ARTICLE IN PRESS

YJESP-03035; No. of pages: 14; 4C:

Journal of Experimental Social Psychology xxx (2013) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Journal of Experimental Social Psychology

journal homepage: www.elsevier.com/locate/jesp

Mental contrasting changes the meaning of reality☆,☆☆

Andreas Kappes [a,⁎], Mike Wendt [b], Tilman Reinelt [a], Gabriele Oettingen [c,a]

[a] University of Hamburg, Germany
[b] Helmut-Schmidt-University, University of the Federal Armed Forces Hamburg, Germany
[c] New York University, USA

HIGHLIGHTS

- We studied how thinking about the future instigates goal pursuit.
- Identifying obstacles increases goal pursuit.
- Studies highlight the importance of obstacles for goal pursuit.

ARTICLE INFO

Article history:
Received 14 March 2012
Revised 15 March 2013
Available online xxxx

Keywords:
Mental contrasting
Expectations
Obstacles
Goal pursuit
Self-regulation
Meaning

ABSTRACT

Mental contrasting of a desired future with the present reality strengthens goal pursuit when expectations of success are high, and weakens goal pursuit when expectations of success are low. We hypothesized that mental contrasting effects on selective goal pursuit are mediated by a change in the meaning of the present reality as an obstacle towards reaching the desired future. Using explicit evaluation of reality (Study 1), implicit categorization of reality as obstacle (Study 2), and detection of obstacle (Study 3) as indicators, we found that mental contrasting (*versus* relevant control groups) fostered the meaning of reality as obstacle when expectations of success were high, but weakened it when expectations of success were low. Importantly, the meaning of reality as obstacle mediated mental contrasting effects on goal pursuit (Studies 1, 2). The findings suggest that mental contrasting produces selective goal pursuit by changing the meaning of a person's reality.

Introduction

Imagine two students wishing to finalize an important assignment over the weekend; the first one expecting to be able to do it, the second one not. While thinking about the assignment, both receive an email reminder about a Saturday night party. For the first student, seeing the party in the context of the assignment makes her realize that this party is standing in the way of completing her assignment. She had been looking forward to attending, but the party is not so alluring anymore; she cannot help but think of it as an obstacle to finishing her assignment. For the second student, seeing the party in the context of the assignment has the opposite effect. She realizes that she will probably not finish the assignment on the weekend anyway; she might as well enjoy the party! For her, the party is not an obstacle, but an opportunity for having fun. The different meanings that the two students give to the party shape their pursuit of finishing the assignment: the first is determined to complete it and refrains from attending the party, the second refrains from trying to finish and enjoys the party whole-heartedly.

In these and similar situations, goal pursuit is influenced by the meaning that people assign to aspects of their life that are potential obstacles, such as the party in the example above. The present research tests whether these meanings stem from the way that people think about their wishes—specifically, using the self-regulatory strategy of mentally contrasting a desired future (*e.g.*, finishing an assignment) with the reality standing in the way of the desired future (*e.g.*, a party on Saturday night). We also test whether the meaning of the reality — as obstacle or not — is at least partially responsible for the effects of mental contrasting on goal pursuit.

Mental contrasting and goal pursuit

Fantasy realization theory (Oettingen, 2000; Oettingen, Pak, & Schnetter, 2001) identifies mental contrasting as a self-regulation

☆ Andreas Kappes is now at the Department of Cognitive, Perceptual and Brain Sciences, University College London, Mike Wendt, Helmut-Schmidt-University/University of the Federal Armed Forces Hamburg, Tilman Reinelt is now at the German Institute for International Educational Research, and Gabriele Oettingen, Psychology Department, New York University and University of Hamburg, Germany.

☆☆ The research reported in this article was supported by the German Science Foundation grant OE 237/13-1, awarded to Gabriele Oettingen. We thank ChessBase© for providing chess computer games.

⁎ Corresponding author at: University College London, Cognitive, Perceptual and Brain Sciences, 26 Bedford Way, London, WC1H 0AP, United Kingdom.
E-mail address: kappes.andreas@gmail.com (A. Kappes).

0022-1031/$ – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jesp.2013.03.010

Please cite this article as: Kappes, A., et al., Mental contrasting changes the meaning of reality, *Journal of Experimental Social Psychology* (2013), http://dx.doi.org/10.1016/j.jesp.2013.03.010

strategy that leads people to utilize their expectations of reaching the desired future. When people engage in mental contrasting, they first imagine a desired future, such as completing an assignment over the weekend, and then elaborate the present reality that stands in the way, such as a party on Saturday. Thereby, the question of whether the desired future can be attained is raised. Expectations of success provide the answer, and guide subsequent goal pursuit. When expectations of success are high, people commit to and strive for attaining the desired future, and when expectations of success are low, people disengage from attaining the desired future (*e.g.*, Oettingen et al., 2001).

