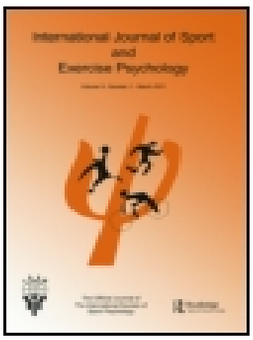

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Exploring the influence of goals at different levels of abstraction on self-reported and electronically measured exercise frequency: an experimental field study

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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, we 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. We used a 2×2 between-subjects design 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. 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.

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Goal pursuit; goal hierarchy; long-term physical activity; intervention

Many people struggle with initiating and maintaining sufficient physical activity (PA) (Lewis et al., 2017). In 2016, more than a quarter of all adults worldwide were not sufficiently physically active. As a result, more than 1.4 billion adults are at risk of developing or worsening illnesses related to physical inactivity (Guthold et al., 2018). Interventions that promote PA and health behaviour in general are seen as promising for the

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prevention of non-communicable diseases (McEwan et al., 2016; World Health Organisation, 2017). Among interventions and behavioural change techniques to foster PA, goal setting is one of the most widely applied and universally accepted strategies (Glanz & Bishop, 2010; Howlett et al., 2019; Michie et al., 2013; Swann et al., 2019).

Goals are mental representations of desired outcomes to which people are committed (Fishbach & Ferguson, 2007; Fujita & MacGregor, 2012). Goals are powerful in changing a behaviour, 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 goal state (Carver & Scheier, 2001; McEwan et al., 2016).

Research on goal setting has emphasised that goals are particularly useful when formulated in a concrete manner. Across hundreds of studies, it has been shown that challenging, 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 min of medium intensity PA per week (World Health Organisation, 2017) or 10,000 steps per day (Guertler et al., 2015).

The problem: detrimental effects of subordinate goals

Although goal-setting interventions with subordinate goals are effective for behavioural 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 et al., 2019; McEwan et al., 2016; Ordóñez et al., 2009; Swann et al., 2019). In such cases, it is not only a matter of initiating a single, time-limited goal and thus to change a single moment in time; it is also a matter of maintaining behaviour over the longer term, sustaining motivation after a first successful step, and resisting the temptations afforded by conflicting, competing goals (Kenthirarajah & Walton, 2015; Rothman et al., 2004).

In such cases, 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 behaviour 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. Because it is unpleasant, the tension motivates responses to 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 behaviour after achieving a first subordinate goal (e.g., losing 10 pounds) runs against a person's long-term best interests. Interventions that focus on a single subordinate goal run the risk that people will stop pursuing the behaviour after the end of the intervention, and thus fail to achieve long-lasting effects (Geller et al., 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

We propose that attending to superordinate *as well as* subordinate goals would motivate people to work towards 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 idealised conceptualisations, 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 et al., 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 (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 end-point is detrimental to the initiation of behaviour (Locke & Latham, 2002), we argue that it is precisely this open end-point that can be conducive to long-term goal pursuit. Thus, we hypothesise that focusing on a superordinate goal is likely to foster goal pursuit in the long run. Although the formulation of the superordinate goal itself does not take much time, we expect it not only to change a short specific situation but to unfold over time.

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 behaviour (Heckhausen & Gollwitzer, 1987) and when facing unfamiliar, complex situations (Carver & Scheier, 2001; 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 behaviour and also in maintaining it over time (Gollwitzer & Sheeran, 2006; Holland et al., 2006). Of course, implementation intentions and action steps need to be aligned with a goal the person is committed to (Adriaanse et al., 2010). We 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 behaviour initiation vs. behaviour maintenance (Höchli et al., 2018; Mann et al., 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 et al., 2006) and field (Höchli et al., 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 behaviour 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 et al., 2014; Prince et al., 2008).

