



Mental contrasting instigates goal pursuit by linking obstacles of reality with instrumental behavior[☆]

Andreas Kappes^{a,*}, Henrik Singmann^b, Gabriele Oettingen^{a,c,2}

^a University of Hamburg, Germany

^b University of Freiburg, Germany

^c New York University, NY USA

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ABSTRACT

The self-regulatory strategy of mental contrasting a desired future with obstacles of reality instigates goal-directed behavior when expectations of success are high and curbs goal-directed behavior when expectations are low (Oettingen, 2000). Two studies show that mental contrasting paired with high expectations of success creates strong associations between obstacles of reality and behavior instrumental to overcome these obstacles; mental contrasting paired with low expectations of success leads to weak associations. Reverse contrasting and irrelevant content control conditions did not produce expectancy-dependent associations between obstacle and instrumental behavior. Importantly, the strength of these associations mediated mental contrasting effects on goal-directed behavior (Study 2).

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Introduction

A student prepares for her final exam when she receives an invitation to a party on Saturday night. Trying to get back to her studies, her mind wanders into the future, how great it will be to receive the wished-for A and how proud she will feel. But then, there is an obstacle—an invitation to a party—standing in the way of attaining the desired A. Only now, the student realizes that she needs to decline the invitation. Two experiments tested whether mental contrasting a desired and feasible future (e.g., earning an A) with the present reality standing in the way (e.g., attending the party) strengthens the association between this obstacle of reality and instrumental behavior (e.g., declining the invitation). Associations between a critical situation and a respective instrumental behavior have long been identified as a powerful mechanism for behavior initiation. Yet little is known whether such associations can not only emerge when being overlearned (Wood & Neal, 2007) or intentionally set for effective planning (Gollwitzer, 1999), but also by engaging in self-regulatory strategies of selective goal setting such as mental contrasting (Oettingen, Pak, & Schnetter, 2001).

Feeling attracted to a desired future and confident that one can attain it does not necessarily imply that one actually commits to and strives for it (i.e., sets a goal to attain it; Oettingen & Gollwitzer, 2001). For instance, the student above may wish to receive an A in her final exam and may feel capable of doing so, but still not commit herself to realizing this wish. Mental contrasting of a desired future outcome with the relevant obstacle of present reality regulates such goal commitments, as it reveals that action is necessary to overcome the obstacle if one wants to reach the desired future (Oettingen, 2000; Oettingen et al., 2001). People now scrutinize whether they can reach the desired future outcome using their expectations of success: when expectations are high, people will try to attain the desired future; when expectations are low, they will refrain from doing so. And indeed, mental contrasting, in line with expectations of success, improved teacher-rated study effort and math grades, helped to solve interpersonal and professional problems, heightened rater-judged quality of giving a talk, and facilitated immediacy of reducing cigarette consumption as well as self-reported help-seeking and help-giving (Oettingen, Mayer, Stephens, & Brinkmann, 2010; Oettingen, Mayer, & Thorpe, 2010; Oettingen et al., 2001, 2009). These findings suggest that mental contrasting paired with high expectations furthers the initiation of goal-directed behavior.

The present research investigates how mental contrasting produces this effect. We hypothesized that mental contrasting paired with high expectation of success creates a strong association between an obstacle of reality and the behavior that is instrumental to overcome this obstacle. We reasoned that mental contrasting can be understood as a cognitive procedure similar to propositional learning,

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* Corresponding author at: New York University, 6 Washington Place, 7th floor, New York, NY 10003, USA.

E-mail address: kappes.andreas@gmail.com (A. Kappes).

¹ Psychology Department, New York University, NY USA.

² Psychology Department, New York University, NY USA and Department of Psychology, University of Hamburg, Germany.

where the endorsement or negation of propositions affects associations between mental concepts. The creation of such associations takes place in two steps (Gawronski & Bodenhausen, 2006; Lagnado et al., 2007; Waldmann & Hagmayer, 2001). First, a preliminary proposition between two mental representations is generated (Lagnado et al., 2007). For example, seeing a red spot on one's skin after eating strawberries might suggest that one is allergic to strawberries (Waldmann & Hagmayer, 2001). Second, reasoning processes evaluate the validity of this proposition by assessing its consistency with relevant knowledge. In the previous example, one might recall the last times eating strawberries, assessing whether one had or had not health problems afterwards. These reasoning processes result in either the endorsement of the proposition (e.g., I'm allergic to strawberries) or in its negation (e.g., I'm not allergic to strawberries). The extent of endorsement or negation of the proposition changes the strength of the resulting association (De Houwer, 2009).

