillover. First, the intrinsic importance of superordinate goals and their crucial role for the overriding sense of self (Carver and Scheier, 2001) can have a stabilizing effect on behavior. More specifically, it is likely that people experience cognitive dissonance if they engage in behaviors that jeopardize their superordinate goals (Festinger, 1957). Because cognitive dissonance is unpleasant, avoiding it could be an important driver for consistently carrying out goal-conducive behaviors (Sintov et al., 2019). Similar arguments can be made concerning theories of identity and self-perception: The more people see themselves as environmentalists or health-conscious persons, the more they are likely to experience cognitive dissonance and negative emotions such as guilt or remorse when they do not act according to their identity or self-perception (Lanzini and Thøgersen, 2014; Van der Werff et al., 2014a; Byrka and Kaminska, 2015; Lacasse, 2016). Importantly, this stabilizing effect can be expected only among people who hold relevant superordinate goals. This is why we expect superordinate goals to moderate spillover: To the extent that people hold a superordinate goal (or have strong values, identity, self-perception) in a given domain, the more they should engage in behaviors that qualify as positive spillover after an initial goal-conducive act (and as negative spillover after an initial act that is inconsistent with their goal) (Fishbach et al., 2006; Thøgersen and Crompton, 2009; Meijers et al., 2014; Nilsson et al., 2017).

Second, the interconnected structure of goals is likely to enhance this stabilizing effect. Superordinate goals typically include multiple concrete sub-goals that are instrumental to achieving them (Carver and Scheier, 2001; Kruglanski et al., 2002). For example, to “be healthy,” a person needs to do more than hit the gym once a week – they need to be physically

active in other ways as well (e.g., take the stairs instead of the elevator), and pursue additional broad and specific health goals such as “eat healthily” and “have fruit instead of a chocolate bar as a snack.” It can be assumed that the more people represent an issue as a superordinate goal (i.e., the more it matters to them), the more salient are the connections between the superordinate goal and relevant behaviors, and the more different goal-conducive behaviors should be linked to each other through the superordinate goal. A characteristic of this interconnectedness is that goals can activate (or inhibit) each other: Dealing with a concrete action or a subordinate goal can activate the associated superordinate goal (bottom-up activation; Shah and Kruglanski, 2003), and focusing on a superordinate goal can activate the associated subordinate goals or actions (top-down activation; Kruglanski et al., 2002). Thus, when people carry out a behavior for which they have a corresponding superordinate goal, this should increase the salience of the goal, highlight the importance of carrying out other goal-conducive behaviors, and increase the likelihood of doing so (Bargh et al., 1992; Ratneshwar et al., 2001; Kruglanski et al., 2002; Thøgersen and Noblet, 2012). Positive spillover effects can therefore be understood as the result of an initial goal-conducive behavior that activates a superordinate goal, that in turn guides other behaviors (Lanzini and Thøgersen, 2014; Margetts and Kashima, 2017). Again, this process is contingent on people holding a relevant superordinate goal (or identity, self-perception, values).

Support for this idea comes, for example, from a community field experiment that tested an intervention to save electricity (Steinhorst et al., 2015). Participants received electricity-saving tips, combined with either a monetary (savings in euros) or an environmental framing (savings in CO₂), or no framing in the control group. Although an increase in the target behavior – saving electricity – was observed in both framing groups, spillover to other pro-environmental behaviors was observed only in the environmental condition.

There is also empirical evidence to support the idea that the more importance people attach to an issue or a cause, the more they tend to engage in behaviors that maintain, advance, and defend it. To illustrate, the effect of personal importance on behavior is evident in positive correlations between a broad range of environmentally friendly behaviors and concepts related to the personal importance of environmentalism, such as an *ecocentric belief structure* (i.e., humans are a part of natural systems and constrained by their limits; Dunlap and Van Liere, 1978; see also Olli et al., 2001; Kortenkamp and Moore, 2006), *self-transcending and biospheric values* (Karp, 1996; Stern et al., 1998; Schultz, 2001; Schultz et al., 2005; Thøgersen and Ölander, 2006; Gatersleben et al., 2014), *connectedness to nature* (Schultz, 2001; Brügger et al., 2011; Otto and Pensini, 2017), *identity/self-perception as someone who acts in an environmentally friendly way* (Nigbur et al., 2010; Whitmarsh and O’Neill, 2010; Gatersleben et al., 2014; Kashima et al., 2014; Van der Werff et al., 2014b; Meijers et al., 2015), and *environmental attitude* (Hines et al., 1986; Bamberg and Möser, 2007). Similar relationships can also be found between higher scores on similar concepts and health behavior (e.g., Theodorakis, 1994; Godin and Kok, 1996; Sparks and Guthrie, 1998; Hagger et al., 2007).

The literature also holds more direct evidence for the idea that following an initial goal-conducive act, personal importance should increase positive and reduce negative spillover. For instance, the higher people score on measures that reflect personal importance, the less likely they are to endorse the idea that they can justify or neutralize environmentally harmful behaviors with other, more environmentally friendly behaviors (Bratt, 1999; Kaklamanou et al., 2015).

The most direct support for the idea that personal importance can explain behavioral spillover comes from three experiments that examined how a first behavior affected a second behavior. The first study found that the expression of a non-racist intention (to vote for Obama in the 2008 election) tends to lead to racist behavior (allocating more resources to Whites than Blacks), but only for those with higher racist scores (Effron et al., 2009, Study 3).

Another study found that after imagining purchasing an environmentally friendly product, participants with a strong environmental identity tended to express pro-environmental intentions to the same extent as their counterparts who had bought a conventional product. By contrast, when participants with a weak environmental identity purchased an environmentally friendly product, they expressed lower environmentally friendly intentions than after buying the conventional product (Meijers, 2014).

The third experiment (Noblet and McCoy, 2018) manipulated whether participants perceived their past ecological behavior as either environmentally friendly or unfriendly, then asked them how strongly they supported a pro-environment energy policy. It was found that the perception of one's past behavior as environmentally friendly decreased support for the policy among those with low intrinsic environmental motivation. However, those with high environmental motivation supported the policy to an equal extent, irrespective of whether they were led to see their past behavior as environmentally friendly or not. These studies provide compelling initial evidence for the idea that after an initial goal-conducive behavior, personal importance – in the reported studies, operationalized as attitude, identity, or intrinsic environmental motivation – leads to positive spillover effects, whereas low personal importance leads to negative spillover effects.

Behavior-Based Attitude as a Measure of Personal Importance

From a methodological point of view, how to measure abstract concepts such as personal relevance, superordinate goals, values, or possible selves is not a trivial matter. It is *technically* feasible to ask questions that directly tap into such abstract concepts: Schwartz (1992) assessed values by asking people to indicate the extent to which different values act as “guiding principles” in their lives. However, such direct ways of assessing abstract concepts require introspection and self-reflection. This is problematic because abstract concepts are by definition difficult to grasp intellectually; respondents may not necessarily understand the concepts in the same way researchers do. A second problem is that the information required to evaluate such abstract concepts

is often not readily available, which makes these types of question prone to recollection bias (Dillman, 2001), response bias (e.g., Wittenbrink and Schwarz, 2007), and social desirability bias (Crowne and Marlowe, 1960).

In this paper, we take an *indirect* approach to measuring personal relevance that is grounded in the Campbell paradigm (Kaiser et al., 2010), an innovative paradigm from attitude research. Based on Donald Campbell's conceptualization of attitude as an “acquired behavioral disposition” (Campbell, 1963, p. 97), Kaiser et al. (2010) argue that attitudes and behaviors are formally – but not causally – linked. This means that a latent attitude is manifest in people's behaviors and, conversely, that the attitude denotes the subjective importance of the behavior to the person (Kaiser et al., 2010). A second crucial proposition of Kaiser et al. (2010) is that behavior is determined by two factors: (1) the strength of the latent attitude and (2) the costs of the behavior (e.g., money, physical effort, time, sacrifice, or social risk).

An implication of this conceptualization is that the latent attitude can be inferred from a *systematic* inspection of behaviors that are ordered according to their cost (Kaiser et al., 2010): The more costly, difficult, and demanding a person's behaviors are, the stronger must be their corresponding attitude. Why would someone install expensive solar panels or spend a lot of time traveling by train rather than by airplane if they did not have a strong environmental attitude? Likewise, when the tiniest difficulty is enough to stop a person from engaging in a healthy behavior, their health attitude is probably weak.¹

Conceptualizing attitude as a behavior-based latent trait has several advantages: Answering questions about past actions requires a minimal amount of introspection (see Otto et al., 2018). Therefore, answering questions about one's behavior should be easier than answering questions about abstract concepts such as superordinate goals, values, or identity. Furthermore, previous research suggests that questions about one's behavior are less vulnerable to response biases such as social desirability than conventional attitude questions (Milfont, 2009). Moreover, behavior-derived attitudes are relatively stable across time (Kaiser et al., 2014), which makes them particularly useful for measuring trait-like individual preferences.

This approach of assessing latent constructs through behaviors has already been implemented in various contexts. They include environmental attitude (Kaiser et al., 2013, 2014; Ogunbode et al., 2018), attitude toward nature (Brügger et al., 2011; Kaiser et al., 2013, 2014), attitude toward climate change (Urban, 2016), health attitude (Byrka and Kaiser, 2013), attitude toward conformity (Brügger et al., 2019), and need for recovery at work (Smolders et al., 2012). Although most instruments developed within the Campbell paradigm are formally denoted as attitude scales, the latent trait being assessed can also be thought of as an indication of people's motivation: how “personally important” a goal is to them (Kaiser et al., 2017). As such, using behavior-based attitude scales is a promising approach to measuring the extent

¹Importantly, though, the Campbell paradigm does not suggest that a single behavior can be equated with attitude. The latent trait can be inferred only by inspecting a broad range of behaviors, ordered by difficulty.

to which environmental protection and health are personally important to people.

Overview of Studies

The goal of the research is to examine whether personal importance – operationalized as the strength of behavior-based attitude – can shed light on when positive and negative behavioral spillover occurs. To examine the role of attitude strength as a moderator, we conducted two experiments. In both, we used an experimental paradigm that is often used in research on moral licensing (Blanken et al., 2015): Participants recalled a recent past behavior that was either consistent or inconsistent with the goal to be healthy or to protect the environment, and that therefore had the potential to trigger spillover effects, and then answered questions about future behaviors.

Using this recall paradigm offers at least three advantages over other approaches. First, participants are not forced to carry out behaviors that they would not do of their own free will, which could otherwise raise ethical questions for researchers. Second, using a design in which participants are either selected because they already perform a specific behavior or are asked to adopt a specific behavior could lead to samples in which, for example, relevant individual attitudes are already very positive. Using the recall paradigm should result in more inclusive samples in which the variance in participants' attitudes is not restricted. Third, asking participants to describe an event of their own choice guarantees that the behavior has the intended subjective meaning (see also Thøgersen, 2004).

Study 1 provided initial evidence for the expected role of attitude strength as a moderator. However, it did not include a neutral control group and its sample ($N = 378$) consisted mainly of female students. By using a broader and larger sample ($N = 929$) and by including an additional neutral condition, Study 2 overcame these shortcomings, and again found some support for the predicted role of attitude strength as a moderator.

STUDY 1

To examine the moderating influence of attitude strength, we tested for interaction effects between the experimental conditions (recalling a behavior that was consistent vs. inconsistent with the goals to protect the environment and to be healthy) and attitude strength in the contexts of environmental protection and health. (For a similar approach, see Conway and Peetz, 2012; Cornelissen et al., 2013; Noblet and McCoy, 2018.)

We predicted that participants with a strong attitude would engage in positive spillover after an initial goal-conducive behavior and in negative spillover after an initial goal-inconsistent behavior, leading to high motivation to engage in goal-conducive behaviors in both experimental conditions. These predictions were based on the following assumptions: When participants with a strong attitude carry out a behavior that is relevant to their attitude, this should (a) increase the salience of their attitude; and (b) the relationships between different attitude-relevant behaviors and how they are relevant to the underlying attitude; and (c) they would

experience cognitive dissonance if behaviors were inconsistent with their attitude.

By contrast, we expected that, after recalling a goal-consistent behavior, participants with low attitude strength would feel that they had “done enough” and therefore be less motivated to engage in further behaviors than their counterparts who recalled a goal-inconsistent behavior.

Materials and Methods

Procedure

Data were collected through a web-based survey tool (Qualtrics) in spring 2013.

To reduce the risk that questions about participants' attitudes had carryover effects on either the recall manipulation or the dependent variables, we collected the data at two points in time. At time 1, respondents were asked if they wanted to participate seriously or only look at the survey. A “seriousness check” is a recommended means of reducing dropout rates and increasing data quality (Reips, 2002). Participants then answered questions about their attitudes toward the environment, health, and various risks. These items were intermixed and presented in eight question blocks. The risk-related questions were filler items. The survey also included socio-demographic questions.

At time 2 (10–14 days later), participants were again asked if they were willing to participate seriously. They then completed one of four recall conditions, to which they were assigned randomly. After a short filler task (unscramble 12 sequences of four to eight letters into words), participants answered the questions that were used as dependent variables. Finally, participants completed a manipulation check, were thanked and debriefed.

Participants

The sample was recruited via various Swiss Internet forums (e.g., Swiss variations of Craigslist such as pinwand.ch, platforms for students such as students.ch) and social media networks. As an incentive, those who participated in both parts of the survey were entered in a raffle to win Amazon vouchers (4 × EUR 100 and 10 × EUR 10). In total, 738 participants accessed the survey at time 1. Of those, 190 were removed because they responded to fewer than 20% of the questions or because they participated more than once (in which case we discarded the second participation). Of the 548 participants who participated at time 1, 490 accessed the study at time 2. Two participants participated twice; we again excluded the answers from their second participation.

To ensure good data quality, we retained participants only (a) who in both parts passed the seriousness check (Reips, 2002), (b) whose participation time in both surveys lasted at least one third of the sample's median time (16 min at time 1; 17 min at time 2), and (c) who provided a semantically meaningful answer in the recall task (judged by two independent raters). The mean age of participants who met these criteria ($N = 378$) was 28.78 ($SD = 9.29$). The proportion of women was 71%. Of the participants who revealed their academic affiliation, 61% were students.

A comparison between the 170 participants who participated at time 1 but either did not participate at time 2 or did participate but were excluded to ensure good data quality and the 378 participants who were retained for the analyses revealed that the proportion of these two groups was not associated with the experimental conditions [$\chi^2(3) = 0.45, p = 0.93$]. However, the 378 participants who were retained had a more environmentally friendly attitude ($M = 0.12, SD = 0.85$) than those excluded [$M = -0.10, SD = 0.96; t(294.18) = -2.56, p = 0.01$]. Importantly, though, this self-selection bias did not reduce the variance in environmental attitude, which suggests that the sample was still broad enough to conduct the intended analyses. The two groups did not differ with respect to health attitude, $t(324.98) = -1.57, p = 0.12$.