The present study

The present study tests whether focusing on goals at different levels of abstraction affects exercise frequency in the short term (during a three-week intervention period) and in the long term (during a six-month follow-up period). All participants committed to the subordinate goal of exercising in the gym three times per week for three weeks. After making this commitment, the participants either formulated no additional goal, additionally formulated action steps, additionally formulated a superordinate goal or additionally formulated both action steps and a superordinate goal. Our primary hypothesis was that combining goals at different levels of abstraction, i.e., formulating additionally both action steps and a superordinate goal, will motivate goal pursuit both in the short and the long term. In the short term, an additional focus on action steps has a positive effect on exercise frequency, as action steps translate abstract intentions into simple, executable actions, and this effect will particularly come to light when aligned with a superordinate goal the person is committed to. In the long term, a focus on a superordinate goal will have a positive effect on exercise frequency. While the subordinate goal includes a time span of three weeks, the superordinate goal extends over a longer period of time without an exact end-point. For this reason, we expect that the formulation of a superordinate goal, even if the intervention itself is carried out in a short period of time, will have an effect on exercise frequency beyond the intervention period. This effect will particularly come to light when combined with action steps that help to implement the required actions in everyday life.

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 wanted to increase their training. As incentives, at the end of the three-week intervention period, 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 et al., 2007). A total of 201 participants signed up for the study; two participants did not complete the start questionnaire

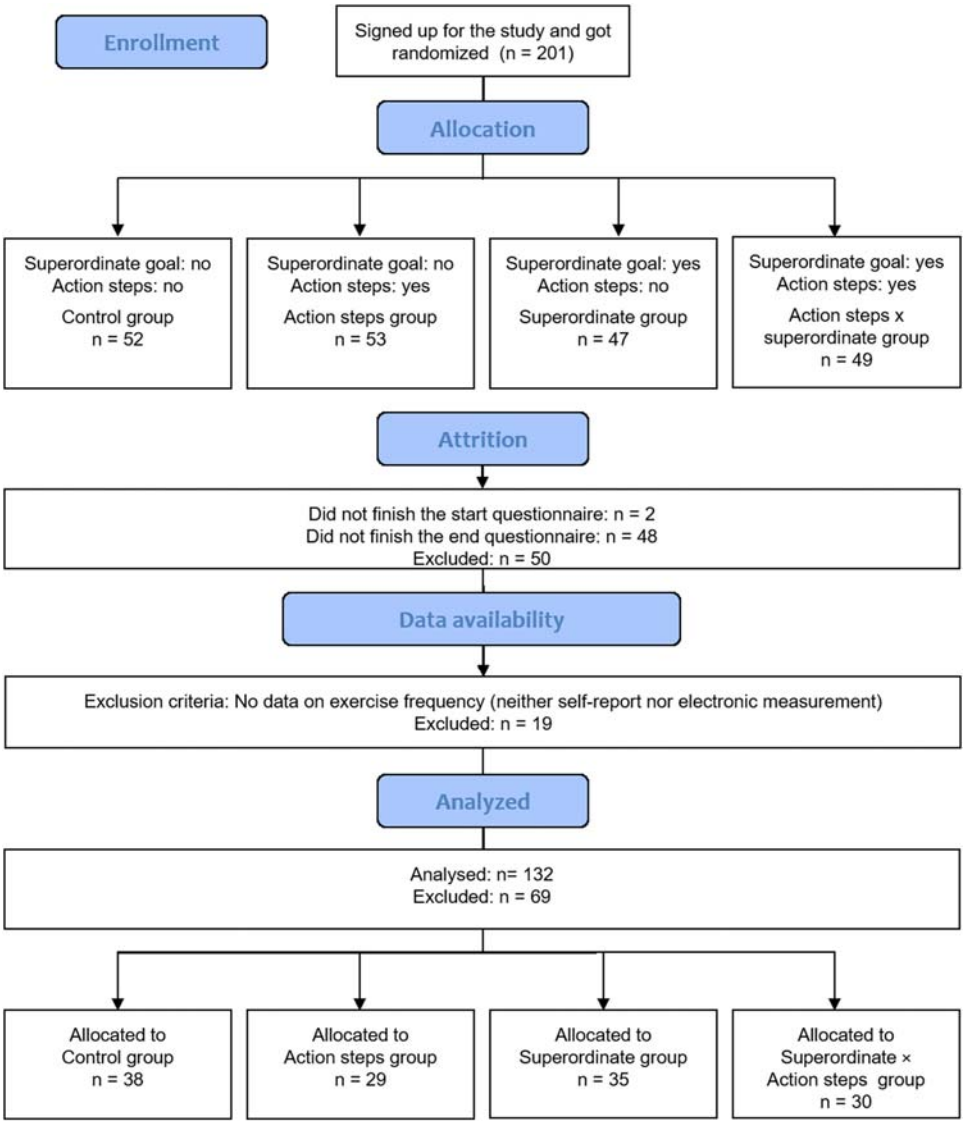

Figure 1. Flow diagram.