Applying these ideas to mental contrasting suggests that (1) mental contrasting creates the preliminary proposition that the obstacle of reality can be overcome by instrumental behavior, and (2) that this proposition needs to be tested for its validity. Expectations of success, then, provide the necessary information for testing the validity: When they are high, this proposition will be endorsed, when being low, the proposition will be negated. Hence, only when expectations are high, people should confirm the proposition that the obstacle can be overcome by instrumental behavior, resulting in a strong association between the obstacle and the behavior. In our example above, mental contrasting and high expectations should strengthen the mental association between the party and decline; when expectations of success are low, the link should be weakened. The results of such expectancy-dependent reasoning processes should then be observable in associative memory, resulting in either strong associations between the obstacle and the instrumental behavior when the proposition is endorsed (high expectations of success) or in weak associations when the proposition is rejected (low expectations of success).

Order plays an important role in propositional learning. For example, when pressing a button turns on a device one might suspect causality, whereas when the order is reversed, one would not (Lagnado et al., 2007). Similarly, we predicted that order plays a role when thinking about a desired future outcome and an obstacle of reality. Contrary to mental contrasting, where the obstacle of reality is elaborated after the desired future, in reverse contrasting, people start with thinking about the obstacle, and then turn to the desired future; hence they do not think about the obstacle of reality in the context of the desired future. Therefore, reverse contrasting should lead to thinking about the obstacle *per se*. In our example, the student thinking about being invited to the party might imagine what to wear or what to bring as a gift. That is, the obstacle is not perceived as standing in the way of the desired future. Hence, the obstacle should not be linked to respective instrumental behavior, thus leaving the associations between obstacle and behavior untouched. For instance, the strength of association between party and decline would neither be strengthened nor weakened (when expectations are high or low, respectively).

Study 1: Mental contrasting establishes obstacle–behavior associations

We hypothesized that mental contrasting (versus control conditions) affects the strength of associations between the obstacle of reality and instrumental behavior (hereafter referred to as obstacle–behavior associations) in line with expectations of success. We included two control conditions, a reverse contrasting and an irrelevant content control condition. In the reverse contrasting condition, participants started with elaborating an obstacle of reality. In the irrelevant content control condition, participants elaborated an unrelated experience. Both manipulations should not affect the strength of associations between obstacle and instrumental behavior, regardless

of expectations of success. Furthermore, all participants named a desired future outcome and an obstacle of reality as well as an instrumental behavior for two concerns, an interpersonal and a health concern. Only the interpersonal concern had to be elaborated. We then measured associative strength between obstacle and instrumental behavior for the elaborated (interpersonal) and for the unelaborated (health) concern. We predicted that mental contrasting will only influence the strength of associations between the obstacle and its instrumental behavior for the elaborated concern. Strength of the unelaborated obstacle and its instrumental behavior should be left untouched.

Method

Participants

Ninety-seven students of a German university (79 female, age $M = 24.76$ years, $SD = 6.20$) participated in return for partial course credit. They were randomly assigned to one of three conditions: mental contrasting ($n = 33$), reverse contrasting ($n = 33$), and irrelevant content control ($n = 31$).

Procedure and measures

Participants were told that the study dealt with important concerns. They then had to name their most important *interpersonal* concern. Participants named interpersonal concerns such as “improving relationship with boyfriend.” To measure expectations of success, we asked how likely participants thought it was that their concern would have the wished-for ending. The 7-point scale ranged from 1 (*not at likely*) to 7 (*extremely likely*). Participants then named one outcome of the desired future (e.g., feelings of harmony) and one obstacle of present reality that stood in the way of successfully solving their interpersonal concern (e.g., being jealous). Finally, they had to indicate one instrumental behavior, which was described as one that would help them to overcome the obstacle of present reality in order to reach the desired future (e.g., distracting myself). To obtain words for use in the lexical decision task (i.e., the measure of associative strength, see below), participants summarized their interpersonal obstacle of reality as well as the respective instrumental behavior with one word each (e.g., jealous and distracting).

Participants did the same for an important health concern. They named health concerns such as eating healthier, outcomes of desired future such as being fitter, obstacles of reality such as too much stress, and instrumental behaviors such as taking a break. Again, participants summarized their obstacle of reality and the respective instrumental behavior with one word (e.g., stress and break). Importantly, to avoid elaboration before the manipulation, we alternated the prompts for the consecutive steps (concern, expectation, outcome, obstacle, behavior) between the interpersonal concern and the health concern. Therefore, participants switched between the two concerns when completing each step.

Thereafter, to establish the three conditions, all participants first learnt that the interpersonal concern was randomly picked for them to write about in more detail. In the mental contrasting condition, participants mentally elaborated and wrote about their named outcome of the desired future and their obstacle of reality, beginning with the desired future. Participants were told they should not hesitate to let events and experiences play out in their minds. The instructions in the reverse contrasting condition were identical except that participants started with elaborating the obstacle of reality and only then the outcome of the desired future. In the irrelevant content control condition, participants first elaborated a recent positive and then a recent negative experience with one of their teachers at school.

Dependent variables: Associative strength

A sequential priming paradigm was used to measure the strength of the obstacle–behavior associations for both the interpersonal and the health concern. Participants read that they had to indicate as quickly as possible whether each presented item was a word or a non-word. Each experimental trial started with a fixation cross (500 ms) followed by the prime word (50 ms), which was backward masked by a random letters string (100 ms). The mask was replaced by a blank screen (150 ms to 300 ms), which was replaced by the target letter string.