Manipulation

Participants were randomly assigned to one of four experimental conditions in which they were asked to recall one of the following types of behavior carried out during the past week: (1) environmentally friendly, (2) environmentally harmful, (3) healthy, or (4) unhealthy. Participants were instructed to take 5–10 min to write down their action in detail (Jordan et al., 2011; Weibel et al., 2014).

To examine whether the manipulation had the intended effect, two manipulation checks were used. First, participants were asked to indicate the valence of the described deed (seven-point scale: $-3 =$ very negative, $+3 =$ very positive). Second, two coders who were blind to conditions rated how environmentally friendly and healthy the deeds were (seven-point scale: $-3 =$ very environmentally harmful/very unhealthy, $+3 =$ very environmentally friendly/very healthy) (Jordan et al., 2011). Interrater reliability was high for both contexts (intraclass correlation coefficient [ICC]_{environmentally friendly}) = 0.92, ICC _{healthy} = 0.93). The ratings of the two coders were combined to create an environmental friendliness and a healthiness scale.

Moderators

To test the hypothesis that the extent of positive and negative spillover is contingent on people's attitudes, we included two behavior-based attitude scales (Kaiser and Wilson, 2004; Byrka and Kaiser, 2013; Kaiser et al., 2014). Following Kaiser et al.'s (2010) suggestion, we used the probabilistic Rasch model (for details, see Bond and Fox, 2007) to estimate attitude levels for persons and behavioral difficulties. This approach is consistent with previous implementations of the Campbell paradigm (Smolders et al., 2012; Kaiser et al., 2013; Urban, 2016; Ogunbode et al., 2018; Brügger et al., 2019).

Environmental attitude was measured with 50 items from Kaiser and Wilson (2004) (see **Supplementary Table 1**). Of the 50, items 32 were presented in a five-point frequency format. Responses to these items were recoded into a dichotomous format by collapsing "never," "seldom," and "occasionally" into "unreliable pro-environmental engagement," and "often" and "always" into "reliable pro-environmental engagement." The remaining 18 items were presented in a yes/no format. Nineteen behaviors represented environmentally unfriendly activities and were recoded prior to analysis. The dichotomization, calibration

of the behavior scale, and estimation of person scores were based on the classical Rasch model and consistent with previous calibrations of the same instrument (see Kaiser and Wilson, 2004). Attitude scores were estimated in logits; the more negative the score, the weaker the person's environmental attitude. All behavior items were found to fit the model very well (infit mean square values < 1.18 ; for reference values, see Bond and Fox, 2007). The Rasch-model-based reliability estimate of the measure was $rel = 0.80$.

Health attitude was measured with 46 items from Byrka and Kaiser (2013) and five items from Kibbe (2011) (**Supplementary Table 2**). For 27 items, we used a five-point frequency answer scale and then dichotomized responses in a similar way as for the environmental scale. The remaining 24 items were presented in a yes/no format. Nine items represented unhealthy behaviors and were recoded prior to analysis. The dichotomization, calibration of the behavior scale, and estimation of person scores were again based on the classical Rasch model and consistent with previous calibrations (Byrka and Kaiser, 2013). All behavior items were found to fit the model very well (infit mean square values < 1.15). The Rasch-model-based reliability estimate of the measure was $rel = 0.66$.

Dependent Variables

To assess the extent of positive and negative spillover, we used two types of dependent variables as proxies for future goal-conducive behaviors. First, participants indicated on a seven-point scale ($1 =$ I will not do that under any circumstances, $7 =$ I will certainly do that) the extent to which they intended to engage in 18 behaviors in different contexts during the next month. Of these *behavioral intentions*, five were related to protecting the environment and five concerned their personal health and were used as dependent variables (**Table 1**). The other eight were fillers.

Second, we asked participants if they would be interested in using online apps that provided support and tips to better achieve goals. Of the nine apps, three were related to environmental protection and three to improving health (**Table 1**); the other three were fillers. Participants used a seven-point scale to indicate how much they were interested in these apps ($1 =$ not interested at all, $7 =$ very interested).

Results

Levels of Environmental and Health Attitudes in the Four Experimental Conditions

We first established that the random allocation of participants to the four conditions was successful with respect to the strength of attitudes. Levels of environmental [$F(1,376) = 0.03, p = 0.86, \eta^2 = 0.00$] and health attitude [$F(1,376) = 0.40, p = 0.53, \eta^2 = 0.00$] were not statistically different in the four conditions.

Manipulation Checks

Environmental behavior

Manipulation checks showed that the recall manipulation had the intended effect. Participants in the environmentally friendly condition rated the recalled environmental action as more positive ($M = 5.63, SD = 0.99$) than participants in the

environmentally unfriendly condition ($M = 3.10$, $SD = 1.14$), $t(179) = 16.04$, $p < 0.001$, $d = 2.39$. Coders also rated the recalled environmental behaviors in the environmentally friendly condition as more positive ($M = 2.00$, $SD = 0.61$) than those in the environmentally unfriendly condition ($M = -1.58$, $SD = 0.85$), $t(183) = 32.93$, $p \leq 0.001$, $d = 4.84$.

Health behavior

The recall manipulation had the intended effect. Participants in the healthy condition rated the recalled health behavior as more positive ($M = 6.18$, $SD = 0.77$) than participants in the unhealthy condition ($M = 2.90$, $SD = 1.11$), $t(188) = 23.84$, $p < 0.001$, $d = 3.46$. Coders rated the health behaviors in the healthy condition as more positive ($M = 2.14$, $SD = 0.48$) than those in the unhealthy condition ($M = -1.71$, $SD = 0.54$), $t(190) = 52.11$, $p \leq 0.001$, $d = 7.53$.

Environmental Attitude Moderates the Effect of Past Environmental Actions on Some Intentions

Multiple regression analyses examined the effects of the recall manipulation (environmentally friendly vs. unfriendly behavior), environmental attitude, and their interaction on pro-environmental intentions and interest in apps. We tested two models for each dependent variable. In the first step, environmental attitude and the recalled behavior were entered as predictors. In the second step, the interaction term (Recall \times Attitude) was added to the model. If adding the interaction term resulted in a statistically significant improvement to the model, we used the Johnson-Neyman conditional analysis (Spiller et al., 2013), made available through the R package *jtools* (Long, 2018), to identify the range of the environmental attitude for which the simple effect of the recall manipulation was significant. Simple slope analyses were then

used to better understand the interactions (Cohen et al., 2003; Spiller et al., 2013).

Interaction effects

To test the prediction that attitude strength would influence the extent of positive and negative spillover, we first explored potential interaction effects. For two (of five) intentions, the effect of the recall manipulation depended on the strength of participants' environmental attitude (Table 2).

The first interaction was found when the intention to compost green waste was used as the dependent variable (Table 2). Analysis of this interaction with the Johnson-Neyman technique showed that the recall manipulation had an effect only on participants with attitude scores less than 0.16 (i.e., the 53rd percentile; Figure 2A).² The simple slopes for participants with strong attitudes (75th percentile) showed that these participants were equally motivated to compost regardless of whether they had recalled an environmentally friendly versus unfriendly action ($B = 0.08$, $SE = 0.43$, $p = 0.85$; Figure 2B). By contrast, those with medium or weak attitudes less strongly intended to compost when they had recalled an environmentally friendly compared to an environmentally unfriendly action (50th percentile: $B = -0.65$, $SE = 0.32$, $p = 0.04$; 25th percentile: $B = -1.38$, $SE = 0.44$, $p < 0.001$; Figure 2B).

The second interaction effect was found when participants indicated whether they intended to turn off the lights when leaving a room (Table 2). Using the Johnson-Neyman technique, it was found that recalling either an environmentally friendly or an unfriendly behavior significantly predicted the

²The Johnson-Neyman technique suggested that the recall condition would also have an effect on participants with an extremely favorable environmental attitude (i.e., scores larger than 4.08). However, because our sample did not include any participants with such extreme scores, this extrapolated effect should be seen as hypothetical and treated with caution.

TABLE 1 | Descriptive statistics for behavioral intentions (I1–I5) and interest in apps (A1–A3) in the contexts of environment and health, Study 1.

| | Mean | Median | SD | Range |
|--|------|--------|------|-------|
| Environmental protection | | | | |
| I1: Composting green waste | 4.71 | 6 | 2.35 | 1–7 |
| I2: Using biodegradable cleaning agents | 4.56 | 5 | 1.84 | 1–7 |
| I3: Switching off electronic devices on standby completely overnight | 4.93 | 5 | 1.90 | 1–7 |
| I4: Buying locally grown vegetables and fruits | 5.86 | 6 | 1.28 | 1–7 |
| I5: Switching off lights when leaving a room | 6.54 | 7 | 0.84 | 2–7 |
| A1: Saving energy at work | 4.38 | 4 | 1.78 | 1–7 |
| A2: Saving energy at home | 5.28 | 6 | 1.58 | 1–7 |
| A3: How to reduce my CO ₂ emissions | 4.71 | 5 | 1.79 | 1–7 |
| Health | | | | |
| I1: Treating myself with a high-calorie or fatty snack (e.g., chocolate bar or potato chips) (reverse-coded) | 2.32 | 2 | 1.64 | 1–7 |
| I2: Taking time to relax | 5.51 | 6 | 1.42 | 1–7 |
| I3: Exercising for at least 2 h per week | 5.74 | 7 | 1.70 | 1–7 |
| I4: Drinking no more than one glass of alcohol per day | 4.62 | 5 | 2.24 | 1–7 |
| I5: Preparing at least one fresh meal per day | 5.55 | 6 | 1.59 | 1–7 |
| A1: How to maintain a healthy diet | 5.71 | 6 | 1.45 | 1–7 |
| A2: Simple relaxation techniques in your spare moments | 5.02 | 5 | 1.58 | 1–7 |
| A3: More physical activity in everyday life | 5.28 | 6 | 1.73 | 1–7 |

intention to turn off lights for participants who scored lower than -0.62 or higher than 1.66 on environmental attitude (**Figure 2C**). More specifically, the simple slopes again show that participants with a weak attitude (25th percentile) less strongly intended to turn off the lights after recalling an environmentally friendly than an environmentally unfriendly behavior ($B = -0.33$, $SE = 0.16$, $p = 0.04$; **Figure 2D**). By contrast, recalling either an environmentally friendly or unfriendly behavior did not have any effect on participants with medium or strong environmental attitudes, respectively (50th percentile: $B = -0.05$, $SE = 0.11$, $p = 0.65$; 75th percentile: $B = 0.22$, $SE = 0.15$, $p = 0.16$; **Figure 2D**). However, for 16 participants with an extremely environmentally friendly attitude (>1.66 , 95th percentile), recalling an environmentally friendly behavior increased the intention to turn off lights compared to those who recalled a negative behavior ($B = 0.52$, $SE = 0.25$, $p = 0.04$).

We also tested for possible interactions between the recall manipulation and environmental attitude on participants' interest in using three pro-environmental apps. None were statistically significant.

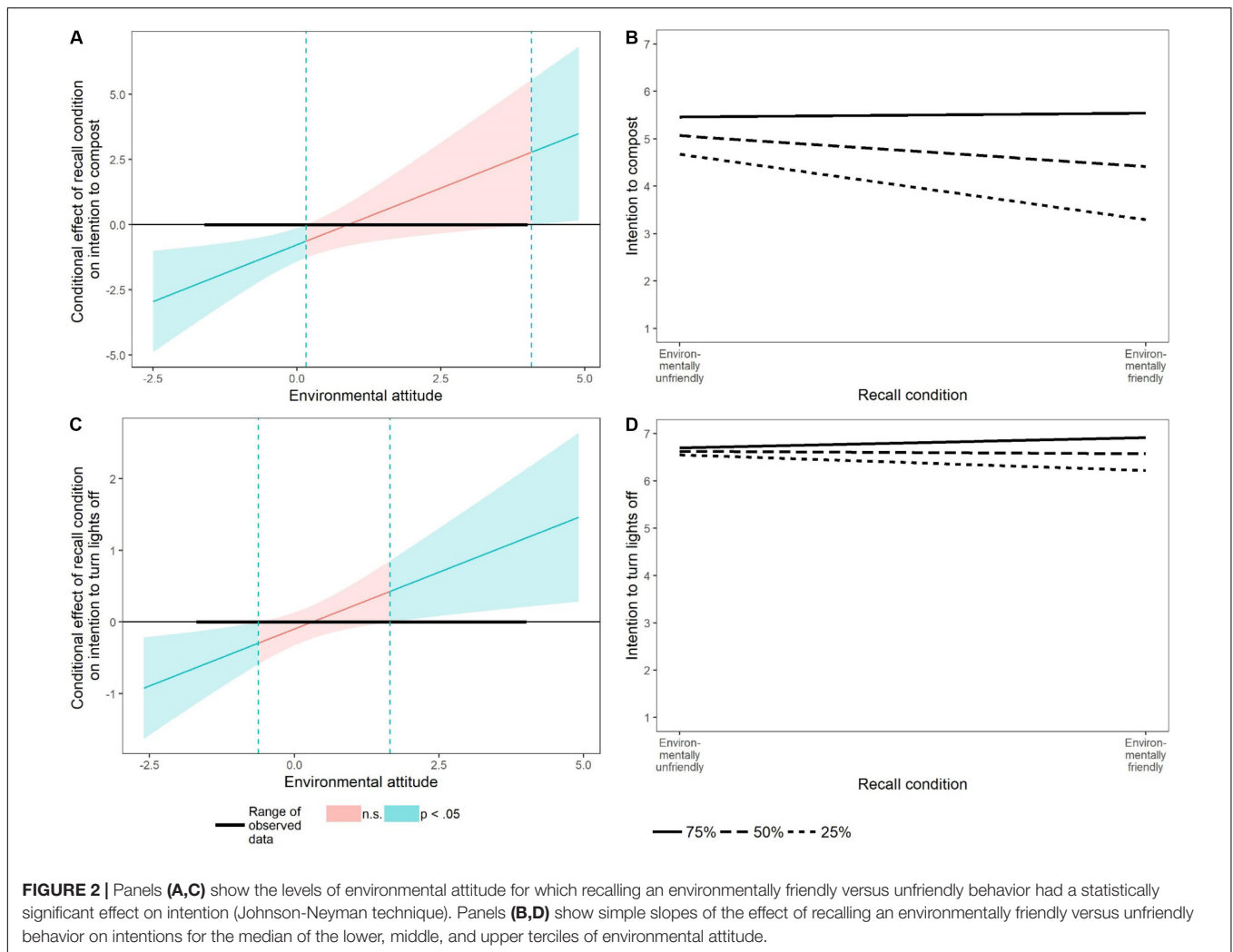
Direct effects of the recall manipulation and environmental attitude

Because the absence of statistically significant interaction effects implies that direct effects can be meaningfully interpreted, we examined whether the recall manipulation and environmental attitude had a direct influence on the dependent variables where the two predictors did not interact. Of eight dependent variables, there were no direct effects of the recall manipulation significant at the 5% level. However, it was found that the stronger participants' level of environmental attitude, the more they were motivated to protect the environment and the more they were interested