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 they 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-up period or that their gym subscription did not require an electronic login. The final sample consisted of 132 participants (100 women, 32 men, $M_{age} = 36.27$ years, $SD_{age} = 13.26$ years; see Figure 1). All 132

participants performed the assigned manipulation task as intended. For the drop-out analysis and the manipulation check, see supplementary material.

Design

Participants were randomly assigned to one of four conditions using a 2 (superordinate goal: no/yes) × 2 (action steps: no/yes) between-subjects design. All participants committed to the subordinate goal of exercising in the gym three times a week for three weeks. In the first condition, the control group, participants focused solely on this goal, whereas in the three intervention conditions, participants were asked to think additionally on goals at different levels of abstraction. The superordinate group was asked to think about *why* they want exercise more, and on this basis to formulate a superordinate goal (just how this was accomplished is explained in greater detail in the following paragraphs). The action steps group was asked to think about *how* to pursue the exercise goal, and on this basis to formulate action steps. The superordinate group × action steps 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.

Goal intervention

As explained above, the control group ($n = 38$) focused solely on the goal of exercising three times a week for three weeks. The other three groups, however, were given an additional assignment. The superordinate group ($n = 35$) was additionally asked to consider why they would like to exercise more and to write down the answer. They were given the following instructions: *The aim of the study is to help you exercise more often. In order to pursue a goal successfully, it is important to consider WHY you want to achieve it. We do a lot of things in our everyday life for certain reasons. Often behind these reasons are important life goals and visions that we pursue over a long period of time and in many areas of our everyday life. Why do you want to exercise more often? Reasons could be, for example, that you want to feel more vital, lose weight or live longer. For the successful implementation of a goal it is very important to understand the superordinate goals behind it. Please consider why you would like to exercise more often.* Participants were asked to complete a diagram with three boxes (see supplementary material, Supplementary Figure 1). The first box was labelled "exercise more often". They were asked to consider why they would like to exercise more and to write down the answer in the second box. Next, they were asked why their answer was important to them, and to write it down in the third box. 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).

The action steps group ($n = 29$) was asked, in addition to the exercise goal, to consider how they could integrate the three weekly exercise sessions in their everyday life. They were given the following instructions: *For the successful pursuit of a goal, it is very helpful to think carefully about how the three exercise sessions per week can be integrated into your everyday life. This will make it easier for you to actually exercise three times a*

week. For example, you can plan your exercise for a specific time (Wednesday at 5 pm) or for a specific situation (When I'm done with the meeting, I go straight to the gym). Participants were asked to complete a diagram with three circles (see supplementary material, Supplementary Figure 2) by considering how they can incorporate the three weekly exercise sessions into their daily routines. They were asked to write down three specific situations or "time windows" in which they planned to exercise.

The superordinate × action steps group ($n = 30$) was asked to formulate both a superordinate goal and action steps in the same way as the superordinate and action steps groups (see supplementary material, Supplementary Figure 3).

After completing their diagrams, all participants received a sheet of paper with the exercise goal (exercising in the gym three times a week for three weeks) on which they additionally noted their superordinate goal and/or action steps, if any. This sheet also served as a manual exercise plan and a log on which the participants could record their exercise frequency by self-report during the three weeks of intervention.

Measures

Exercise frequency (electronic)

Frequency of training sessions was recorded electronically via a badge system. All gyms taking part in the study had an electronic badge system in which all members register electronically upon entry. Thus the gyms recorded how often each participant attended the gym. With the consent of the participants, these electronic data were made available to the authors for use in the present study. 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 by self-report. During the three-week intervention period, participants reported on a manual exercise plan (see above) the dates they exercised. These manual exercise plans were submitted to the authors after the three-week intervention period.