To index the strength of the obstacle–behavior associations for the (elaborated) interpersonal concern, we used four trials with the interpersonal obstacle word as prime and the interpersonal behavior word as target. To ensure that mental contrasting effects on obstacle–behavior associations were not due to mere heightened accessibility of goal-relevant information, we also measured the mere accessibility of the instrumental behavior on four trials with unrelated words (e.g., *house, concrete*) as primes and the interpersonal behavior words as targets.

Similarly, we assessed the processing of the obstacle and instrumental behavior also for the health concern (which participants did not mentally elaborate) on four trials with the health obstacle as prime and the corresponding behavior as target. Finally, one may suspect that the elaborated interpersonal obstacle prime increases subsequent information processing in general. Hence, we indexed the associative strength between the interpersonal obstacles and the health behaviors on four trials with the interpersonal obstacles as primes and the health behaviors as targets. Thirty-six filler trials containing neutral words as primes and as targets (e.g., *umbrella, noon*) and 48 non-word trials were included. Thus, the complete lexical decision task contained 96 trials. Half of these trials were real word trials, of which one-fourth were critical trials.

Results

Data preparation and descriptive analysis

Only correct responses on the lexical decision trials were included in the analyses (error rate was 2.6%), and reaction times slower than 3000 ms or faster than 250 ms were excluded (.4% of all trials). The mere accessibility of the interpersonal behaviors (i.e., speed of identifying the interpersonal behavior word when primed with a neutral word) correlated with strength of the interpersonal obstacle–behavior associations, $r = .51, p < .001$, and the mere accessibility of the health behavior (i.e., speed of identifying the health behavior word when primed with a neutral word) correlated with the health obstacle–behavior associations, $r = .45, p < .001$. Therefore, we adjusted for the mere accessibility of the respective behaviors in all the analyses below. Mere accessibility did not differ between conditions, $F(2,94) = 1.49, p = .25$. Finally, expectations of success were relatively high ($M = 5.05, SD = 1.33$, answers ranged from 1 to 7).

Interpersonal versus health domain

First, we tested whether mental contrasting versus control conditions differentially affected expectancy-dependence of obstacle–behavior associations in the interpersonal versus the health domain. Generalized estimating equations (Schafer, 2006) showed a three-way interaction effect between condition, expectations, and type of domain, $\chi^2(1) = 8.08, p = .02$, indicating that the effects of conditions on expectancy-dependent obstacle–behavior associations differed for the health domain and the interpersonal domain. Therefore, we analyzed the interaction effects of condition and expectations on obstacle–behavior associations for the health domain and the interpersonal domain separately.

Obstacle–behavior associations for the interpersonal concern

As participants elaborated the desired future and obstacles of reality for the interpersonal concern, we hypothesized that mental contrasting more than the control conditions established expectancy-dependent associations between participants' obstacles and the behaviors instrumental to overcoming them. We used hierarchical regression analysis (Aiken and West, 1991) entering expectations, accessibility of the behavior, and two dummy codes for the three conditions in the first step, and the two interaction terms between expectations and each condition in the second step. As predicted, adding the interaction terms significantly improved the model, $R^2_{\text{change}} = 9\%, F_{\text{change}}(2,90) = 3.97, p = .02$ (Fig. 1, left side). In the mental contrasting condition expectations predicted strong obstacle–behavior associations (indicated by faster reaction times), $\beta = -.44, t(90) = 2.36, p = .02$. Expectations did neither predict obstacle–behavior associations in the reverse contrasting condition, $\beta = .14, t(90) = .97, p = .33$, nor in the irrelevant content control condition, $\beta = .18, t(90) = 1.12, p = .23$. The relation between expectations and obstacle–behavior associations was stronger in the mental contrasting condition than in the reverse contrasting condition, $t(90) = 2.45, p = .02$, and stronger than in the irrelevant content control condition, $t(90) = 2.58, p = .01$, whereas the relation did not differ between the reverse contrasting and irrelevant control content conditions, $t(90) = .29, p = .81$.

When expectations of success were high (expectations = 7), students in the mental contrasting condition showed stronger obstacle–behavior associations than students in the reverse contrasting condition, $t(90) = 2.46, p = .02$, and students in the irrelevant content control condition, $t(90) = 2.58, p = .01$. Yet, when expectations of success were low (expectations = 1), students in the mental contrasting condition showed weaker obstacle–behavior associations effects than those in the reverse contrasting condition, $t(90) = 2.32, p = .02$, and in the irrelevant content control condition, $t(90) = 2.45, p = .02$.

Obstacle–behavior associations for the health concern

Next, we tested the effects of condition on expectancy-dependent associative strength between obstacles of reality and instrumental behaviors for the health concern (the non-elaborated concern) by using the same set of analysis. Adding the interaction terms did not improve the model, $F_{\text{change}}(2,90) = .008, p = .99$ (Fig. 1, right side), and there was neither a main effect for expectations, $t(90) = .88, p = .38$, nor an interaction effect between expectations and condition, $ts > .16, ps < .90$. Apparently, mental contrasting is specific in affecting obstacle–behavior associations for elaborated, but not for unelaborated, concerns.