TABLE 2 | Direct and interactive effects of environmental attitude and recalled behavior on intentions and interest in apps, Study 1.

| | Step 1 | | | Step 2 | | | |
|---|--------------------|---------------|-----------------------|--------------------|----------------|-----------------------|--------------|
| | <i>B</i> | 95% <i>CI</i> | <i>R</i> ² | <i>B</i> | 95% <i>CI</i> | <i>R</i> ² | ΔR^2 |
| I1: Composting | | | | | | | |
| Attitude | 0.91*** | [0.56, 1.26] | 0.15 | 0.47 [§] | [-0.02, 0.96] | 0.18 | 0.03* |
| Recall manipulation | -0.64 [§] | [-1.28, 0.01] | | -0.77* | [-1.42, -0.13] | | |
| Recall × attitude | | | | 0.87* | [0.18, 1.56] | | |
| I2: Cleaning agents | | | | | | | |
| Attitude | 0.99*** | [0.74, 1.24] | 0.27 | 0.96*** | [0.60, 1.32] | 0.27 | 0.00 |
| Recall manipulation | 0.09 | [-0.37, 0.56] | | 0.08 | [-0.39, 0.56] | | |
| Recall × attitude | | | | 0.07 | [-0.44, 0.57] | | |
| I3: Switching off electronic devices | | | | | | | |
| Attitude | 0.96*** | [0.71, 1.20] | 0.26 | 0.78*** | [0.43, 1.14] | 0.27 | 0.01 |
| Recall manipulation | -0.43 [§] | [-0.88, 0.03] | | -0.48* | [-0.94, -0.02] | | |
| Recall × attitude | | | | 0.33 | [-0.16, 0.82] | | |
| I4: Local food | | | | | | | |
| Attitude | 0.54*** | [0.38, 0.71] | 0.19 | 0.44*** | [0.19, 0.68] | 0.19 | 0.01 |
| Recall manipulation | -0.04 | [-0.36, 0.27] | | -0.07 | [-0.39, 0.25] | | |
| Recall × attitude | | | | 0.20 | [-0.14, 0.54] | | |
| I5: Switching off lights | | | | | | | |
| Attitude | 0.25*** | [0.13, 0.38] | .09 | 0.09 | [-0.09, 0.26] | 0.12 | 0.03* |
| Recall manipulation | -0.05 | [-0.28, 0.18] | | -0.10 | [-0.33, 0.13] | | |
| Recall × attitude | | | | 0.32* | [0.07, 0.56] | | |
| A1: Saving energy at work | | | | | | | |
| Attitude | 0.51*** | [0.25, 0.77] | 0.10 | 0.53** | [0.15, 0.90] | 0.10 | 0.00 |
| Recall manipulation | -0.44 [§] | [-0.93, 0.04] | | -0.44 [§] | [-0.94, 0.05] | | |
| Recall × attitude | | | | -0.02 | [-0.55, 0.50] | | |
| A2: Saving energy at home | | | | | | | |
| Attitude | 0.34** | [0.12, 0.56] | 0.06 | 0.26 | [-0.06, 0.58] | 0.06 | 0.00 |
| Recall manipulation | -0.24 | [-0.65, 0.17] | | -0.27 | [-0.69, 0.15] | | |
| Recall × attitude | | | | 0.16 | [-0.29, 0.60] | | |
| A3: Reduce CO₂ | | | | | | | |
| Attitude | 0.61*** | [0.37, 0.86] | 0.13 | 0.56** | [0.21, 0.92] | 0.13 | 0.00 |
| Recall manipulation | -0.35 | [-0.80, 0.11] | | -0.36 | [-0.83, 0.10] | | |
| Recall × attitude | | | | 0.09 | [-0.40, 0.59] | | |

Environmentally unfriendly behavior = 0, environmentally friendly behavior = 1. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, [§] $p < 0.10$.



in relevant apps. This direct effect was found for all eight dependent variables.

Taken together, these results provide some support for our hypothesis. The patterns of the interactions are consistent with the prediction that participants with a weak environmental attitude would be affected by the valence of the recalled behavior such that they would be less motivated to engage in environmentally friendly behavior after recalling an environmentally friendly behavior (negative spillover). Among those with an *extremely* positive environmental attitude, the stronger intention to turn lights off after recalling an environmentally friendly action is an example of positive spillover.

Health Attitude Does Not Moderate the Effect of Past Health Behavior

Interaction effects

Following the same analytic approach, the prediction that a strong health attitude would increase the likelihood of positive spillover and reduce the likelihood of negative spillover was not confirmed. Health attitude did not moderate the effect of recalling

an healthy or unhealthy behavior with respect to any of the five health intentions or interest in health-related apps (Table 3).

Direct effects of the recall manipulation and health attitude

The recall manipulation again did not affect any of the dependent variables at the 5% significance level. Health attitude was, however, positively related to three behavioral intentions and interest in two apps.

Discussion

Study 1 tested the hypothesis that attitude strength would moderate the effect of an initial behavior on subsequent behaviors. We expected that those with a strong (favorable) attitude would be equally motivated to engage in additional goal-conducive behaviors after recalling either a goal-consistent (environmentally friendly/healthy) or a goal-inconsistent past behavior (environmentally unfriendly/unhealthy), whereas those with a weak attitude would be less motivated to engage in further behaviors after recalling a goal-consistent compared to a goal-inconsistent behavior.

The results of Study 1 provided initial support for this prediction in two of five pro-environmental intentions but in none of the health-related intentions. One possible explanation for why the predicted interaction was not found in more dependent variables is that Study 1 did not have sufficient statistical power to detect the interaction effect. To obtain a rough estimate of the power of Study 1, we conducted a power analysis using the special *F*-test assessing the increase in explained variance due to the interaction with three predictors (i.e., attitude, dummy representing the experimental condition, and their interaction) and a significance level of 0.05 (Faul et al., 2009). Based on these assumptions, the sample size of the two regression analyses ($N_s = 185, 193$) provided high power ($1 - \beta > 0.98$) for finding a conventional medium-sized effect (i.e., $|B| = 0.30$) but only weak power ($1 - \beta = 0.27/0.28$) for finding a small effect (i.e., $|B| = 0.10$). The power analysis

suggests that a larger sample size is necessary to find small interaction effects.

Another limitation of Study 1 was that the control condition was recalling a goal-inconsistent (unhealthy or environmentally unfriendly) behavior rather than a more neutral task. A weakness of this design is that it is impossible to conclude whether effects of the experimental conditions originate uniquely from recalling a goal-consistent behavior, a goal-inconsistent behavior, or from their combined effects (Mullen and Monin, 2016). To illustrate, the finding that 16 participants with an extremely strong pro-environmental attitude were more motivated to turn lights off after recalling a goal-consistent action (environmentally friendly) could stem from an increase in this intention among those who recalled a goal-consistent behavior, from a decrease among those who recalled a goal-inconsistent behavior – or both. Although all three explanations are logically possible, from a theoretical perspective

TABLE 3 | Direct and interactive effects of health attitude and recalled behavior on intentions and interest in apps, Study 1.

| | Step 1 | | | Step 2 | | | |
|--|--------------------|---------------|-----------------------|--------------------|---------------|-----------------------|--------------|
| | <i>B</i> | 95% CI | <i>R</i> ² | <i>B</i> | 95% CI | <i>R</i> ² | ΔR^2 |
| I1: Treating myself with a snack | | | | | | | |
| Attitude | 0.35 [§] | [−0.03, 0.74] | 0.02 | 0.11 | [−0.46, 0.68] | 0.03 | 0.01 |
| Recall manipulation | 0.12 | [−0.35, 0.59] | | 0.06 | [−0.42, 0.54] | | |
| Recall × attitude | | | | 0.45 | [−0.32, 1.22] | | |
| I2: Taking time to relax | | | | | | | |
| Attitude | 0.42* | [0.09, 0.74] | 0.03 | 0.49 [§] | [−0.00, 0.98] | 0.03 | 0.00 |
| Recall manipulation | −0.04 | [−0.43, 0.35] | | −0.02 | [−0.42, 0.38] | | |
| Recall × attitude | | | | −0.13 | [−0.78, 0.53] | | |
| I3: Exercising at least 2 h/week | | | | | | | |
| Attitude | 0.95*** | [0.58, 1.31] | 0.12 | 0.76** | [0.22, 1.30] | 0.13 | 0.00 |
| Recall manipulation | −0.04 | [−0.48, 0.40] | | −0.08 | [−0.53, 0.37] | | |
| Recall × attitude | | | | 0.35 | [−0.38, 1.08] | | |
| I4: Drinking less than 1 glass/day | | | | | | | |
| Attitude | 0.26 | [−0.29, 0.81] | 0.01 | 0.31 | [−0.48, 1.10] | 0.01 | 0.00 |
| Recall manipulation | 0.10 | [−0.57, 0.76] | | 0.11 | [−0.57, 0.78] | | |
| Recall × attitude | | | | −0.09 | [−1.20, 1.02] | | |
| I5: Prepare at least 1 fresh meal/day | | | | | | | |
| Attitude | 0.90*** | [0.55, 1.26] | 0.12 | 0.96*** | [0.43, 1.49] | 0.12 | 0.00 |
| Recall manipulation | 0.31 | [−0.13, 0.74] | | 0.32 | [−0.13, 0.76] | | |
| Recall × attitude | | | | −0.10 | [−0.83, 0.62] | | |
| A1: How to keep a healthy diet | | | | | | | |
| Attitude | 0.69*** | [0.39, 1.00] | 0.12 | 0.63** | [0.19, 1.08] | 0.12 | 0.00 |
| Recall manipulation | −0.36 [§] | [−0.73, 0.01] | | −0.37 [§] | [−0.75, 0.00] | | |
| Recall × attitude | | | | 0.11 | [−0.50, 0.72] | | |
| A2: Relaxation techniques | | | | | | | |
| Attitude | 0.29 | [−0.07, 0.66] | 0.02 | 0.35 | [−0.19, 0.90] | 0.02 | 0.00 |
| Recall manipulation | 0.15 | [−0.30, 0.60] | | 0.16 | [−0.30, 0.62] | | |
| Recall × attitude | | | | −0.11 | [−0.85, 0.63] | | |
| A3: More physical activity | | | | | | | |
| Attitude | 0.50* | [0.09, 0.90] | 0.04 | 0.34 | [−0.26, 0.94] | 0.04 | 0.00 |
| Recall manipulation | −0.31 | [−0.80, 0.18] | | −0.35 | [−0.85, 0.15] | | |
| Recall × attitude | | | | 0.30 | [−0.51, 1.11] | | |

Unhealthy behavior = 0, healthy behavior = 1. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $^{\$}p < 0.10$.

it seems somewhat implausible that those with the most extreme pro-environmental attitude would act against their goal after an environmentally friendly action. Ultimately, however, this is an empirical question that requires empirical testing and can best be investigated with an additional neutral condition.

A further limitation of Study 1 is that the sample consisted mainly of female students. Consequently, environmental and health attitudes may have been more homogeneous than in the general adult population. Without a more representative sample, the findings of Study 1 might be limited to well-educated female students.

STUDY 2

Study 2 aimed to replicate the findings of Study 1 and address its shortcomings by adding a neutral control condition and by using a larger and demographically more heterogeneous sample. We used the neutral control condition as a baseline and examined the moderating effect of attitude strength on recalling a goal-inconsistent (environmentally unfriendly/unhealthy) or goal-consistent (environmentally friendly/healthy) behavior.

We expected that participants with a strong attitude would be more motivated to engage in goal-conducive behaviors after recalling either a goal-consistent or goal-inconsistent behavior than after recalling a neutral behavior. The prediction is based on the following assumptions: when such participants carry out a behavior that is relevant to their attitude, it increases (a) the salience of the attitude and (b) the relationships between different attitude-relevant behaviors and how they are relevant to the underlying attitude; and (c) if such participants carry out a behavior inconsistent with their attitude, they experience cognitive dissonance. Regarding participants with weak attitudes, we predicted that they would feel that they had “done enough” and be less motivated to engage in further similar behaviors after recalling a goal-consistent behavior compared to a neutral behavior. For these participants, previous environmentally unfriendly or unhealthy actions are unlikely to lead to cognitive dissonance because they do not conflict with attitudes. We therefore did not expect motivation to differ after recalling a goal-inconsistent behavior relative to recalling a neutral behavior.

Materials and Methods

Procedure

The general procedure was the same as Study 1. Data were again collected through Qualtrics at two points in time in 2018. At time 1, participants answered questions regarding their environmental and health attitudes and socio-demographic questions.

At time 2 (8–12 days later), participants completed one of five recall conditions, to which they were assigned randomly. After answering two sets of questions that are beyond the scope of Study 2 (i.e., relating to possible additional moral processes), participants answered the questions used as dependent variables. Finally, they were thanked and debriefed.

Participants

A power analysis using the special *F*-test assessing the increase in explained variance due to the interaction with five predictors (i.e., attitude, two dummies representing the experimental conditions, and their interactions; Faul et al., 2009) suggested that to find a small-to-medium effect ($|B| = 0.15$) with 90% power at the 5% level, at least 553 participants are required for an experimental design with three groups. To be able to conduct the analysis in two contexts (environment and health), we increased the target sample size proportionally and aimed for a total sample of $N = 922$.

The United States-based sample was recruited via Amazon Turk. Those who participated in both parts of the survey were paid US \$4. In total, 1,208 participants started the survey at time 1. Of those, 26 were removed due to a missing personal identifier. Eighteen were removed because they participated more than once (in which case we discarded the participation that included more missing values, and in case of a similar amount of missing values, the second participation). A further 38 participants were removed because they responded to fewer than 20% of the questions.

Of all participants who finished the survey at time 1, 1,003 accessed the study at time 2. Ten participants participated twice; we again excluded the answers from the participation that included more missing values, and in case of a similar amount of missing values, the second participation. A further 37 participants were removed because they responded to less than 20% of the questions.

Some 174 participants were excluded as they did not take part in both parts of the study. To ensure good data quality, we again retained only participants (a) who passed the seriousness check (Reips, 2002), (b) whose participation time in both surveys lasted at least one third of the sample's median time (10.55 min at time 1, 10.19 min at time 2), (c) who provided a semantically meaningful answer in the recall task (judged by three independent raters), and (d) who passed the attention checks that were included in both parts of the study. Based on these criteria, 25 participants were excluded. The mean age of participants who met the criteria ($N = 929$) was 37.42 ($SD = 12.01$). The proportion of women was approximately 65%. Of participants who revealed their academic background, for 10.1% the highest degree was high school or lower, 20.1% partially completed college, 13.5% fully completed college, 39.6% had a bachelor's degree, and 16.7% a master's or Ph.D. degree.

A comparison of the 199 participants who either did not participate in the survey both times ($N = 174$) or who did participate but were excluded to ensure good data quality and the 929 participants who were retained for the analyses did not reveal any differences in environmental or health attitudes (t -tests, $ps = 0.17, 0.60$). The proportion of participants who dropped out or were excluded was not associated with experimental condition, $\chi^2(4) = 1.75, p = 0.782$.