Goal achievement

Based on the exercise frequencies, it was determined (yes/no) whether a person achieved the exercise goal of training three times per week for three weeks. When a person exercised at least nine times during the three intervention weeks, goal achievement was recorded as 1; when a person exercised fewer than nine times, goal achievement was recorded as 0. Thus, goal achievement was determined both by means of (a) electronically measured and (b) self-reported exercise frequency.

Commitment

Participants rated their commitment to their exercise goal at the start of the study using Klein et al.'s (2001) five-item scale (Cronbach's $\alpha = 0.56$). Ratings were made on 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 the four experimental groups by virtue of the questionnaires' being distributed at random. The start questionnaire included a consent form (consent to participate in the study and to pursue the goal of exercising three times a week for three weeks), the goal intervention, and some demographic questions. Additionally, participants were given a printed exercise plan. They were asked to enter their goal(s) formulated during the goal intervention 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 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.

Statistical analysis

The results are analysed and presented in three parts. First, we report descriptive analyses and a randomisation check. Second, we report the effect of the intervention on exercise frequency and goal achievement during the three-week intervention period. The first dependent variable (exercise frequency) is count data – i.e., the number of times the participant exercised. Counts of this type are often modelled using a Poisson distribution due to unmet assumption necessary for parametric tests such as ANOVA, such as heteroskedasticity, skewness and discreteness (Bilder & Loughin, 2014). In order to account for under- or overdispersion, respectively, we opt for a quasi-Poisson regression (Bilder & Loughin, 2014; Hoef & Boveng, 2007; Mangiafico, 2016). Using the glm function of the R package "stats" (Team, 2013), we analysed the effect of the goal intervention (superordinate goal: yes/no; action steps: yes/no and their interaction) on electronically measured and self-reported exercise frequency, accounting for participant's exercise frequency at baseline. Furthermore, we analysed the effect of the goal intervention on whether a person achieved the subordinate goal of exercising three times a week during the intervention period. Since this second dependent variable (goal achievement: yes/no) is binomial, we opted for a binomial logistic regression (Bilder & Loughin, 2014; Mangiafico, 2016). Again using the glm function of the R package "stats" (Team, 2013), we analysed the effect of the goal intervention (superordinate goal: yes/no; action steps: yes/no and their interaction) on goal achievement, accounting for participant's exercise frequency at baseline.

Third, we report the effect of the intervention on exercise frequency up to six months after the study. Analogous to the analysis of the effect of the goal intervention on exercise frequency during the three-week intervention period, we opted for a quasi-Poisson regression to analyse the effect of the goal intervention (superordinate goal: yes/no; action steps: yes/no and their interaction) on the electronically measured on exercise frequency during the six-month follow-up period, accounting for baseline exercise frequency.

Results

Descriptive statistics

On average, participants exercised 1.14 times the week before the study started, with a range between 0 and 5 exercise sessions per week (electronically measured frequency). During the intervention period, the average number of exercise sessions was 7.66 (range 0–15) according to self-reports, and 6.28 sessions (range 0–16) 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.

Randomisation 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 randomisation was successful. The MANOVA revealed no significant effects (all *p*s > .379), indicating successful randomisation.

Goal focus influences self-reported but not electronically measured exercise frequency during the intervention period

We analysed the effect of the goal intervention (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.

With respect to self-reported frequency (see Table 1, Model A), a quasi-Poisson regression showed a significant interaction between a superordinate goal and action