Interpersonal obstacle–health behavior associations

Still, the results may not be due to a specific obstacle–behavior association, but might be just an artifact of the obstacles activating behavior in general. Hence, we tested whether mental contrasting had an effect on trials on which the prime was the interpersonal obstacle and the target was the health behavior. Adding the interaction terms did not significantly improve the model, $F_{\text{change}}(2,90) = .34, p = .71$, and there was neither a main effect for expectations, $t(90) = .23, p = .82$, nor an interaction effect between expectations and condition, $ts > .78, ps < .42$.

Discussion

Participants in the mental contrasting condition with high expectations of success exhibited stronger associations between their idiosyncratic obstacle and the relevant instrumental behavior; participants with low expectations exhibited weaker associations than corresponding participants in the control groups. Mental contrasting effects on

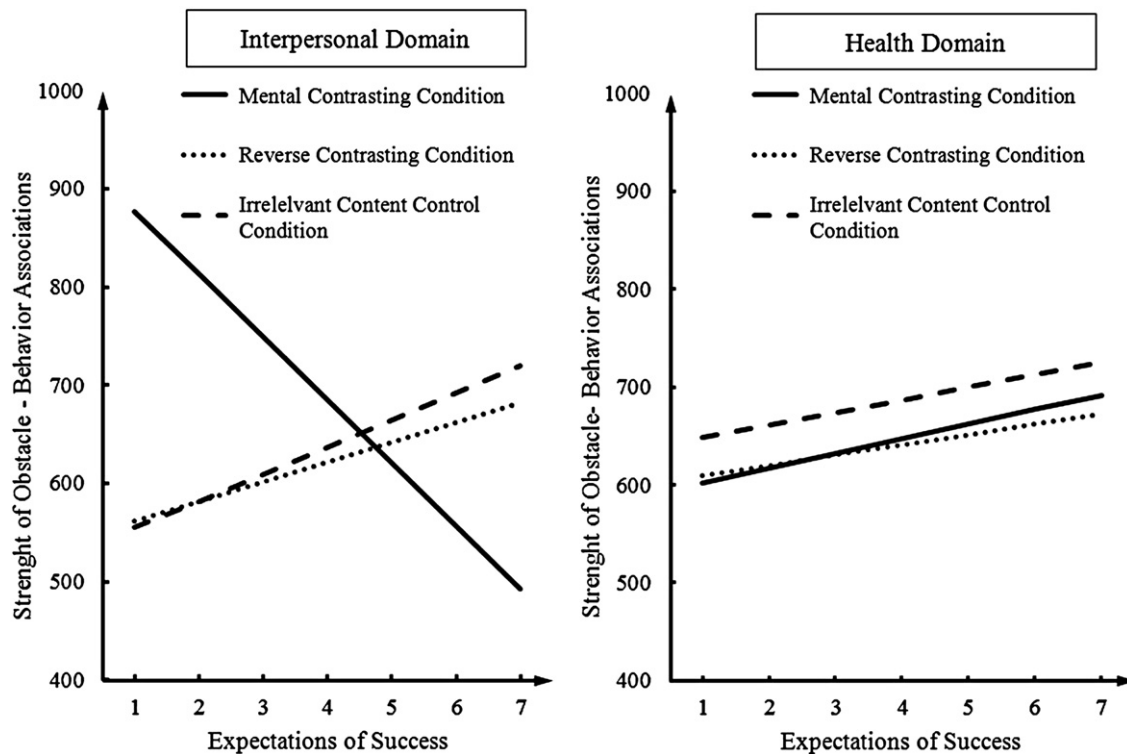


Fig. 1. Study 1: Regression lines depict the relation between expectations of success and strength of obstacle–behavior associations adjusted for accessibility of the behavior for the interpersonal concern (left) and strength of obstacle–behavior associations adjusted for accessibility of the behavior for the health concern (right) as a function of self-regulatory thought.

obstacle–behavior associations were specific to the elaborated concern: Participants in the mental contrasting condition showed expectancy-dependent effects on obstacle–behavior associations for their interpersonal concerns, the concerns they elaborated on; but they did not show effects for their health concerns, the concerns they did not elaborate on. Neither the reverse contrasting condition nor the irrelevant content control conditions affected the obstacle–behavior associations, regardless of expectations of success.

We ruled out several alternative explanations. First, we adjusted for the mere accessibility of the instrumental behavior (i.e., the mere accessibility of the target), suggesting that mental contrasting effects on the strength of obstacle–behavior associations were not due to the accessibility of the instrumental behavior *per se*. Second, we did not find mental contrasting effects on the strength of associations between the interpersonal obstacle and health behavior, suggesting that mental contrasting effects on obstacle–behavior associations were not the result of the obstacle prime affecting information processing *per se*. In sum, Study 1 established that mental contrasting creates associations between obstacle and instrumental behavior in line with expectations of success. However, the study did not test whether the obstacle–behavior associations created by mental contrasting are beneficial for initiating instrumental behavior once the obstacle of reality is actually encountered. We tested this hypothesis in the next study.