Manipulation

Participants were randomly assigned to one of five experimental conditions. In addition to the four conditions used in Study 1, a control condition was included in which participants were asked to recall their routine on a typical Tuesday (Jordan et al.,

2011; Cornelissen et al., 2013). In all conditions, participants were instructed to take 5–10 min to write down their action or routine in detail (Jordan et al., 2011; Weibel et al., 2014).

To examine whether the manipulation had the intended effect, three coders blind to condition rated how environmentally friendly and healthy the recalled deeds were (seven-point scale: -3 = very environmentally harmful or unhealthy, $+3$ = very environmentally friendly or healthy). Interrater reliability was high (intraclass correlation coefficient $[ICC]_{\text{environmentally friendly}} = 0.88$, $ICC_{\text{healthy}} = 0.89$). The ratings of the coders were averaged into an environmental friendliness and a healthiness scale.

Moderators

Environmental attitude was measured with 47 items (see **Supplementary Table 1**) from Kaiser and Wilson (2004). Of the 47 items, 30 were presented in a five-point frequency format. The responses to these items were recoded into a dichotomous format by collapsing “never,” “seldom,” and “occasionally” into “unreliable pro-environmental engagement,” and “often” and “always” into “reliable pro-environmental engagement.” The remaining 17 items were presented in a yes/no format. Nineteen behaviors represented environmentally unfriendly activities and were recoded prior to analysis. The dichotomization, calibration of the behavior scale, and the estimation of person scores were based on the classical Rasch model and in line with previous calibrations of the same instrument (Kaiser and Wilson, 2004). All behavior items were found to fit the model very well (infit mean square values < 1.29 ; for reference values, see Bond and Fox, 2007). The Rasch-model-based reliability estimate of the measure was $rel = 0.74$.

Health attitude was measured with 44 items from Byrka and Kaiser (2013) and nine newly developed items (**Supplementary Table 2**). For 27 items, a five-point frequency scale was used; then responses were dichotomized as for the environmental scale. The remaining 24 items were in a yes/no format. Nine items represented unhealthy behaviors and were recoded prior to analysis. All behavior items fit the model very well (infit mean square values < 1.23). The Rasch-model-based reliability estimate was $rel = 0.77$.

Dependent Variables

To assess the extent of positive and negative spillover, we used four types of dependent variables. First, participants indicated on a seven-point scale (1 = very unlikely, 7 = very likely) how likely they are to engage in 17 behaviors in the near future. Of these behavioral intentions, eight were related to the environment and nine to their personal health (**Table 4**).

Second, participants indicated on a seven-point scale (1 = very unlikely, 7 = very likely) how likely they were to sign nine petitions from online sites^{3,4}. Of the nine petitions, six were related to environmental protection (**Table 4**) and three to improving health.

Third, participants indicated (yes/no) whether they were interested in receiving tips about pro-environmental or healthy behaviors. Fourth, they were given the chance to donate any part of their reimbursement to either an organization for the protection of the environment (**Table 4**) or the promotion of health.

We did not examine any effects on support for health-related petitions or donations. This is because health attitude focuses on people's *personal* health. This makes it difficult or impossible to anticipate any systematic relationship between health attitude and decisions that focus predominantly on promoting *others'* health.

Results

Levels of Environmental and Health Attitudes in the Five Experimental Conditions

The random allocation of participants to the five conditions was successful with respect to the strength of the attitudes: The levels of environmental $[F(4,924) = 1.39, p = 0.235, \eta^2 = 0.01]$ and health attitude $[F(4,924) = 1.59, p = 0.175, \eta^2 = 0.01]$ were not statistically different in the five conditions.

Manipulation Checks

Environmental behavior

The manipulation check showed that the recall manipulation had the intended effect. Coders rated the recalled environmental behaviors in the three conditions differently $[F(2,535) = 1814.00, p < 0.001, \eta^2 = 0.87]$. *Post hoc* comparisons using the Tukey HSD test indicated that coders rated the recalled action as more positive in the environmentally friendly condition ($M = 1.50, SD = 0.56$) than in the control condition ($M = 0.00, SD = 0.00$) and the environmentally unfriendly condition ($M = -1.21, SD = 0.48$), and as more positive in the control condition than in the environmentally unfriendly condition.

Health behavior

The recall manipulation also had the intended effect with respect to health. Coders rated the recalled behaviors in the three conditions differently $[F(2,532) = 2442.00, p < 0.001, \eta^2 = 0.90]$. *Post hoc* comparisons using the Tukey HSD test indicated that coders rated the recalled health action as more positive in the healthy condition ($M = 1.43, SD = 0.48$) than in the control condition ($M = 0.00, SD = 0.00$) and the unhealthy condition ($M = -1.29, SD = 0.42$), and as more positive in the control than the unhealthy condition.

Environmental Attitude Moderates the Effect of Past Environmental Actions on One Petition and Has a Direct Positive Effect on All Dependent Variables

To examine the effects of the recall manipulation, environmental attitude, and their interaction on intentions and support for petitions, we used the same multiple linear regression approach as in Study 1. Because of the dichotomous answer format of the pro-environmental information sheet, we used a logistic regression analysis to examine effects on this dependent variable. Furthermore, only 14% of the sample donated to any organization, resulting in a high frequency of zero data points

³change.org

⁴thepetitionsite.com

TABLE 4 | Descriptive statistics for behavioral intentions (I1–I8), petitions (P1–P6), interest in behavior tips, and donations in the contexts of environment and health, Study 2.

| | Mean | Median | SD | Range |
|---|------|--------|------|-------|
| Environmental protection | | | | |
| I1: Switching off electronic devices instead of leaving them on stand-by | 4.02 | 4 | 1.87 | 1–7 |
| I2: Forego air travel and instead choose a means of transport with less negative effects on the environment | 3.85 | 4 | 1.92 | 1–7 |
| I3: Buy ecologically produced food | 3.92 | 4 | 1.55 | 1–7 |
| I4: Only eat seasonal produce | 3.83 | 4 | 1.68 | 1–7 |
| I5: Boycott products from businesses that harm the environment | 3.71 | 4 | 1.7 | 1–7 |
| I6: Buy the environmentally friendly alternative of a product | 4.52 | 5 | 1.53 | 1–7 |
| I7: Always recycle plastic bottles (even in public places) | 5.35 | 6 | 1.61 | 1–7 |
| I8: Join an environmental group | 2.7 | 2 | 1.59 | 1–7 |
| P1: Fee for paper cups | 3.41 | 3 | 1.96 | 1–7 |
| P2: Plastic bag tax | 4.17 | 5 | 2.17 | 1–7 |
| P3: Ban non-sustainable palm oil | 4.32 | 5 | 1.97 | 1–7 |
| P4: Ban plastic dishes | 3.87 | 4 | 2.07 | 1–7 |
| P5: Invest in renewable energy | 5.2 | 6 | 1.92 | 1–7 |
| P6: No drilling in arctic national wildlife refuge | 5.01 | 6 | 2.03 | 1–7 |
| S1: Interest in information sheet | 0.6 | 1 | 0.49 | 0–1 |
| D1: Amount environmental donation | 0.15 | 0 | 0.47 | 0–4 |
| Health | | | | |
| I1: Eat four to five servings of fruit/vegetables per day | 4.62 | 5 | 1.67 | 1–7 |
| I2: Avoid snacks high in calories (e.g., chips, chocolate) | 4.15 | 4 | 1.79 | 1–7 |
| I3: Choose lean over fatty food options | 4.81 | 5 | 1.58 | 1–7 |
| I4: Regularly take the stairs instead of the elevator | 4.89 | 5 | 1.64 | 1–7 |
| I5: Do 150 min/week of moderate physical activity (gentle swimming, golf, horseback riding) | 4.46 | 5 | 1.89 | 1–7 |
| I6: Do 75 min/week of vigorous physical activity (joggin, cycling, aerobics, competitive tennis) | 4.33 | 5 | 1.91 | 1–7 |
| I7: Have regular health check-ups (dental hygiene, gynecologist, cancer checks) | 4.96 | 5 | 1.68 | 1–7 |
| I8: Drink no more than two beers or similar per week | 5.37 | 7 | 2.11 | 1–7 |
| I9: Use sunscreen consistently when exposed to the sun | 4.73 | 5 | 1.86 | 1–7 |
| S1: Interest in information sheet | 0.61 | 1 | 0.49 | 0–1 |

and a strongly positively skewed distribution. We therefore used negative binomial regression analyses when donations to a pro-environmental organization was the dependent variable (Carrico et al., 2018).

Interaction effects

For one (of six) petitions, the effect of the environmentally unfriendly recall manipulation depended on the strength of participants' environmental attitude: The significant interaction was found when petition 6 (no drilling in the arctic national wildlife refuge) was used as the dependent variable and the terms that represented the interaction between environmental attitude and participants who either recalled a typical Tuesday (control group) or an environmentally unfriendly behavior were included as predictors (Table 5). Analysis of this interaction with the Johnson-Neyman technique showed that the environmentally unfriendly recall manipulation had an effect only on participants with attitude scores less than -1.04 (39th percentile), not for participants whose environmental attitude was equal to or greater than -1.04 (Figure 3A). The simple slopes for participants with a weak environmental attitude (25th percentile) showed that they

less strongly intended to sign the petition when they had recalled an environmentally unfriendly compared to a neutral behavior ($B = -0.63$, $SE = 0.26$, $p = 0.02$; Figure 3B). By contrast, those with a strong or medium attitude were equally motivated to sign the petition after recalling a neutral or an environmentally unfriendly deed (75th percentile: $B = 0.10$, $SE = 0.27$, $p = 0.71$; 50th percentile: $B = -0.28$, $SE = 0.20$, $p = 0.17$; Figure 3B).

Similar trends were observed for petition 1 (fee for paper cups), petition 3 (ban unsustainable palm oil) and petition 4 (ban plastic dishes); however, with only marginally significant effects (Figures 3C–E). These patterns are not consistent with the prediction that after recalling an environmentally unfriendly versus a neutral behavior, participants with a strong attitude would increase their support for environmental policies, whereas participants with a weak attitude would be relatively unaffected by the two types of memories.

Direct effects of environmental attitude and the recall manipulation

When the valence of the recalled behavior was held constant, participants with a strong environmental attitude acted

TABLE 5 | Direct and interactive effects of environmental attitude and recalled behavior on intentions, willingness to sign petitions, interest in information sheet and amount donated, Study 2.

| | Step 1 | | | Step 2 | | | |
|--|-------------------|----------------|-----------------------|--------------------|----------------|-----------------------|--------------|
| | <i>B</i> | 95% <i>CI</i> | <i>R</i> ² | <i>B</i> | 95% <i>CI</i> | <i>R</i> ² | ΔR^2 |
| I1: Switch off electronic devices | | | | | | | |
| Attitude | 0.90*** | [0.71, 1.09] | 0.16 | 1.04*** | [0.72, 1.36] | 0.16 | 0.00 |
| Recall environmentally Friendly | 0.69*** | [0.34, 1.03] | | 0.58* | [0.08, 1.07] | | |
| Recall environmentally Unfriendly | 0.11 | [-0.24, 0.46] | | -0.13 | [-0.64, 0.38] | | |
| Recall environmentally Friendly × attitude | | | | -0.15 | [-0.61, 0.30] | | |
| Recall environmentally Unfriendly × attitude | | | | -0.30 | [-0.76, 0.17] | | |
| I2: Switch from air travel other means of transport | | | | | | | |
| Attitude | 0.63*** | [0.43, 0.84] | 0.06 | 0.77*** | [0.42, 1.12] | 0.07 | 0.01 |
| Recall environmentally Friendly | 0.23 | [-0.16, 0.61] | | -0.11 | [-0.66, 0.43] | | |
| Recall environmentally Unfriendly | 0.07 | [-0.32, 0.45] | | 0.11 | [-0.46, 0.67] | | |
| Recall environmentally Friendly × attitude | | | | -0.44 [§] | [-0.94, 0.07] | | |
| Recall environmentally Unfriendly × attitude | | | | 0.02 | [-0.49, 0.53] | | |
| I3: Buy ecologically produced food | | | | | | | |
| Attitude | 0.92*** | [0.77, 1.08] | 0.21 | 0.86*** | [0.60, 1.11] | 0.21 | 0.01 |
| Recall environmentally Friendly | 0.24 [§] | [-0.04, 0.52] | | 0.18 | [-0.22, 0.58] | | |
| Recall environmentally Unfriendly | -0.02 | [-0.30, 0.26] | | 0.22 | [-0.19, 0.63] | | |
| Recall environmentally Friendly × attitude | | | | -0.07 | [-0.44, 0.30] | | |
| Recall environmentally Unfriendly × attitude | | | | 0.29 | [-0.09, 0.66] | | |
| I4: Eat seasonal produce | | | | | | | |
| Attitude | 0.66*** | [0.49, 0.84] | 0.09 | 0.57*** | [0.28, 0.87] | 0.09 | 0.00 |
| Recall environmentally Friendly | 0.09 | [-0.23, 0.42] | | 0.15 | [-0.31, 0.61] | | |
| Recall environmentally Unfriendly | 0.03 | [-0.30, 0.36] | | 0.19 | [-0.28, 0.67] | | |
| Recall environmentally Friendly × attitude | | | | 0.08 | [-0.35, 0.51] | | |
| Recall environmentally Unfriendly × attitude | | | | 0.21 | [-0.23, 0.64] | | |
| I5: Boycott products | | | | | | | |
| Attitude | 1.09*** | [0.92, 1.25] | 0.24 | 1.00*** | [0.73, 1.28] | 0.24 | 0.00 |
| Recall environmentally Friendly | 0.22 | [-0.08, 0.52] | | 0.20 | [-0.22, 0.62] | | |
| Recall environmentally Unfriendly | 0.13 | [-0.18, 0.43] | | 0.36 | [-0.08, 0.80] | | |
| Recall environmentally Friendly × attitude | | | | -0.02 | [-0.41, 0.38] | | |
| Recall environmentally Unfriendly × attitude | | | | 0.29 | [-0.11, 0.69] | | |
| I6: Buy the environmentally friendly alternative of a product | | | | | | | |
| Attitude | 0.88*** | [0.73, 1.03] | 0.20 | 0.96*** | [0.70, 1.21] | 0.21 | 0.01* |
| Recall environmentally Friendly | 0.37** | [0.09, 0.65] | | 0.10 | [-0.30, 0.49] | | |
| Recall environmentally Unfriendly | -0.04 | [-0.32, 0.24] | | 0.08 | [-0.32, 0.49] | | |
| Recall environmentally Friendly × attitude | | | | -0.35 [§] | [-0.72, 0.01] | | |
| Recall environmentally Unfriendly × attitude | | | | 0.13 | [-0.24, 0.50] | | |
| I7: Always recycle plastic bottles | | | | | | | |
| Attitude | 0.76*** | [0.60, 0.93] | 0.19 | 0.89*** | [0.61, 1.16] | 0.19 | 0.00 |
| Recall environmentally Friendly | 0.47** | [0.18, 0.77] | | 0.23 | [-0.19, 0.65] | | |
| Recall environmentally Unfriendly | -0.46** | [-0.76, -0.16] | | -0.48* | [-0.91, -0.04] | | |
| Recall environmentally Friendly × attitude | | | | -0.32 | [-0.71, 0.07] | | |
| Recall environmentally Unfriendly × attitude | | | | -0.04 | [-0.44, 0.35] | | |
| I8: Join an environmental group | | | | | | | |
| Attitude | 0.90*** | [0.74, 1.06] | 0.18 | 1.01*** | [0.73, 1.28] | 0.18 | 0.00 |
| Recall environmentally Friendly | -0.09 | [-0.38, 0.21] | | -0.29 | [-0.71, 0.13] | | |
| Recall environmentally Unfriendly | -0.10 | [-0.41, 0.20] | | -0.13 | [-0.57, 0.30] | | |
| Recall environmentally Friendly × attitude | | | | -0.26 | [-0.66, 0.13] | | |
| Recall environmentally Unfriendly × attitude | | | | -0.06 | [-0.45, 0.34] | | |
| P1: Fee for paper cups | | | | | | | |
| Attitude | 0.88*** | [0.67, 1.08] | 0.12 | 0.69*** | [0.35, 1.04] | 0.12 | 0.00 |
| Recall environmentally Friendly | 0.12 | [-0.26, 0.49] | | 0.22 | [-0.31, 0.76] | | |
| Recall environmentally Unfriendly | -0.18 | [-0.56, 0.20] | | 0.16 | [-0.39, 0.72] | | |
| Recall environmentally Friendly × attitude | | | | 0.15 | [-0.34, 0.65] | | |
| Recall environmentally Unfriendly × attitude | | | | 0.43 [§] | [-0.07, 0.93] | | |