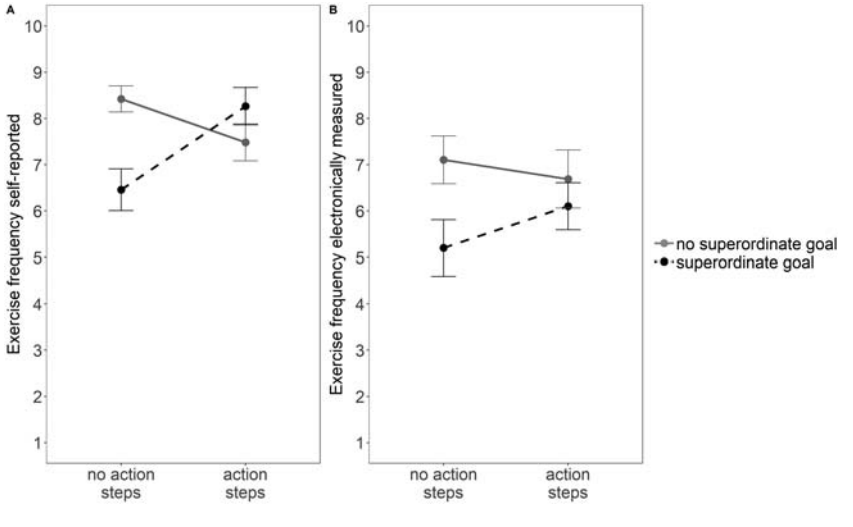

Figure 2. Intervention period: Effects of a superordinate goal and action steps on exercise frequency measured by (A) self-reports and (B) electronic login data from the gym.

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.

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).

Table 1. Exercise frequency as a function of goal manipulation and baseline measure.

		Model A DV: Self-reported exercise frequency	Model B DV: Electronically measured exercise frequency
Superordinate goal (1 = yes/0 = no)	*B*	-0.259***	−0.239
	95% CI	(−0.401, −0.117)	(−0.491, 0.014)
	t	−3.584	−1.853
Action steps (1 = yes/0 = no)	*B*	−0.117	−0.040
	95% CI	(−0.258, 0.025)	(−0.284, 0.203)
	t	−1.611	−0.325
Baseline	*B*	0.014	0.140***
	95% CI	(−0.032, 0.060)	(0.062, 0.218)
	t	0.585	3.517
Superordinate goal × Action steps	*B*	0.359***	0.149
	95% CI	(0.153, 0.565)	(−0.217, 0.516)
	t	3.412	0.798
Constant	*B*	2.112***	1.760***
	95% CI	(2.003, 2.222)	(1.561, 1.959)
	t	37.904	17.327
Observations		132	132

Note: *$p < .05$; **$p < .01$; ***$p < .001$. As quasi models are characterised only 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).

Table 2. Goal achievement as a function of goal manipulation and baseline measure.

		Model A DV: Self-reported goal achievement	Model B DV: Electronically measured goal achievement
Superordinate goal (1 = yes/0 = no)	*B*	−1.827***	−0.817
	95% CI	(−2.871, −0.783)	(−1.939, 0.305)
	z	−3.431	−1.427
	OR	0.161	0.442
Action steps (1 = yes/0 = no)	*B*	−1.289*	−0.119
	95% CI	(−2.309, −0.270)	(−1.162, 0.924)
	z	−2.479	−0.223
	OR	0.275	0.888
Baseline	*B*	0.106	0.230
	95% CI	(−0.233, 0.445)	(−0.118, 0.578)
	z	0.614	1.295
	OR	1.112	1.259
Superordinate goal × Action steps	*B*	2.878***	0.604
	95% CI	(1.392, 4.364)	(−0.993, 2.201)
	z	3.797	0.742
	OR	17.782	1.830
Constant	*B*	0.517	−0.969*
	95% CI	(−0.279, 1.313)	(−1.807, −0.131)
	z	1.274	−2.267
	OR	1.677	0.380
Observations		132	132
Log Likelihood		−81.908	−74.966
Akaike Inf. Crit.		173.816	159.932

Note: *$p < .05$; **$p < .01$; ***$p < .001$.

No effect of goal focus on exercise frequency up to six months after the study

Next, we analysed 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).

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.

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 (1 = yes/0 = no)	*B*	−0.333
	95% CI	(−0.812, 0.146)
	t	−1.364
Action steps (1 = yes/0 = no)	*B*	0.130
	95% CI	(−0.293, 0.553)
	t	0.603
Baseline	*B*	0.226**
	95% CI	(0.090, 0.361)
	t	3.265
Superordinate goal × Action steps	*B*	0.166
	95% CI	(−0.494, 0.827)
	t	0.494
Constant	*B*	3.367***
	95% CI	(2.999, 3.736)
	t	17.912
Observations		132

Note: *$p < .05$; **$p < .01$; ***$p < .001$. As quasi models are characterised only 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).