Study 2: Mental contrasting establishes obstacle–behavior

Associations that guide behavior

We created an experimental setting in which we could observe participants' instrumental behavior in the lab. Specifically, the behavior, taking the stairs, was instrumental to the goal of becoming fit. We established everyday conveniences such as taking the *elevator* as obstacle, and daily physical *exercise* as a behavior instrumental to overcome the obstacle, and then let participants mentally contrast or reverse contrast about becoming fit. After measuring the obstacle–behavior associations (i.e., elevator–exercise), we observed whether participants

actually exercised (i.e., took the stairs), when they encountered their obstacle of reality in the form of the elevator. We predicted that participants in the mental contrasting condition with high expectations of successfully becoming fitter would form stronger associations between the elevator and exercise (i.e., obstacle–behavior associations) than in the control condition, which in turn would lead them to take the stairs when they encountered the elevator.

Method

Participants

Ninety-nine students of a large German university (65 female, age $M = 22.70$ years, $SD = 3.80$) participated in return for partial course credit. They were randomly assigned to one of two conditions: mental contrasting condition ($n = 49$) and reverse contrasting condition ($n = 50$).

Procedure and materials

The cover story explained that students entering college tend to change their lifestyle in an unhealthy way. However, studies from the World Health Organization revealed that adding another half an hour of exercise into the daily routine is sufficient to improve fitness. Students learned that the additional exercise could be implemented in daily life, but conveniences like taking the *elevator* were often obstacles to fitness. Participants read: “Students just like you who manage to *exercise* by taking the stairs on a daily basis report feeling much fitter.” This cover story introduced the obstacle of reality (i.e., elevator) and the instrumental behavior (i.e., exercise).

Next, using the same procedure as in Study 1, we assessed participants' expectations of successfully improving their fitness, and their outcome of the desired future. We then established two experimental conditions: a mental contrasting condition and a reverse contrasting condition. In the mental contrasting condition, participants elaborate

their idiosyncratic outcome of the desired future; we then provided the obstacle of reality: daily conveniences such as the elevator. In the reverse contrasting condition, we first provided the obstacle, and then participants elaborated their idiosyncratic outcome. We induced the mental elaborations using the same instructions as in Study 1.

Thereafter, all participants completed a lexical decision task like in Study 1. Associations between the obstacle (i.e., elevator) and the instrumental behavior (i.e., exercise) were measured with trials on which *elevator* was the prime and *exercise* the target. Accessibility of the instrumental behavior was measured with trials on which a row of Xs was the prime and exercise was the target. The information processing speed after an obstacle prime was measured by trials on which *elevator* was the prime and shopping (i.e., an unrelated behavior) was the target.

Finally, we measured whether participants instigated the instrumental behavior when they encountered the obstacle of reality. Specifically, participants learnt that their Body-Mass-Index would now be measured in the physical education department, three floors down. Stairs and an elevator were located directly opposite the experimental room on the fourth floor. After participants left the experimental room, the door automatically swung shut, leaving participants on their own. When participants arrived at the BMI measurement room, they found a handwritten note saying: "The BMI measurement is cancelled!" After returning, participants were asked what they thought about the experiment, debriefed, and thanked.

We recorded via a hidden camera whether participants took the stairs or the elevator on their way down and on their way up again. Taking the stairs or the elevator on the way down and up again were highly correlated ($r = .71$, $p < .001$; Cronbachs $\alpha = .83$). Therefore, we combined both to form one index of instrumental behavior with 0 standing for elevator taken both ways, .5 for stairs taken either up or down, and 1 for stairs taken both ways.

Results

We excluded nine participants because they showed suspicion concerning the BMI measurement, two participants because they did not come back on their own from the BMI measurement, and one participant due to an extremely high error rate in the lexical decision task (error rate = 30%). This left a final sample of 87, consisting of 45 participants in the mental contrasting condition and 42 participants in the reverse contrasting condition.

Data preparation and descriptive analyses

Only correct responses on the lexical decision trials were included in the analyses (error rate was 3.2%), and reaction times slower than 3000 ms or faster than 250 ms were excluded (.4% of all trials). The mere accessibility of the behavior (i.e., speed of identifying the word "elevator" when primed with a neutral word) correlated strongly with the strength of the obstacle–behavior associations (i.e., elevator–exercise associations), $r = .60$, $p < .001$. Therefore, we adjusted for the mere accessibility of the behavior in the analyses. Mere accessibility did not differ between conditions, $F(1,85) = .09$, $p = .77$. Finally, expectations of success were relatively high ($M = 4.88$, $SD = 1.35$, answers ranged from 2 to 7). The elevator–exercise associations correlated significantly with stair use, $r_b = -.31$, $p = .004$, adjusting for the mere accessibility of exercise.