(Continued)

TABLE 5 | Continued

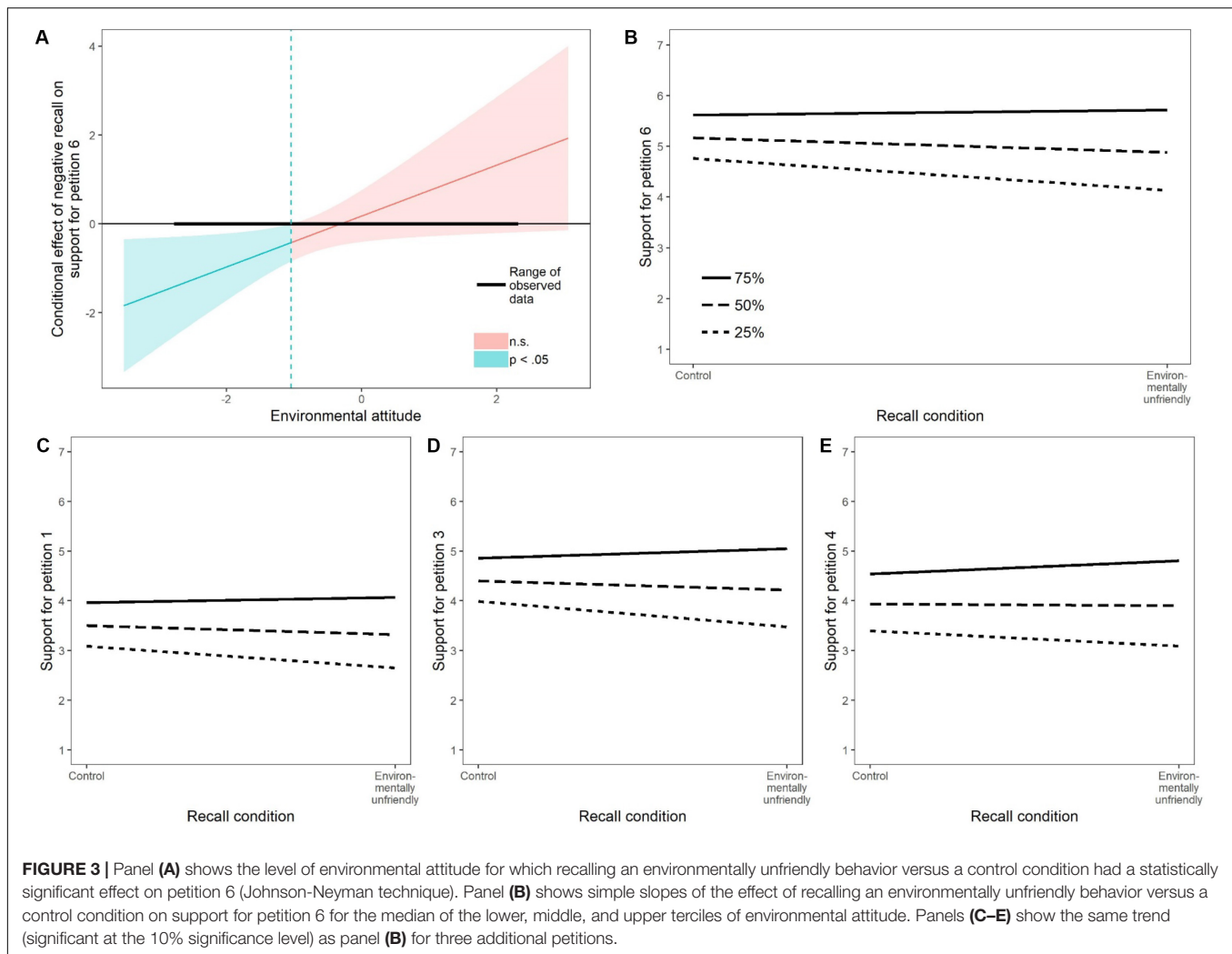
| | Step 1 | | | Step 2 | | | |
|---|----------|----------------|-----------------------|-------------------|---------------|-----------------------|-------------------|
| | <i>B</i> | 95% <i>CI</i> | <i>R</i> ² | <i>B</i> | 95% <i>CI</i> | <i>R</i> ² | ΔR^2 |
| P2: Plastic bag tax | | | | | | | |
| Attitude | 1.00*** | [0.78, 1.23] | 0.12 | 0.87*** | [0.49, 1.24] | 0.13 | 0.00 |
| Recall environmentally Friendly | 0.05 | [-0.36, 0.46] | | 0.06 | [-0.52, 0.64] | | |
| Recall environmentally Unfriendly | -0.02 | [-0.44, 0.40] | | 0.31 | [-0.29, 0.92] | | |
| Recall environmentally Friendly \times attitude | | | | 0.03 | [-0.51, 0.57] | | |
| Recall environmentally Unfriendly \times attitude | | | | 0.41 | [-0.14, 0.96] | | |
| P3: Ban non-sustainable palm oil | | | | | | | |
| Attitude | 0.86*** | [0.65, 1.07] | 0.11 | 0.69*** | [0.33, 1.04] | 0.12 | 0.01 [§] |
| Recall environmentally Friendly | 0.15 | [-0.23, 0.54] | | 0.13 | [-0.42, 0.67] | | |
| Recall environmentally Unfriendly | -0.19 | [-0.58, 0.20] | | 0.26 | [-0.30, 0.83] | | |
| Recall environmentally Friendly \times attitude | | | | -0.01 | [-0.52, 0.49] | | |
| Recall environmentally Unfriendly \times attitude | | | | 0.56* | [0.04, 1.07] | | |
| P4: Ban plastic dishes | | | | | | | |
| Attitude | 1.06*** | [0.85, 1.27] | 0.15 | 0.90*** | [0.55, 1.26] | 0.16 | 0.01 |
| Recall environmentally Friendly | 0.04 | [-0.35, 0.42] | | 0.07 | [-0.48, 0.61] | | |
| Recall environmentally Unfriendly | -0.04 | [-0.44, 0.35] | | 0.33 | [-0.24, 0.89] | | |
| Recall environmentally Friendly \times attitude | | | | 0.06 | [-0.45, 0.56] | | |
| Recall environmentally Unfriendly \times attitude | | | | 0.45 [§] | [-0.06, 0.97] | | |
| P5: Invest in renewable energy | | | | | | | |
| Attitude | 0.63*** | [0.43, 0.84] | 0.07 | 0.55** | [0.21, 0.88] | 0.07 | 0.00 |
| Recall environmentally Friendly | -0.03 | [-0.40, 0.34] | | -0.06 | [-0.58, 0.47] | | |
| Recall environmentally Unfriendly | -0.23 | [-0.60, 0.15] | | 0.02 | [-0.52, 0.57] | | |
| Recall environmentally Friendly \times attitude | | | | -0.02 | [-0.51, 0.47] | | |
| Recall environmentally Unfriendly \times attitude | | | | 0.31 | [-0.19, 0.80] | | |
| P6: No drilling in arctic national wildlife refuge | | | | | | | |
| Attitude | 0.79*** | [0.58, 1.01] | 0.10 | 0.68*** | [0.32, 1.03] | 0.11 | 0.01* |
| Recall environmentally Friendly | 0.14 | [-0.25, 0.53] | | -0.02 | [-0.57, 0.53] | | |
| Recall environmentally Unfriendly | -0.30 | [-0.70, 0.09] | | 0.17 | [-0.40, 0.74] | | |
| Recall environmentally Friendly \times attitude | | | | -0.18 | [-0.69, 0.33] | | |
| Recall environmentally Unfriendly \times attitude | | | | 0.57* | [0.06, 1.09] | | |
| S1: Information sheet y/n^a | | | | | | | |
| Attitude | 0.48*** | [0.24, 0.73] | 0.03 | 0.62** | [0.19, 1.09] | 0.03 | 0.00 |
| Recall environmentally Friendly | -0.22 | [-0.65, 0.22] | | -0.45 | [-1.14, 0.21] | | |
| Recall environmentally Unfriendly | -0.44* | [-0.87, -0.01] | | -0.53 | [-1.23, 0.16] | | |
| Recall environmentally Friendly \times attitude | | | | -0.28 | [-0.90, 0.32] | | |
| Recall environmentally Unfriendly \times attitude | | | | -0.11 | [-0.74, 0.50] | | |
| D1: Amount environmental donation^b | | | | | | | |
| Attitude | 0.84*** | [0.57, 1.12] | 0.07 | 0.63** | [0.17, 1.08] | 0.07 | 0.00 |
| Recall environmentally Friendly | 0.15 | [-0.41, 0.71] | | 0.28 | [-0.30, 0.87] | | |
| Recall environmentally Unfriendly | 0.36 | [-0.19, 0.92] | | 0.42 | [-0.19, 1.02] | | |
| Recall environmentally Friendly \times attitude | | | | 0.44 | [-0.21, 1.11] | | |
| Recall environmentally Unfriendly \times attitude | | | | 0.20 | [-0.46, 0.87] | | |

Environmentally unfriendly behavior = 0, environmentally friendly behavior = 1. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $p < 0.10$. ^aLogistic regression. ^bNegative binomial regression.

more environmentally friendly than participants with a weak environmental attitude. This direct effect was observed in all 16 dependent variables (Table 5) and is evident, for example, in the varying levels of support for petitions in Figures 3B–E.

Recalling a neutral versus an environmentally friendly or unfriendly behavior also had some direct effects on the environmental outcome variables: When controlling for the

influence of environmental attitude, recalling an environmentally friendly (vs. neutral) behavior increased the motivation to engage in three pro-environmental behaviors (switch off electronic devices, buy eco-friendly products, and recycle plastic bottles). In other words, recalling an environmentally friendly deed promoted positive spillover across all levels of environmental attitude with respect to these intentions. When the intention



to recycle plastic bottles was the dependent variable, this behavioral consistency was also observed in the other direction: Recalling an environmentally unfriendly (vs. neutral) behavior decreased the intention to recycle, irrespective of the strength of environmental attitude. Finally, behavioral consistency was found when participants who recalled an environmentally unfriendly behavior were asked if they wanted to receive tips about pro-environmental behavior: Compared to the neutral condition, they were less interested in receiving such information.

Health Attitude Has a Direct Positive Effect on All Dependent Variables

Interaction effects

The prediction that a strong health attitude would increase the likelihood of positive spillover and reduce the likelihood of negative spillover after an initial healthy behavior was not confirmed (Table 6). There was even some evidence to suggest a detrimental influence of a strong health attitude. We found a significant interaction when interest in tips for how to live healthily was used as a dependent variable and the healthy (vs. neutral) recall manipulation, health attitude, and their

interactions were used as predictors (Table 6). A decomposition of this interaction with the Johnson-Neyman technique showed that recalling a healthy behavior had an effect only on participants with attitude scores less than -1.13 (i.e., the 3rd percentile) and more than 0.55 (i.e., the 74th percentile; Figure 4A). The simple slopes for participants with strong attitudes (75th percentile) showed that these participants requested the information sheet less frequently when they had recalled a healthy compared to a neutral deed ($B = -0.74$, $SE = 0.32$, $p = 0.02$, Figure 4B). By contrast, those with moderate and weak health attitudes did not differ in their interest in the information when they had recalled a healthy or a neutral deed (50th percentile: $B = -0.16$, $SE = 0.22$, $p = 0.46$; 25th percentile: $B = 0.41$, $SE = 0.30$, $p = 0.18$; Figure 4B).

Direct effects of health attitude and the recall manipulation

Attitude was positively related to all nine health intentions; that is, the stronger a person's health attitude, the more likely they were to act in a healthy way (Table 6). When controlling for the influence of attitude, recalling a healthy (vs. neutral) behavior increased the intention to avoid snacks high in calories

TABLE 6 | Direct and interactive effects of health attitude and recalled behavior on intentions and interest in information sheet 2.