A multitude of studies identified the effects of mental contrasting on goal commitment and goal striving (*i.e.*, goal pursuit; summary by Oettingen, 2012): Given high expectations of success, participants in the mental contrasting condition showed immediate and tenacious goal pursuit; given low expectations of success, these participants showed weak goal pursuit. This pattern of results was replicated with diverse indicators of goal pursuit, including cognition (*e.g.*, making plans), affect (*e.g.*, feelings of anticipated disappointment in case of failure), motivation (*e.g.*, feelings of energization, systolic blood pressure), and behavior (*e.g.*, invested effort and actual achievement), and with outcomes assessed *via* self-report or observations, directly after the experiment or weeks later (Kappes, Pak, & Oettingen, 2012; Kappes, Singmann, & Oettingen, 2012; Oettingen, 2000; Oettingen, Mayer, Stephens, & Brinkmann, 2010; Oettingen, Mayer, & Thorpe, 2010; Oettingen, Mayer, Thorpe, Janetzke, & Lorenz, 2005; Oettingen et al., 2001, 2009).

Although the effects of mental contrasting on goal pursuit have been consistently identified, relatively little is known about how mental contrasting generates these effects. In the present research, we hypothesized that mental contrasting modulates the meaning of the present reality. When people have high expectations of success, mental contrasting should strengthen the meaning of reality as an obstacle. In the opening example, for the student with high expectations, the party became an obstacle to complete the assignment. When people have low expectations of success, mental contrasting should weaken the meaning of the reality as an obstacle. Again in the opening example, for the student with low expectations, the party was *not* an obstacle, so she was able to whole-heartedly enjoy it. That is, mental contrasting should shape the meaning that people assign to the reality (*i.e.*, to potential obstacles), which should in turn direct their goal pursuit.

Assigning meaning to obstacles

Two features of the mental contrasting exercise should enable a change in meaning of the reality, the elaboration of the present reality, and the context of the elaboration (*i.e.*, after the desired future). Mental and written elaborations can change the meaning of the elaborated events and experiences by organizing and structuring them (*e.g.*, Pennebaker & Beall, 1986; Pennebaker, Mayne, & Francis, 1997; Taylor, Pham, Rivkin, & Armor, 1998). Elaborating in writing on traumatic events, for instance, people gain insight into these events and are better able to appreciate the meaning of the events for their lives (Bower, Kemeny, Taylor, & Fahey, 1998; Creswell et al., 2007; Chung & Pennebaker, 2008; Pennebaker et al., 1997; Ullrich & Lutgendorf, 2002). Importantly, the context of the elaborations influences the meaning that people extract (Barsalou, 2010, for an overview). When thinking about desired futures and the present reality, only elaborating on the reality against a backdrop of the desired future (as in mental contrasting) highlights the fact that the reality stands in the way of the desired future.

In the studies listed above, the effects of mental contrasting on goal pursuit have been distinguished from the effects of three other self-regulatory thoughts: Elaborating only the desired future (*i.e.*, indulging), elaborating only the present reality (*i.e.*, dwelling), or elaborating first the reality and then the desired future (*i.e.*, reverse contrasting). These alternatives differ from mental contrasting in that either the present reality is not elaborated (indulging), or that the reality is not elaborated in the context of the desired future (dwelling on reality and reverse contrasting). Elaborating just the reality (as in dwelling) or elaborating the reality before turning to the future (as in reverse contrasting) allows people to think about the reality without the context of the desired future. Therefore, dwelling and reverse contrasting leads to thinking about the reality *per se*. The students from our opening example, for instance, might think about what to wear to Saturday's party, or with whom to attend. Only mental contrasting should induce her to think about the party as an obstacle to complete the desired assignment.

Because mental contrasting depicts the present reality against a backdrop of the desired future, expectations of success should guide the degree to which people come to understand the reality as an obstacle. The elaboration of the present reality in the context of the desired future during mental contrasting should strengthen the understanding of the reality as an obstacle when expectations of success are high. People realize that they can attain the desired future, but have to overcome the present reality to do so. In contrast, when expectations are low, people should realize that it is unlikely that they will attain the desired future, and that trying to overcome the present reality will be in vain. In sum, mental contrasting with high expectations of success should strengthen the meaning of the reality as an obstacle; mental contrasting with low expectations of success should weaken it.

Obstacle meaning as a guide for goal pursuit

We predicted that not only does mental contrasting change the meaning of the reality in line with expectations of success, but that this change in meaning guides subsequent pursuit of the desired future. Research finds that the identification of obstacles in the way of goal attainment furthers goal pursuit (Gollwitzer, Bayer, & McCulloch, 2005; Oettingen, 1996; Oettingen et al., 2001; Zhang & Fishbach, 2010). Zhang and Fishbach (2010, Study 1), for instance, found that students who anticipated obstacles during an upcoming task increased their performance standards compared to those who did not expect obstacles. The increase in performance standards led participants to be more persistent on the subsequent task. Thus, following mental contrasting, once the reality acquires the meaning of an obstacle (*i.e.*, when expectations are high), people should muster their efforts to overcome it and display strong goal pursuit. In contrast, once the reality loses the meaning of an obstacle (*i.e.*, when expectations are low), people should refrain from efforts to overcome it in order to turn to other more promising endeavors.