Obstacle–behavior associations

First, we tested whether mental contrasting established expectancy-dependent associations between the obstacle of present reality and the instrumental behavior. We used hierarchical regression analysis entering expectations of success, accessibility of the behavior and a dummy code for the two conditions in the first step, the

interaction term between expectations and condition in the second step. As predicted, adding the interaction term significantly improved the model, $R^2_{change} = 3\%$, $F_{change}(1,82) = 3.97$, $p = .02$ (Fig. 2, left side). In the mental contrasting condition, the higher were expectations of success, the stronger were the obstacle–behavior associations, indicated by faster reaction times, $\beta = -.24$, $t(82) = 1.95$, $p = .05$. There was no relationship between expectations and obstacle–behavior associations in the reverse contrasting condition, $\beta = .14$, $t(82) = 1.12$, $p = .25$. Accordingly, the relationship between expectations and obstacle–behavior associations was stronger in the mental contrasting condition than in the reverse contrasting condition, $t(82) = 2.18$, $p = .03$. When expectations of success were high (expectations = 7), students in the mental contrasting condition showed stronger obstacle–behavior associations than students in the reverse contrasting condition, $t(82) = 2.34$, $p = .02$. Yet, when expectations of success were low (expectations = 2), students in the mental contrasting condition showed no weaker obstacle–behavior associations effects than students in the reverse contrasting condition, $t(82) = 1.58$, $p = .11$.

Obstacle-unrelated behavior associations

The effect of mental contrasting on the expectancy-dependence in obstacle–behavior associations might be due to general changes in processing speed after the obstacle (elevator) prime. To exclude this alternative explanation, we used the same set of analysis as above to predict obstacle-unrelated behavior (i.e., shopping) associations. As expected, adding the interaction terms did not significantly improve the model, $F_{change}(2,82) = 1.98$, $p = .16$, and there was neither a main effect for expectations, $t(82) = .80$, $p = .42$, nor an interaction effect between expectations and condition, $t(82) = 1.41$, $p = .16$.

Stair use

We then tested whether mental contrasting affected instrumental behavior, i.e., whether participants used the stairs on the way down and up. We used hierarchical regression analysis entering expectation of success, and a dummy code for the two conditions in the first step, and the interaction term between expectations and condition in the second step.³ As predicted, adding the interaction terms improved the model, $R^2_{change} = 7\%$, $F_{change}(1,83) = 6.27$, $p = .01$ (Fig. 2, right side). In the mental contrasting condition, the higher were expectations of success, the more often the stairs were used, $\beta = .33$, $t(83) = 2.20$, $p = .03$. There was no relationship between expectations and stair use in the reverse contrasting condition, $\beta = -.20$, $t(83) = 1.36$, $p = .18$, with the relation between expectations and stair use being stronger in the mental contrasting condition than in the reverse contrasting condition, $t(83) = 2.50$, $p = .01$. When expectations of success were high (expectations = 7), students in the mental contrasting condition used more often the stairs than students in the reverse contrasting condition, $t(83) = 2.19$, $p = .03$. Yet, when expectations of success were low (expectations = 2), students in the mental contrasting condition used less often the stairs than students in the reverse contrasting condition, $t(83) = 2.50$, $p = .01$.

Mediation analyses of mental contrasting effects on stair use

We tested whether the associations between obstacle of reality and instrumental behavior (i.e., between elevator and exercise) mediated the effects of mental contrasting on stair use. Using moderated

³ Stair-use is an ordinal variable, not a continuous variable. However, we treated stair-use as a continuous variable in our regression analyses. To test the robustness of the results, we redid the regression analyses in a general linear model, using robust standard errors for the estimation, which help to control for deviations from model assumption. We found the exact same pattern of results.