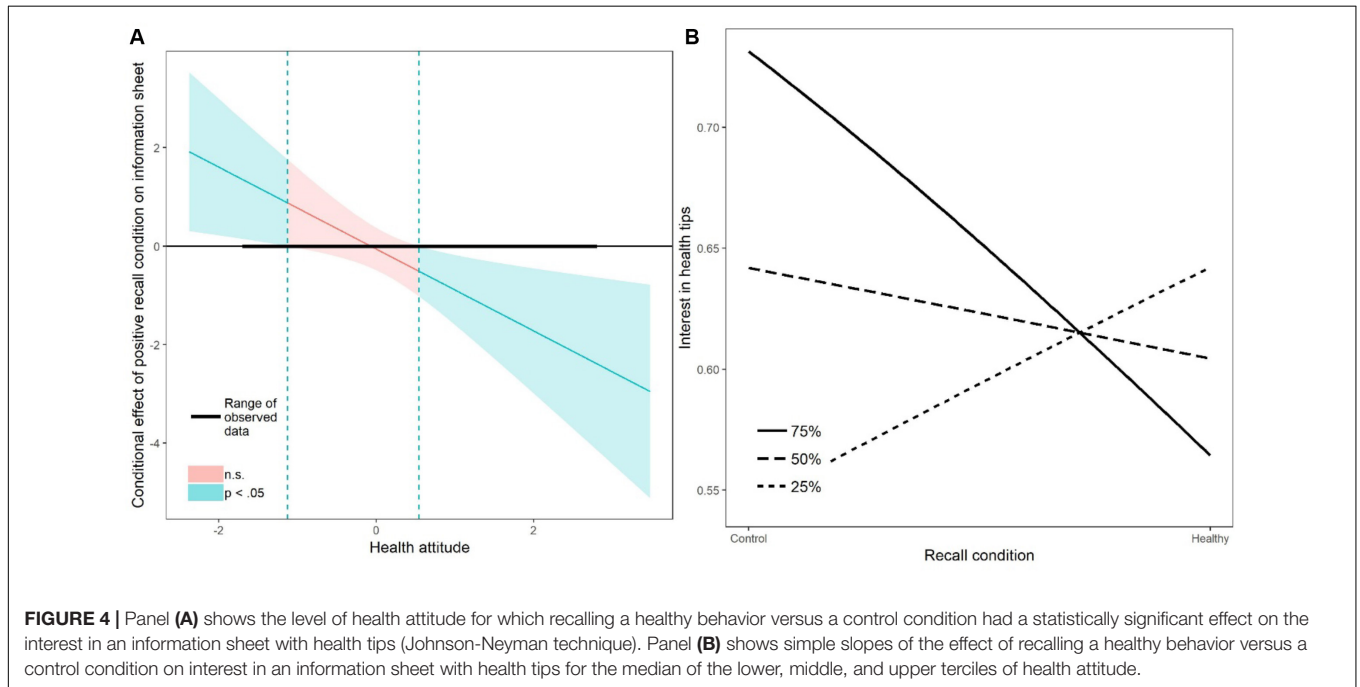
| | Step 1 | | | Step 2 | | | |
|--|----------|---------------|-----------------------|--------------------|---------------|-----------------------|-------------------|
| | <i>B</i> | 95% <i>CI</i> | <i>R</i> ² | <i>B</i> | 95% <i>CI</i> | <i>R</i> ² | ΔR^2 |
| I1: Four to five servings of fruit/vegetables per day | | | | | | | |
| Attitude | 0.95*** | [0.76, 1.13] | 0.16 | 1.08*** | [0.77, 1.39] | 0.16 | 0.00 |
| Recall healthy | -0.11 | [-0.42, 0.20] | | -0.07 | [-0.39, 0.24] | | |
| Recall unhealthy | -0.24 | [-0.55, 0.07] | | -0.21 | [-0.53, 0.10] | | |
| Recall healthy × attitude | | | | -0.29 | [-0.73, 0.16] | | |
| Recall unhealthy × attitude | | | | -0.13 | [-0.57, 0.32] | | |
| I2: Avoid snacks high in calories | | | | | | | |
| Attitude | 0.89*** | [0.69, 1.08] | 0.13 | 0.81*** | [0.49, 1.14] | 0.14 | 0.01 [§] |
| Recall healthy | 0.41* | [0.07, 0.74] | | 0.42* | [0.08, 0.76] | | |
| Recall unhealthy | 0.22 | [-0.11, 0.56] | | 0.17 | [-0.17, 0.51] | | |
| Recall healthy × attitude | | | | -0.16 | [-0.64, 0.32] | | |
| Recall unhealthy × attitude | | | | 0.38 | [-0.10, 0.86] | | |
| I3: Choose lean over fatty food options | | | | | | | |
| Attitude | 0.84*** | [0.66, 1.01] | 0.14 | 0.81*** | [0.52, 1.10] | 0.14 | 0.00 |
| Recall healthy | -0.02 | [-0.31, 0.28] | | -0.01 | [-0.31, 0.29] | | |
| Recall unhealthy | -0.21 | [-0.50, 0.08] | | -0.24 | [-0.53, 0.06] | | |
| Recall healthy × attitude | | | | -0.08 | [-0.50, 0.34] | | |
| Recall unhealthy × attitude | | | | 0.15 | [-0.27, 0.57] | | |
| I4: Take the stairs instead of the elevator | | | | | | | |
| Attitude | 0.80*** | [0.61, 0.98] | 0.12 | 0.98*** | [0.68, 1.28] | 0.13 | 0.01 |
| Recall healthy | 0.08 | [-0.22, 0.39] | | 0.13 | [-0.17, 0.44] | | |
| Recall unhealthy | -0.11 | [-0.41, 0.20] | | -0.08 | [-0.39, 0.23] | | |
| Recall healthy × attitude | | | | -0.42 [§] | [-0.86, 0.02] | | |
| Recall unhealthy × attitude | | | | -0.16 | [-0.59, 0.28] | | |
| I5: Moderate physical activity | | | | | | | |
| Attitude | 1.08*** | [0.87, 1.28] | 0.16 | 0.96*** | [0.62, 1.30] | 0.16 | 0.00 |
| Recall healthy | 0.17 | [-0.18, 0.52] | | 0.14 | [-0.21, 0.49] | | |
| Recall unhealthy | 0.27 | [-0.07, 0.62] | | 0.25 | [-0.11, 0.61] | | |
| Recall healthy × attitude | | | | 0.23 | [-0.27, 0.74] | | |
| Recall unhealthy × attitude | | | | 0.14 | [-0.36, 0.64] | | |
| I6: Vigorous physical activity | | | | | | | |
| Attitude | 1.14*** | [0.92, 1.35] | 0.17 | 1.09*** | [0.73, 1.44] | 0.17 | 0.00 |
| Recall healthy | -0.02 | [-0.38, 0.33] | | -0.02 | [-0.38, 0.35] | | |
| Recall unhealthy | -0.08 | [-0.43, 0.28] | | -0.11 | [-0.48, 0.25] | | |
| Recall healthy × attitude | | | | -0.09 | [-0.61, 0.43] | | |
| Recall unhealthy × attitude | | | | 0.25 | [-0.27, 0.76] | | |
| I7: Have regular health check-ups | | | | | | | |
| Attitude | 0.69*** | [0.50, 0.88] | 0.08 | 0.67*** | [0.35, 0.99] | 0.08 | 0.00 |
| Recall healthy | 0 | [-0.32, 0.33] | | 0 | [-0.33, 0.33] | | |
| Recall unhealthy | 0.1 | [-0.22, 0.43] | | 0.1 | [-0.23, 0.43] | | |
| Recall healthy × attitude | | | | 0.02 | [-0.45, 0.48] | | |
| Recall unhealthy × attitude | | | | 0.05 | [-0.41, 0.52] | | |
| I8: Drink maximum two drinks/week | | | | | | | |
| Attitude | 0.37** | [0.12, 0.62] | 0.02 | 0.61** | [0.20, 1.03] | 0.02 | 0.00 |
| Recall healthy | 0.01 | [-0.41, 0.43] | | 0.05 | [-0.38, 0.48] | | |
| Recall unhealthy | -0.05 | [-0.47, 0.37] | | 0.02 | [-0.41, 0.45] | | |
| Recall healthy × attitude | | | | -0.27 | [-0.88, 0.34] | | |
| Recall unhealthy × attitude | | | | -0.48 | [-1.09, 0.12] | | |
| I9: Use sunscreen consistently | | | | | | | |
| Attitude | 0.73*** | [0.52, 0.95] | 0.08 | 0.70*** | [0.34, 1.06] | 0.08 | 0.00 |
| Recall healthy | 0.04 | [-0.32, 0.41] | | 0.03 | [-0.34, 0.40] | | |

(Continued)

TABLE 6 | Continued

| | Step 1 | | | Step 2 | | | |
|--|--------|---------------|----------------|---------|----------------|----------------|-----------------|
| | B | 95% CI | R ² | B | 95% CI | R ² | ΔR ² |
| Recall unhealthy | -0.25 | [-0.62, 0.11] | | -0.25 | [-0.63, 0.12] | | |
| Recall healthy × attitude | | | | 0.12 | [-0.41, 0.65] | | |
| Recall unhealthy × attitude | | | | -0.01 | [-0.53, 0.52] | | |
| S1: Information sheet^a | | | | | | | |
| Attitude | 0.20 | [-0.05, 0.46] | 0.00 | 0.60** | [0.16, 1.06] | 0.01 | 0.01* |
| Recall healthy | -0.14 | [-0.56, 0.28] | | -0.06 | [-0.49, 0.37] | | |
| Recall unhealthy | -0.13 | [-0.55, 0.29] | | -0.09 | [-0.52, 0.34] | | |
| Recall healthy × attitude | | | | -0.83** | [-1.47, -2.11] | | |
| Recall unhealthy × attitude | | | | -0.36 | [-0.99, 0.27] | | |

Unhealthy behavior = 0, healthy behavior = 1. ***p < 0.001, **p < 0.01, *p < 0.05, \$p < 0.10. ^aLogistic regression.



(intention 2, Table 6). No other positive or negative spillover effects of the recall manipulation were found.

Discussion

Study 2 provided little evidence for the expected moderating effect of attitude strength: In only two instances – when participants were asked whether they would support a petition against drilling in an arctic wildlife refuge and when they were asked whether they wanted to receive health tips – did the respective attitude moderate the effect of the recalled behavior at the 5% significance level.

What is more, these interactions were not entirely in line with our predictions: We expected that recalling a healthy (vs. a neutral) behavior would increase the interest in receiving health tips among those with a strong health attitude, but found that the recalled behavior decreased their interest in such tips. It is striking that the latter interaction was the only one across both studies in

which those with a strong attitude *reduced* their efforts to act in line with their attitude.

To explain this unexpected pattern, we look to the content of the dependent variable: the choice to receive information. It could be argued that participants who have a strong health attitude tend to already know a lot about health. This expertise may have become particularly obvious after recalling a healthy behavior, which might in turn have reduced the subjective need for further information. In other words, this dependent variable may have tapped more into participants’ evaluation of whether they require information than their motivation to act healthily. Empirical evidence strengthens the notion that this variable worked differently than questions about behavioral intentions: It was the only variable *not* directly associated with health attitude (Table 6).

Adding to the impression that information-related questions might be of only limited use as proxies of behavioral spillover

is the finding that all participants – irrespective of attitude strength – were less interested in receiving tips about pro-environmental behavior after recalling an environmentally unfriendly (vs. neutral) behavior. Moreover, the predictive power of environmental attitude with respect to interest in pro-environmental tips was also considerably smaller than when other dependent variables were used. The diminished influence of attitude strength suggests that additional processes might be in play when participants make decisions about receiving information.

Also contrary to the prediction that recalling an environmentally unfriendly past behavior would increase pro-environmental tendencies among those with a strong attitude and leave those with a weak attitude unaffected, this condition had no discernible effect among those with a strong attitude, but decreased the support for one pro-environmental petition among participants with a weak attitude. One possible explanation for this pattern is that recalling a past environmentally harmful behavior may have increased the salience of participants' existing attitude, which then could have led to behavioral patterns consistent with their respective attitude strength. We will discuss these issues in more detail in the next section.

GENERAL DISCUSSION

This research examined whether attitude strength can explain whether the likelihood of engaging in additional behaviors in the domains of environmental protection and health promotion increases (positive spillover) or decreases (negative spillover) after recalling a goal-conducive behavior in the same domain. We argued that when people who have a strong attitude toward an issue carry out a behavior that benefits the issue, such a behavior is an integral part of a wider network of behaviors that serve a more comprehensive, superordinate goal (Carver and Scheier, 2001). We further argued that this mental structure implies that when people with strong attitudes carry out a goal-conducive behavior, it will increase the salience of related behaviors and the importance of continuing to work toward their attitude (or their superordinate goal), not least because failing to do so would elicit cognitive dissonance and negative feelings (Festinger, 1957; Bargh et al., 1992; Ratneshwar et al., 2001; Thøgersen and Crompton, 2009; Thøgersen and Noblet, 2012; Lanzini and Thøgersen, 2014). In short, we predicted that a strong attitude would promote positive spillover and mitigate the risk of negative spillover after an initial goal-conducive behavior (and vice versa: it would promote negative spillover after an initial goal-inconsistent behavior).

Across two studies, we found limited empirical support for the predicted moderating role of attitude strength. In Study 1, attitude strength moderated the effect of a first behavior in two instances: participants with a weak attitude (25th percentile) less strongly intended to act environmentally friendly after recalling an environmentally friendly versus unfriendly action, while participants with a strong attitude (75th percentile) were similarly motivated regardless of the valence of the recalled action. This

pattern is consistent with the prediction that a strong attitude toward an issue should promote positive spillover and mitigate the risk of negative spillover after an initial goal-conducive behavior, while those with a weak attitude should feel that they had done enough and not engage in further behaviors in the same behavioral context. A similar pattern was found in Study 2: Recalling an environmentally unfriendly past behavior again had no discernible effect among those with a strong environmental attitude but decreased support for a pro-environmental petition among participants with a weak attitude.

Taken together, these results suggest that a strong attitude can work as a “behavioral stabilizer” that protects against self-complacency and goal disengagement – it keeps people on track. By contrast, a weak attitude can fuel two tendencies that threaten pro-environmental and healthy behavior: First, it can, as suggested by Study 1, make people susceptible to the kind of behavioral fluctuations that are described in the literature as “moral licensing” (Merritt et al., 2010) or the tendency to “rest on one's laurels” (Amir and Ariely, 2008). Second, a weak attitude can, as suggested by Study 2, increase the susceptibility to disengage entirely from environmental or health goals after an initial setback (i.e., the recall of a goal-inconsistent behavior), a tendency that has been referred to as the “what-the-hell effect” (Cochran and Tesser, 1996; see also Dolan and Galizzi, 2015).

A possible explanation for why participants with a weak environmental attitude acted in line with “moral licensing” (inconsistent behavior or negative spillover) in Study 1 but in line with the “what-the-hell effect” (consistently goal-inconsistent behavior or positive spillover) in Study 2 is that the two samples differed in terms of absolute attitude strength. To examine whether environmental attitude differed across studies, we pooled participants from both studies and recalibrated the Rasch scale (including all items from both studies), so that attitude scores were on the same metric and directly comparable. Participants in Study 1 were more environmentally friendly ($M = 0.06$, $SD = 0.77$) than participants in Study 2 [$M = -0.91$, $SD = 0.73$; $t(663.84) = 20.87$, $p < 0.001$]. Because we defined attitude strength *relative* to other participants in the respective samples, participants with a weak environmental attitude in Study 2 were less environmentally friendly in absolute terms than participants with a weak attitude in Study 1. In other words, participants with a weak attitude in Study 1 probably still cared at least somewhat about the environment and might therefore have displayed the kinds of self-regulation processes well known from research on moral licensing (e.g., Merritt et al., 2010; Jordan et al., 2011; Mullen and Monin, 2016). By contrast, participants with a weak attitude in Study 2 might have felt indifferent or even hostile toward the idea of environmental protection. Recalling an environmentally unfriendly behavior could therefore have highlighted the latter group's anti-environmental attitude and motivated them to engage in further attitude-consistent behaviors, accounting for the observed consistency in their behavior.