During the intervention period, the goal manipulation affected the self-reported exercise frequency. We 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 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, we cannot fully support the hypothesis that a focus on both action steps and a superordinate goal promotes exercise frequency and goal achievement in the short term. There was a statistical interaction, but its shape was not as expected: the control group did unexpectedly well. The interaction effect only shows in comparison with the superordinate group and the action steps group, but not in comparison with the control group, which has not formulated an additional goal. Furthermore, 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; 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 has a positive influence on goal pursuit only 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 makes sense only 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 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 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.

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 behaviour (e.g., 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 behaviour 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 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 behaviour

The hindering effect of superordinate goals on overstating one's behaviour aligns with research on goal setting and unethical behaviour that explores how the type and structure of goals can influence the resulting potential for unethical behaviour (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 behaviour (Ordóñez et al., 2009; Schweitzer et al., 2004). A reason for such unethical behaviour is that goal failure is connected to psychological costs (Heath et al., 1999; Ordóñez & Welsh, 2015; Schweitzer et al., 2004). The more challenging a goal is, the higher the risk of goal failure. Behaving unethically 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 behaviour (Schweitzer et al., 2002; Schweitzer et al., 2004).

In the present study, focusing on a superordinate goals hinders overstating one's behaviour. 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, achievement (or non-achievement) is easy to determine. If a person did not exercise nine times in three weeks, they incur the psychological cost of goal failure. This creates an incentive to overstate the behaviour and thereby eliminate the costs of failure. When focusing on a superordinate goal, however, goal achievement is much more difficult 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 behaviour when focusing on a superordinate goal than when not.

Hindering effect of action steps on overstating one's behaviour

The hindering effect of action steps on overstating one's behaviour 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 behaviour threatens their self-image (Mazar & Zhong, 2010; Sachdeva et al., 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 et al., 2015). Such justifications occur more frequently when the behaviour in question permits certain ambiguities, for example, when there are grey 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 et al., 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 behaviour. This reduces the ambiguity and the scope for interpretation, which could facilitate the misrepresentation of one's behaviour (Pittarello et al., 2013). This could explain why 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. We can only hypothesise which boundary conditions and mechanisms also affect exercise behaviour 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 our 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 behaviour during the time of the campaign but 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 behaviour, 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 behaviour 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, etc.). In the lab, these influences are averaged out, but they may directly influence behaviour in a field study, and may indeed have overridden any effects of goal manipulation.

Furthermore, note that goal pursuit was operationalised as exercise frequency. However, other aspects of exercise – type, duration, intensity – are also relevant, and could potentially be used for operationalisation (Kelly et al., 2016). Different operationalisations of behaviour 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 behaviour as precisely as possible or with high concentration, learning or enjoying the goal-related behaviours – 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 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 et al., 2013; Oettingen, 2012; Stadler et al., 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 behaviours (Förster et al., 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 behaviour 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 we 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 hypothesised effect. Future studies with an appropriate sample size are necessary in order to shed more light on the research questions dealt with here.

A second limitation is the lack of a control group with no experimenter-assigned 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 behavioural 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 intervention task in the context of the start questionnaire, which took only a few minutes. Although participants were reminded of their 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 and thus that the goal intervention was too short-term to induce a long-term effect. Several studies have shown that short, theory-based psychological interventions can induce long-term behavioural change. However, in order to promote long-term behavioural change, it is crucial for short-term interventions to investigate how and ensure that the psychological processes at which the intervention is aimed unfolds over time (Kenthirarajah & Walton, 2015). These processes were not the focus of the present study.

Future research

In order to substantiate the results and better place them in the context of existing research, we 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 and processes. This should be carried out, first, over various stages of PA adoption (setting, achieving, maintaining behaviour). Goals at different levels of abstraction may not be equally beneficial over all stages. More specifically, several psychological models of behavioural change conceptualise goal pursuit and behavioural 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 behaviour (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 and how the psychological process targeted by the respective goal intervention unfolds over time. Future investigations could explore the ways that switching between goals at different levels of abstraction could facilitate goal pursuit, especially in the long term. Second, 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 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., 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 behaviour.

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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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