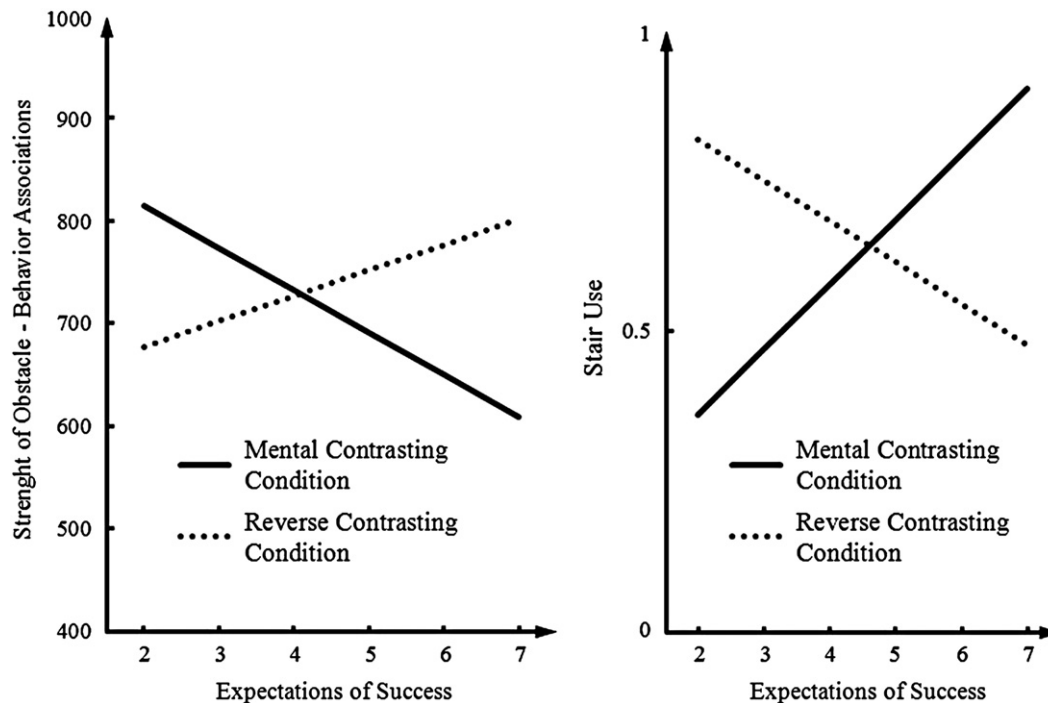


Fig. 2. Study 2: Regression lines depict the relation between expectations of success and strength of obstacle–behavior associations adjusted for accessibility of the behavior (left) and stair use (right) as a function of self-regulatory thought.

mediation analysis (Muller et al., 2005), we included as independent variable condition, as moderator expectations and the interaction term of condition and expectations, as mediator the obstacle–behavior associations as well as the expectations by obstacle–behavior associations interaction term (i.e., the moderator–mediator interaction term). The predicted outcome variable in this model was stair use. To show moderated mediation, the interaction term of condition and expectations in the described model should be smaller than that in the initial model (containing only the independent variable, the moderator, and their interaction term). Note that no formal test for the difference is necessary (see also Preacher et al., 2007). Indeed, the expectations by condition interaction effect, $\beta = -.28$ (being marginally significant, $t(82) = 1.84$, $p = .07$) was smaller than in the initial model, $\beta = -.38$. This result indicates that the difference between the mental contrasting condition and the reverse contrasting condition in the relation between expectations and stair use was at least partially mediated by the obstacle–behavior associations.

Discussion

Replicating the results from Study 1, mental contrasting paired with high expectations established strong associations between the obstacle and instrumental behavior, whereas paired with low expectations it weakened the associations between obstacle and instrumental behavior. In the reverse contrasting condition, we did not find expectancy-dependent effects on the obstacle–behavior associations. We also analyzed the contribution of obstacle–behavior associations for goal-directed behavior. First, we observed that obstacle–behavior associations correlated with actual instrumental behavior, over and above the conditions. Furthermore, mental contrasting effects on behavior were at least partially mediated by the obstacle–behavior associations.

Study 2 additionally highlights the range of mental contrasting effects. Whereas in most mental contrasting studies, participants are free to pick idiosyncratic obstacles of reality (Oettingen, Mayer, Stephens et al., 2010; Oettingen, Mayer, & Thorpe, 2010; Oettingen et al., 2001, 2009), in Study 2 we suggested the obstacle of reality

(i.e., elevator) to participants. Hence, supporting previous research (Oettingen, 2000; Oettingen et al., 2005), mental contrasting effects do not necessarily rely on idiosyncratic obstacles of reality but apply to assigned ones as well. In the present research, we additionally suggested the instrumental behavior (i.e. exercise) to participants, which they then incorporated in the representations of their obstacle.

General discussion

Two experiments showed that mental contrasting modulates obstacle–behavior associations in line with expectations of successfully reaching the desired future. Importantly, in Study 2 the obstacle–behavior associations created by mental contrasting predicted respective goal-directed behavior. The effects of mental contrasting on obstacle–behavior associations prevailed for an interpersonal concern (Study 1) and for a health concern (Study 2), independent of whether students used idiosyncratic obstacles and behaviors (Study 1) or assigned obstacles and behaviors (Study 2). Importantly, the associations predicted instrumental behavior in a real life setting: Students used the instrumental behavior *exercise* when the obstacle *elevator* was encountered. Specifically, students in the mental contrasting condition who had high expectations showed strong associations between obstacle and instrumental behavior, and accordingly, they instigated the respective behavior of physical exercise when encountering the obstacle in form of the elevator. The opposite was found in students who had low expectations. Here, mental contrasting interfered with the processing of the instrumental behavior. Once the obstacle was activated, mental contrasting weakened instrumental behavior. Future research may analyze whether this weakening effect facilitates the exploration of alternative futures.