In addition to some interaction effects, this research also found compelling evidence for a direct effect of attitude: Across two studies and in both domains, a stronger attitude was associated

with an increased likelihood of engaging in corresponding goal-conducive behaviors. In short, in the context of behavioral spillover, attitude strength assumed two roles – that of a direct predictor and that of a moderator. The direct effect was much more consistent across different dependent variables and contexts than the moderator effect.

In sum, this research provides limited evidence for the idea that attitude strength (as one possible operationalization of relatively stable individual differences in how relevant an issue is to a person) can moderate the extent to which engaging in pro-environmental or healthy behaviors leads to positive or negative spillover.

This finding has implications for theory and practice. First, it provides limited empirical support for plausible but rarely tested assumptions about the role of attitude strength (and similar concepts tapping into personal relevance) in the context of spillover (for notable exceptions, see Effron et al., 2009; Meijers, 2014). As such, our findings improve the field's understanding for *whom* engaging in a goal-conducive behavior leads to positive or negative spillover.

The findings also contribute to a refined theoretical understanding of the conditions under which recalling past behavior affects subsequent behaviors. Based on Bem's (1972) self-perception theory, various spillover researchers have argued that reminding people of past goal-consistent behavior (e.g., pro-environmental actions) could lead to or make salient a corresponding identity and thereby increase the tendency to engage in positive spillover (Van der Werff et al., 2014b; Lacasse, 2015, 2016; Truelove et al., 2016). This line of reasoning points to a relatively malleable conceptualization of identity that is best understood as a *mediator* between recalled and subsequent behavior (Van der Werff et al., 2014a,b). Our findings complement this view by suggesting that when conceptualized and measured as traits, identity – and other similar conceptualizations of relatively stable individual differences such as attitude, superordinate goal, or values – can influence how thinking about past behaviors affects spillover. People who have a firm identity or who hold a very favorable or unfavorable attitude about an issue have few doubts about who they are and what they appreciate. It is therefore unlikely that reminders about what they did or failed to do in the past influence how they see themselves, nor should such reminders have much effect on subsequent behaviors. By contrast – and consistent with Bem's (1972) proposition that people use their behavior to infer information about themselves only “to the extent that internal cues are weak, ambiguous, or uninterpretable” (p. 2) – those with a less firm identity or attitude may find diagnostic value in reminders of past behavior, and adjust subsequent behavior accordingly.

The findings also have implications for practice. It can be assumed that reminding people of past pro-environmental or healthy behaviors (Van der Werff et al., 2014a,b) or labeling them as “environmentalists” or “health-conscious” (Cornelissen et al., 2007; Lacasse, 2016) is an effective strategy to increase positive spillover (after an initial goal-conducive behavior) among those with moderate attitude levels. However, using the same approach is bound to be less effective among those with a firm attitude

or identity. A better understanding of how different levels of attitude strength affect spillover can also help campaigners use their resources more efficiently. For instance, our findings suggest that people with a strong attitude are unlikely to display negative spillover. Thus, when trying to reduce negative spillover effects, campaign designers could economize by focusing their efforts on people with moderate and weak attitudes.

A limitation of the research is that attitude strength accounted for positive and negative spillover for only some of the dependent variables. This raises two major questions. First, why did attitude strength moderate the effect of recalling a goal-consistent versus a goal-inconsistent behavior for some but not for other variables? Previous research suggests that when the second behavior is either extremely difficult or extremely easy, it could attenuate or even override the generally positive relationship between attitude strength and the likelihood of engaging in further goal-conducive behaviors (Kaiser and Schultz, 2009; see also Truelove et al., 2014). If this explanation is valid, the anticipated moderating effect of attitude strength should be more likely for intentions that are neither extremely difficult nor easy. However, if the popularity of the dependent variables (see the arithmetic means in **Tables 1, 4**) is an indication of their difficulty (Kaiser et al., 2007), it can be seen that there is no systematic relationship between item difficulty and whether attitude strength moderated the effect of the recalled behavior. This suggests that the effect of attitude strength on spillover probably did not depend on the difficulty or costs of the behaviors.

On a more speculative note, the fact that the expected moderation was found for only some of the dependent variables could also have to do with the subjective meaning that participants attributed to the respective behaviors. For example, it is possible that participants may have perceived the behaviors as environmentally relevant to different extents (Truelove and Gillis, 2018), and that those with a strong attitude were most likely to engage in behaviors they perceived as impactful. To test this explanation, future research could assess the perceived environmental impact of different behaviors for each participant and examine whether this additional information can help to understand when attitude strength works as a moderator.

The second major question is why did we not find any of the predicted attitude moderations in the health domain. It is striking that much spillover research focuses directly or indirectly on morality, for example, by examining the extent to which engaging in morally relevant behaviors affects people's self-perceptions and subsequent behaviors (Merritt et al., 2010; Jordan et al., 2011; Mullen and Monin, 2016). A possible mechanism through which morality could affect spillover is by highlighting the violation of personal norms after goal-inconsistent behaviors. That is, the stronger people's moral norm regarding the relevant behavior, the more would behaving inconsistently induce cognitive dissonance and threaten their self-perception as a moral person. Thus, people with strong moral norms are likely to behave consistently with their norms and goals and thereby avoid these negative cognitions (Thøgersen, 2004).

This raises the question to what extent moral processes are relevant for the two domains examined here. There is evidence that people understand behaviors that affect the environment to be morally relevant (Stern, 2000; Feinberg and Willer, 2013; Van der Werff et al., 2013; Jia et al., 2017), but the extent to which the same applies to caring for one's own health is less clear. Whereas environmentally harmful actions can negatively affect both the natural environment and other people, eating unhealthily or failing to exercise do not have immediately obvious negative consequences for others, and therefore lack a critical quality of prototypical moral violations (Rottman et al., 2015). It therefore seems plausible that people perceive environmental behavior as more morally charged than health behavior (the comparisons of self-assessed morality of the recalled behaviors support this line of reasoning, see **Supplementary Tables 3, 4**). In short, to the extent that moral processes play a key role in behavioral spillover, it is possible that such effects – and the corresponding moderation by attitude strength – are more likely to occur in the context of environmental behavior. Future research could test this possibility by comparing the extent to which moral processes are triggered when people engage in environmental versus health behaviors.

One last critical point is that we used several dependent variables, which increased the probability to detect (interaction) effects that do not in fact exist (false positives). This research is exploratory in the sense that it is one of the first to investigate the role of attitude as a moderator of spillover effects and does therefore not necessarily require statistical procedures to correct for false positives (Rothman, 1990; Rubin, 2017). However, to be able to assess the extent to which the rate of false positives might challenge our findings, we used the false discovery rate method (FDR; Benjamini and Hochberg, 1995) to adjust the *p*-values of the interaction terms (i.e., the focal interest of this paper).⁵ Applying the FDR method shifted the two relevant interactions of Study 1 just beyond the 5% significance level (*ps* = 0.056); the two relevant interactions of Study 2 were no longer statistically significant (*ps* ≥ 0.18). Thus, while the FDR adjustments do not completely challenge our findings, they further qualify the already limited moderating effect of attitude strength.

CONCLUSION

Overall, the two studies showed that the importance of an issue to a person – in our study operationalized as behavior-based attitude (Kaiser et al., 2007, 2010) – had a direct and positive effect on decisions and behaviors. Additionally, we found limited evidence for the prediction that a strong (favorable) attitude increases the consistency of goal-conducive behavior, whereas a weak attitude was associated with less predictable behavioral patterns. This lends some support to the theoretical considerations derived from goal-theoretical perspectives and

⁵Note that limiting the FDR adjustment to the interaction terms results in their *p*-values being larger as compared to when the *ps* of all predictors are corrected.

self-perception theory (for more details, see Höchli et al., 2018). The findings are relevant for theory because they point to a possible boundary condition of positive and negative spillover. Practically they matter because they enable those seeking to effect change to more accurately anticipate the effects of campaigns and interventions on different groups of people, which should help to allocate resources more efficiently and render campaigns more effective.

ETHICS STATEMENT

At the time these studies were conducted (spring 2013 and summer 2018), our faculty had no Internal Review Board to grant ethical approval. However, we certify that the research adhered to the ethical principles of the American Psychological Association [APA] (2010). Informed consent was attained by asking participants to continue only if they were willing to participate and if they had read and understood the instructions and information provided. Participants were told that participation was voluntary and that they had the right to withdraw from the study at any time. Upon completion of the study, participants were fully debriefed. The data were anonymized and treated confidentially.

AUTHOR CONTRIBUTIONS

AB conceived and designed Study 1, analyzed the data, and wrote the first draft of the manuscript. BH and AB conceived, designed, and analyzed the data from Study 2. BH contributed to the editing process of the first draft and added additional content. Both authors contributed to manuscript revision, and read and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01018/full#supplementary-material>

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary Material Paper 4

The Role of Attitude Strength in Behavioral Spillover: Attitude Matters—But Not Necessarily as a Moderator

Supplementary Table 1.

Behavior-based environmental attitude items.

| Item | English | German | Format | Study 1 | Study 2 | Ref. |
|------|---|---|--------|---------|---------|------|
| 1 | After a picnic, I leave the place as clean as it was originally | Ich verlasse nach einem Picknick den Platz genauso, wie ich ihn angetroffen habe | D | x | x | 1 |
| 2 | <i>At red traffic lights, I keep the engine running</i> | <i>Vor roten Ampeln lasse ich den Motor laufen</i> | F | x | x | 1 |
| 3 | <i>For longer journeys (more than 6 h), I take an airplane</i> | <i>Für längere Reisen (6 Stunden und länger) nehme ich das Flugzeug</i> | F | x | x | 1 |
| 4 | <i>I drive my car in or into the city</i> | <i>Ich fahre mit dem Auto in die Stadt bzw. ich fahre in der Stadt Auto</i> | F | x | x | 1 |
| 5 | I am a member of a car pool | Ich bin in einem CarSharing-Pool | D | x | x | 1 |
| 6 | I am a member of an environmental organization | Ich bin Mitglied in einer Umweltschutzorganisation | D | x | x | 1 |
| 7 | I boycott companies with an unecological background | Ich boykottiere Produkte von Firmen, die sich nachweislich umweltschädigend verhalten | F | x | x | 1 |
| 8 | I bring empty bottles to a recycling bin | Altglas bringe ich zum Sammelcontainer | F | x | x | 1 |
| 9 | <i>I buy beverages in cans</i> | <i>Ich kaufe Getränke in Dosen</i> | F | x | x | 1 |
| 10 | <i>I buy bleached and colored toilet paper</i> | <i>Ich kaufe gebleichtes und gefärbtes Toilettenpapier</i> | F | x | x | 1 |
| 11 | <i>I buy convenience foods</i> | <i>Ich kaufe Fertiggerichte</i> | F | x | x | 1 |
| 12 | I buy domestically grown wooden furniture | Ich kaufe Möbel aus einheimischen Hölzern | F | x | x | 1 |
| 13 | I buy meat and produce with eco-labels | Ich kaufe Lebensmittel aus kontrolliert biologischem Anbau | F | x | x | 1 |
| 14 | I buy products in refillable packages | Ich kaufe Artikel in Nachfüllpackungen | F | x | x | 1 |
| 15 | I buy seasonal produce | Ich kaufe Obst und Gemüse der Jahreszeit entsprechend | F | x | x | 1 |
| 16 | I collect and recycle used paper | Ich sammle altes Papier und gebe es zum Recycling | F | x | x | 1 |
| 17 | I contribute financially to environmental organizations | Ich spende Geld für Umweltschutzorganisationen | F | x | x | 1 |
| 18 | I drive in such a way as to keep my fuel consumption as low as possible | Durch mein Fahrverhalten versuche ich, den Kraftstoffverbrauch so niedrig wie möglich zu halten | D | x | x | 1 |
| 19 | I drive on freeways at speeds under 100 kph (= 62.5 mph) | Ich fahre auf der Autobahn höchstens 100 km/h | F | x | x | 1 |
| 20 | <i>I drive to where I want to start my hikes</i> | <i>Zum Spazierengehen fahre ich mit dem Auto an den Ausgangspunkt des Spazierganges</i> | F | x | x | 1 |
| 21 | I have looked into the pros and cons having a private source of solar power | Ich habe mich über Vor- und Nachteile einer Solaranlage informiert | D | x | x | 1 |
| 22 | I have pointed out unecological behavior to someone | Ich mache jemanden, der / die sich umweltschädigend | F | x | x | 1 |

| | | | | | | |
|----|---|--|---|---|---|---|
| 23 | <i>I keep the engine running while waiting in front of a railroad crossing or in a traffic jam</i> | verhält, darauf aufmerksam <i>Vor geschlossenen Bahnschranken lasse ich den Motor laufen</i> | F | x | x | 1 |
| 24 | <i>I kill insects with a chemical insecticide</i> | <i>Insekten bekämpfe ich mit chemischen Mitteln</i> | F | x | x | 1 |
| 25 | I own a fuel-efficient automobile (less than 7 l per 100 km; i.e., less than 3 gallons per 100 miles) | Ich besitze ein verbrauchsreduziertes Auto (weniger als 7 Liter Treibstoff pro 100 km) | D | x | x | 1 |
| 26 | <i>I put dead batteries in the garbage</i> | <i>Leere Batterien werfe ich in den Hausmüll</i> | D | x | x | 1 |
| 27 | I refrain from owning a car | Ich verzichte auf ein Auto | D | x | x | 1 |
| 28 | I reuse my shopping bags | Ich verwende Einkaufstüten oder -taschen mehrfach | D | x | x | 1 |
| 29 | I ride a bicycle or take public transportation to work or school | Für den Arbeits- bzw. Schulweg benutze ich das Fahrrad, öffentliche Verkehrsmittel oder gehe zu Fuss | F | x | x | 1 |
| 30 | <i>I use a chemical air freshener in my bathroom</i> | <i>In der Toilette benutze ich chemische Duftsteine für den guten Geruch</i> | D | x | x | 1 |
| 31 | <i>I use a clothes dryer</i> | <i>Ich benutze einen Wäschetrockner</i> | F | x | x | 1 |
| 32 | <i>I use fabric softener with my laundry</i> | <i>Ich benutze beim Waschen einen Weichspüler</i> | D | x | x | 1 |
| 33 | I wait until I have a full load before doing my laundry | Ich warte, bis ich eine volle Wäschetrommel habe, bevor ich wasche | F | x | x | 1 |
| 34 | I wash dirty clothes without prewashing | Beim Waschen verzichte ich auf den Vorwaschgang | F | x | x | 1 |
| 35 | <i>If I am offered a plastic bag in a store, I take it</i> | <i>Wenn ich in einem Geschäft eine Plastiktüte bekomme, nehme ich sie</i> | F | x | x | 1 |
| 36 | <i>In hotels, I have the towels changed daily</i> | <i>Im Hotel lasse ich täglich die Handtücher wechseln</i> | D | x | x | 1 |
| 37 | <i>In the winter, I keep the heat on so that I do not have to wear a sweater</i> | <i>In meiner Wohnung ist es im Winter so warm, dass man ohne Pullover nicht friert</i> | D | x | x | 1 |
| 38 | <i>In the winter, I leave the windows open for long periods of time to let in fresh air</i> | <i>Um zu lüften, lasse ich auch im Winter das Fenster längere Zeit offen</i> | F | x | x | 1 |
| 39 | In winter, I turn down the heat when I leave my apartment for more than 4 hours | Im Winter drehe ich meine Heizung herunter, wenn ich meine Wohnung für mehr als 4 Stunden verlasse | F | x | x | 1 |
| 40 | <i>After meals, I dispose of leftovers in the toilet</i> | <i>Breiiige Essensreste leere ich in die Toilette</i> | D | x | - | 1 |
| 41 | I bought solar panels to produce energy | Ich habe eine Solaranlage zur Energieerzeugung angeschafft | D | x | - | 1 |
| 42 | I buy milk in returnable bottles | Ich kaufe die Milch in der Mehrwegflasche | F | x | - | 1 |
| 43 | I own energy-efficient household devices | Ich benutze verbrauchsarme Haushaltsgeräte | D | x | - | 1 |
| 44 | I prefer to shower rather than to take a bath | Ich bevorzuge es, zu duschen statt zu baden | F | x | - | 1 |
| 45 | I get books and other materials that are concerned with environmental problems | Ich besorge mir Bücher, Informationsschriften oder andere Materialien, die sich mit Umweltproblemen befassen | F | x | - | 1 |
| 46 | I requested an estimate on having solar power installed | Ich habe Angebote zur Anschaffung einer Solaranlage eingeholt | D | x | - | 1 |
| 47 | I talk with friends about problems related to the environment | Ich unterhalte mich mit Bekannten über Probleme der Umweltverschmutzung | F | x | - | 1 |

Supplementary Material

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|----|--|---|---|---|---|---|
| 48 | <i>I use an oven cleaning spray to clean my oven</i> | <i>Zum Reinigen des Backofens verwende ich ein Spray</i> | F | x | - | 1 |
| 49 | I use renewable energy sources | Ich nutze erneuerbare Energiequellen zur Stromerzeugung | D | x | - | 1 |
| 50 | In nearby areas (around 30 km; around 20 miles), I use public transportation or ride a bike | Für Fahrten in die umliegende Gegend (bis 30 km) benütze ich öffentliche Nahverkehrsmittel oder das Fahrrad | F | x | - | 1 |
| 51 | I read about environmental issues | Ich lese Artikel zu Umweltfragen | F | - | x | 1 |
| 52 | I am a vegetarian | Ich bin Vegetarier/in | D | - | x | 2 |
| 53 | I have a contract for renewable energy with my energy provider | Ich habe einen Vertrag für erneuerbare Energien mit meinem Stromanbieter | D | - | x | 2 |
| 54 | I own an energy efficient dishwasher (efficiency class A+ or better) | Ich besitze eine energieeffiziente Geschirrspülmaschine (Effizienzklasse A+ oder besser) | D | - | x | 2 |
| 55 | I own solar panels | Ich besitze eine Solaranlage | D | - | x | 2 |
| 56 | I shower (rather than taking a bath) | Ich dusche (statt zu baden) | F | - | x | 2 |
| 57 | I buy beverages and other liquids in returnable bottles | Ich kaufe Getränke und andere Flüssigkeiten in Mehrwegflaschen | F | - | x | 2 |
| 58 | I talk with friends about environmental pollution, climate change, and/or energy consumption | Ich spreche mit Freunden über Umweltverschmutzung, Klimawandel und/oder Energieverbrauch | F | - | x | 2 |

Note. Items in italics = negatively formulated behaviors recoded prior to analysis

D = items presented in dichotomous (yes/no) format

F = items presented in 5-point frequency format and then dichotomized (see text)

x = items used in respective study

1 = Kaiser and Wilson (2004); 2 = new items made available by Florian G. Kaiser.

Supplementary Table 2.
Behavior-based health attitude items.

| Item | English | German | Format | Study 1 | Study 2 | Ref. |
|------|---|--|--------|---------|---------|------|
| 1 | At least 15 minutes a day, I take time to go for a walk | Ich gehe mindestens 15 Minuten täglich spazieren | D | x | x | 1 |
| 2 | At least twice a day, I brush my teeth | Ich putze mir mindestens zweimal täglich die Zähne | D | x | x | 1 |
| 3 | At least twice a week, I floss my teeth | Ich benutze mindestens zweimal wöchentlich Zahnseide | D | x | x | 1 |
| 4 | At least twice a year, I have my teeth checked | Ich gehe mindestens zwei Mal im Jahr zur Zahnvorsorgeuntersuchung | D | x | x | 1 |
| 5 | <i>I allow pets in the kitchen</i> | <i>Ich dulde Haustiere in meiner Küche</i> | D | x | x | 1 |
| 6 | I am a member of a sport facility or club | Ich bin Mitglied in einem Sportverein/ Fitnessstudio | D | x | x | 1 |
| 7 | I avoid eating salty foods or adding salt to my food | Ich vermeide salzige Speisen | D | x | x | 1 |
| 8 | I avoid fast food | Ich vermeide Fastfood | D/F | x | x | 1 |
| 9 | I avoid sweets | Ich vermeide Süssigkeiten | D | x | x | 1 |
| 10 | I check the consumption / best-before dates of food product | Ich überprüfe das Haltbarkeitsdatum von Nahrungsmitteln | F | x | x | 1 |
| 11 | I clean cans before opening them | Ich reinige Konservendosen bevor ich sie öffne | F | x | x | 1 |
| 12 | I count calories | Ich zähle Kalorien | D | x | x | 1 |
| 13 | <i>I cross streets on a red light</i> | <i>Ich überquere bei Rot die Strasse</i> | F | x | x | 1 |
| 14 | <i>I drink more than a glass of wine or a beer a day</i> | <i>Ich trinke täglich mehr als ein Glas Wein oder ein kleines Bier</i> | D | x | x | 1 |
| 15 | <i>I eat after 21.00 hrs. / 9 pm</i> | <i>Ich esse nach 21 Uhr</i> | F | x | x | 1 |
| 16 | I eat fruits or vegetables daily | Ich esse täglich Obst und Gemüse | D | x | x | 1 |
| 17 | I exercise at least 15 minutes per day | Ich treibe mindestens 15 Minuten täglich Sport | D | x | x | 1 |
| 18 | <i>I get drunk</i> | <i>Ich betrinke mich</i> | F | x | x | 1 |
| 19 | I go for one-day hikes | Ich mache Tageswanderungen | F | x | x | 1 |
| 20 | I go to bed before 22.00 hrs. / 10 pm | Ich gehe vor 22 Uhr ins Bett | F | x | x | 1 |
| 21 | I have a hobby | Ich habe ein Hobby | D | x | x | 1 |
| 22 | I have purchased sports gear | Ich besitze Sportgeräte/ -kleidung/ -ausrüstung | D | x | x | 1 |
| 23 | I meditate or practice yoga | Ich praktiziere Entspannungstechniken (Yoga, Meditation, o.ä.) | F | x | x | 1 |
| 24 | I practice sports regularly (swimming, football, etc.) | Ich trainiere regelmässig (Fussball, Schwimmen, o.ä.) | D | x | x | 1 |
| 25 | I regularly examine myself for cancer | Ich untersuche mich selbst regelmässig auf Anzeichen von Krebs | D | x | x | 1 |
| 26 | I sleep at least 7 hours per night | Ich schlafe mindestens 7 Stunden pro Nacht | F/D | x | x | 1 |
| 27 | <i>I smoke</i> | <i>Ich rauche</i> | D/F | x | x | 1 |
| 28 | I spend time in nature | Ich verbringe Zeit an der frischen Luft | F | x | x | 1 |
| 29 | I spend time with other people to socialize | Ich verbringe Zeit damit, meine sozialen Kontakte zu pflegen | F | x | x | 1 |

| | | | | | | |
|----|--|---|----------|----------|----------|----------|
| 30 | I take my breaks at work | Ich mache während der Arbeit ausreichend Pausen | F | x | x | 1 |
| 31 | I take time to relax | Ich nehme mir Zeit, mich zu entspannen | F | x | x | 1 |
| 32 | I use sunscreen | Ich benutze Sonnencreme | D | x | x | 1 |
| 33 | I wash dishes right after a meal or at least on the same day | Ich spüle mein benutztes Geschirr noch am gleichen Tag | F | x | x | 1 |
| 34 | I wash fruits and vegetables | Ich esse nur gewaschenes Obst und Gemüse | D/F | x | x | 1 |
| 35 | I wash meat before preparing it | Ich wasche Fleisch vor der Zubereitung | F | x | x | 1 |
| 36 | <i>I work overtime</i> | <i>Ich leiste Überstunden</i> | <i>F</i> | <i>x</i> | <i>x</i> | <i>1</i> |
| 37 | <i>I would rather take the elevator than the stairs</i> | <i>Ich benutze eher den Aufzug als die Treppe</i> | <i>F</i> | <i>x</i> | <i>x</i> | <i>1</i> |
| 38 | In cars, I wear seatbelts | Ich schnalle mich im Auto an | F | x | x | 1 |
| 39 | <i>In the evening or during weekends, I work at home</i> | <i>Ich arbeite zusätzlich abends oder am Wochenende zuhause</i> | <i>F</i> | <i>x</i> | <i>x</i> | <i>1</i> |
| 40 | My meals last at least 10 minutes | Ich nehme mir zum Essen mindestens 10 Minuten Zeit | D | x | x | 1 |
| 41 | When it is cold, I wear warm clothes | Wenn es kalt ist, ziehe ich mich warm an | F | x | x | 1 |
| 42 | With food, I read the description of content | Ich lese Nährwerttabellen von Lebensmitteln | F | x | x | 1 |
| 43 | With new medication, I read the package insert | Ich lese Nährwerttabellen von Lebensmitteln | F | x | x | 1 |
| 44 | I keep an exercise diary | Ich führe ein Trainingstagebuch | D | x | - | 1 |
| 45 | I possess a fitness video | Ich besitze ein Fitnessvideo/ DVD mit Fitnessübungen | D | x | - | 1 |
| 46 | To let in fresh air, I open windows for a long period of time | Ich lüfte meine Wohnung ausgiebig | F | x | - | 1 |
| 47 | I wash my hands before I cook or eat | Ich wasche meine Hände vor dem Kochen oder Essen | F | x | - | 2 |
| 48 | I use wellness offers (e.g. sauna, massage) | Ich nutze Wellnessangebote (zB Sauna, Massage) | F | x | - | 2 |
| 49 | I protect myself from sexually transmitted diseases (e.g. through condoms) | Ich schütze mich vor sexuell übertragbaren Krankheiten (zB durch Kondome) | F | x | - | 2 |
| 50 | I wear a helmet when cycling | Ich trage beim Fahrradfahren einen Helm | F | x | - | 2 |
| 51 | I drink at least 2 litres per day | Ich trinke mindestens 2 Liter pro Tag | D | - | x | 2 |
| 52 | After using a restroom, I wash my hands | Ich wasche mir nach dem Toilettengang die Hände | F | - | x | 1 |
| 53 | I wake up at the same time every day | Ich stehe jeden Tag zur gleichen Zeit auf | D | - | x | 3 |
| 54 | I clean my smartphone to destroy bacteria | Ich reinige mein Smartphone, um Bakterien abzutöten | F | - | x | 3 |
| 55 | I have fitness wearables | Ich besitze Fitness-Wearables | D | - | x | 3 |
| 56 | <i>I leave the dirty dishes until the next morning</i> | <i>Ich lasse schmutziges Geschirr bis zum nächsten Morgen zurück</i> | <i>F</i> | <i>-</i> | <i>x</i> | <i>3</i> |
| 57 | I regularly disinfect my keyboard | Ich desinfiziere meine Tastatur regelmäßig | D | - | x | 3 |
| 58 | <i>I regularly eat in front of a computer</i> | <i>Ich esse regelmäßig vor einem Computer</i> | <i>D</i> | <i>-</i> | <i>x</i> | <i>3</i> |
| 59 | I regularly stand up while working at a desk | Ich stehe regelmäßig auf, während ich an einem Schreibtisch arbeite | F | - | x | 3 |
| 60 | <i>I text while driving</i> | <i>Ich schreibe während dem Autofahren SMS</i> | <i>F</i> | <i>-</i> | <i>x</i> | <i>3</i> |
| 61 | I use an app to keep track of my exercise | Ich benutze eine App, um den Überblick über mein Training zu behalten | D | - | x | 3 |

Note. Items in italics = negatively formulated behaviors recoded prior to the analysis

D = items presented in dichotomous (yes/no) format

F = items presented in a 5-point frequency format and then dichotomized. The presence of both D and F codes indicates that different response formats were used in Study 1 and Study 2.

x = item used in respective study; 1 = Byrka and Kaiser (2013), 2 = Kibbe (2011), 3 = newly developed items.

Supplementary Table 3.
Fixed-effects ANOVA results using self-assessed morality as the criterion, Study 2.

| Predictor | Sum Of Squares | <i>df</i> | Mean Square | F | p | partial η^2 | 90% CI [LL, UL[|
|------------------|----------------------|-----------|----------------|--------|------|------------------|--------------------|
| (Intercept) | 287.83 | 1 | 287.83 | 217.73 | .000 | | |
| Recall condition | 793.27 | 4 | 198.32 | 150.02 | .000 | .39 | [.35, .43] |
| Error | 1220.16 | 923 | 1.32 | | | | |

Supplementary Table 4.

Tukey HSD comparisons of self-assessed morality between the experimental recall conditions, Study 2.

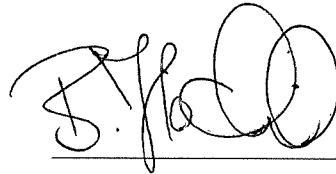
| Group | Mean | SD | Env pos | Env neg | Health pos | Health neg |
|----------------------|-------|------|---------|---------|------------|------------|
| Environment Positive | 1.85 | 1.17 | | | | |
| Environment Negative | -0.71 | 0.96 | <.001 | | | |
| Health Positive | 0.98 | 1.35 | <.001 | <.001 | | |
| Health Negative | -0.09 | 0.83 | <.001 | <.001 | <.001 | |
| Control | 1.24 | 1.34 | <.001 | <.001 | .20 | <.001 |

Selbständigkeitserklärung

Ich erkläre hiermit, dass ich diese Arbeit selbständig verfasst und keine anderen als die angegebenen Quellen benutzt habe. Alle Koautorenschaften sowie alle Stellen, die wörtlich oder sinngemäss aus Quellen entnommen wurden, habe ich als solche gekennzeichnet. Mir ist bekannt, dass andernfalls der Senat gemäss Artikel 36 Absatz 1 Buchstabe o des Gesetzes vom 5. September 1996 über die Universität zum Entzug des aufgrund dieser Arbeit verliehenen Titels berechtigt ist.

Bern, 15.08.2019

Ort, Datum



Bettina Höchli