We included two control conditions, a reverse contrasting condition and an irrelevant content control condition. Both control conditions did not affect obstacle–behavior associations in line with participants' expectations of success. These results exclude two alternative explanations: Just naming an outcome of the desired future and an obstacle of reality is not enough to establish an obstacle–behavior

association; elaboration of the future outcome and of the obstacle is needed. Second, the outcome of the desired future needs to be elaborated first, so that the obstacle can be perceived as standing in the way of the future.

As mental contrasting entails elaborating the future first and the obstacle of reality last, one may wonder whether the effects of mental contrasting stem in part from the recency of thinking about the obstacles of reality. Such a recency effect would suggest that mental contrasting paired with high expectations increases temporally the accessibility of the behavior, and thereby strengthens the obstacle–behavior association as well as the respective behavior. However, such a recency effect would also suggest differences between the conditions in the accessibility of the behavior, which we did not find in both of the studies. Furthermore, we controlled for the accessibility of the behavior in all our analysis, thereby demonstrating that the reported mental contrasting effects on obstacle–behavior associations as well as on the behavior itself are not due to the accessibility of the behavior. Finally, previous research found that dwelling on the obstacles of reality only does not lead to expectancy-dependent behavior (Oettingen, Mayer, Stephens, et al., 2010; Oettingen, Mayer, & Thorpe, 2010; Oettingen, Mayer, Thorpe, Janetzke, & Lorenz, 2005; Oettingen et al., 2001), underscoring that merely ending one's elaborations with the obstacles is not enough to instigate behavior.

Finally, one may argue that mental contrasting effects stem from cognitive dissonance processes (Cooper, 2012; Festinger, 1957). While cognitive dissonance theory focuses on attitude change, mental contrasting theory investigates goal commitment and goal striving (i.e., goal pursuit). Indeed, previous research did not find effects of mental contrasting on changes in attitudes or incentive value, but it did find effects on expectancy-dependent heightened or weakened goal commitment and goal striving (review by Oettingen & Stephens, 2009). Similarly, mental contrasting should not produce cognitive dissonance that is reduced by effort justification (i.e., facing obstacles is effortful and this effort needs to be justified by increasing one's commitment to realize the desired future). In line with this argument, mental contrasting is observed to foster goal pursuit when minor obstacles are considered (i.e., expectations of success are high), but to lower goal pursuit when major obstacles are considered (i.e., when expectations of success are low).

Implications for research on goal pursuit

Our findings suggest that mental contrasting affects goal-directed behavior by modulating the strength of associations between an obstacle and the respective instrumental behavior. Previous research showed that mental contrasting does not only affect behaviors immediately after the procedure, as in Study 2, but also up to three months later (e.g. Oettingen, Hönig, & Gollwitzer, 2000, Study 1). We speculate that changes in implicit cognition (i.e., obstacle–behavior associations) underlie these long-term effects. Specifically, when the mentally contrasted obstacles of reality are encountered, the established obstacle–behavior associations can unfold their behavior-guiding effects without requiring conscious efforts or attention, at least as long as the desired future outcome is not attained yet. Though the present studies do not offer any data on whether the obstacle–behavior associations are stable over time, we suppose that they are as stable as the goal-directed behavior triggered by mental contrasting.

In previous research, mental contrasting instigated expectancy-dependent planning how to attain the desired future (Oettingen et al., 2001, 2005). Planning was operationalized by process simulations (Taylor, Pham, Rivkin, & Armor, 1998) and implementation intentions (Gollwitzer, 1999). In the present research, mental contrasting produced obstacle–behavior associations, which are similar to situation–behavior associations in the form of if-then plans (Adriaanse, Gollwitzer, de Ridder, de Wit, & Kroese, 2011; Webb

& Sheeran, 2007). Again, the present research indicates spontaneous plan formation without the help of prompts. Despite the multitude of research on plans (Gollwitzer, Gawrilow, & Oettingen, 2010), there has been little research on how they spontaneously emerge.

These findings imply that mental contrasting may prepare people to form particularly effective implementation intentions. Indeed, comparing implementation intentions that are preceded by mental contrasting not only produced more adept if-then plans than those which are formed by themselves, but they also lead to better performance in an integrative negotiation paradigm (Kirk, Oettingen, & Gollwitzer, in press). Similarly, implementation intentions preceded by mental contrasting led to more successful breaking of bad habits (snacking) than implementation intentions alone (Adriaanse et al., 2010; Study 2). One might speculate that mental contrasting by allowing people to generate idiosyncratic obstacles and by linking these with respective instrumental behavior prepares people to form high-quality implementation intentions. Indeed, the combination of mental contrasting and implementation intentions has been found to be a powerful intervention of long-term behavior change (e.g., two years, Stadler, Oettingen, & Gollwitzer, 2010).

Conclusion

Booker T. Washington once said that a “man's success should be measured not so much by the position he has reached as by the obstacles which he has overcome” (Harlan, 1972). The present research depicts overcoming obstacles not only as a marker of success, but also as a possibility of instigating effective action. Mental contrasting of a desired and feasible future with an obstacle of reality creates mental associations between the obstacle and instrumental behavior, thereby guiding a person to master the hurdles once they are encountered.

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