Interestingly, Zhang and Fishbach (2010, Study 3) also found that participants responded to obstacles with an increase in performance standards only when they expected that they could overcome the obstacles. Although these results do not speak to how the reality acquires the meaning of an obstacle for goal pursuit — as we have hypothesized that mental contrasting facilitates — these findings are in line with our reasoning, since they suggest that understanding something as an obstacle is important for preparing goal pursuit, and that this process depends on expectations of success. To summarize, whereas previous research showed the importance of obstacles for goal pursuit, we examine whether a conscious process (*i.e.*, mental contrasting) can help people who hold high expectations to understand the reality as on obstacle.

Present research

We conducted three studies to test the idea that mental contrasting changes the meaning of the present reality as an obstacle standing in the way of attaining the desired future. Specifically, when paired with high expectations, mental contrasting should strengthen the meaning of reality as an obstacle, but when paired with low expectations, it should weaken it. In all studies, we first measured expectations of success, then established a mental contrasting condition (*versus* control conditions), and finally, measured indicators of the meaning of reality as obstacle. We used indirect indicators (Osgood, Suci, & Tannenbaum, 1957) differing in each study – evaluation in Study 1, implicit categorization in Study 2, and obstacle detection in Study 3 – to assess the range of the effects.

In Study 1, we inferred the meaning of reality as an obstacle *via* the evaluation of the reality. In his work on measuring meaning, Osgood et al. (1957) identified the evaluation of an object as a fundamental dimension of meaning. The evaluation of a stimulus signifies its meaning in a particular situation (Gawronski & Bodenhausen, 2006), and such evaluations reflect the specific meaning of stimuli for goal pursuit (Ferguson & Bargh, 2008, for an overview). For instance, students with high expectations of academic success (*i.e.*, high GPA) and an active academic goal evaluated distracting temptations more negatively — reflecting the meaning of these temptations as obstacles to academic success — than students without high expectations or without an active academic goal (Ferguson, 2007). Coming back to the initial example, the student who sees the party as an obstacle should also see the party as particularly negative.

In Study 2, we measured the meaning of the reality as obstacle using implicit categorization. Categorization provides the framework for how people assign meaning to stimuli (Macrae, Milne, & Bodenhausen, 1994). In person perception, for instance, people first categorize a person and then use the knowledge associated with the category to infer what the person is like (Bodenhausen & Macrae, 1998; Brewer, 1988; Fiske & Neuberg, 1990). The categorizations applied reflect not only beliefs and attitudes (Choi, Nisbett, & Norenzayan, 1999, Phelps et al., 2000), but also the current goal a person holds (Wheeler & Fiske, 2005). Specifically, the readiness with which the example students categorize an upcoming party as an obstacle to finishing an assignment or as a fun social activity depends on the meaning the party has for them.

In Study 3, we observed whether participants detected new obstacles. Detection of relationally similar objects is another important indicator of meaning (Gentner & Smith, 2012). When people understand which role one object plays in relation to others, they switch from identifying similar objects in the environments based on the surface features (*e.g.*, one man is similar to another man) to identifying similar objects based on the relational role they play in a given context (*e.g.*, one man lifting a box is similar to a forklift lifting a box; Gentner, Anggoro, & Klibanoff, 2011; Gentner & Markman, 1997). Once the student understands that the party is an obstacle towards finishing the assignment, she should see that her favorite TV shows on the weekend are also obstacles.

Whether the meaning of the reality as an obstacle was measured *via* evaluation, categorization, or detection, we had the same set of hypotheses. Mental contrasting paired with high expectations should strengthen the meaning of the reality as obstacle standing in the way of successful attainment of the future. On the other hand, mental contrasting paired with low expectations should weaken the meaning of reality as obstacle: now, the party can be perceived as a fun party. The first two studies also tested whether the meaning of the reality as an obstacle accounted for mental contrasting effects on goal pursuit.

Study 1: evaluation of the reality

In Study 1, we assessed the meaning of reality aspect as an obstacle *via* explicit evaluations of participants' reality as being more or less negative. Explicit evaluations bring affective reactions in line with current beliefs (Gawronski & Bodenhausen, 2006). For instances, one might have a positive, immediate reaction to a party, but when taking into account that the party is an obstacle standing in the way of successfully completing an assignment over the weekend, one might explicitly evaluate that party is as more negative than when the party has no obstacle meaning. In other words, the explicit evaluation as negative should reflect whether participants understand the reality as obstacle standing in the way of attaining the desired future.

Invited to a study about academic achievement, students first indicated their expectations of getting a desired grade in a given class, and then named an aspect of attaining the desired grade and an aspect of reality that might stand in the way of attaining the grade. Next, we induced a mental contrasting condition *versus* relevant control conditions. To measure the meaning of reality as obstacle, we asked students to evaluate their idiosyncratic reality aspect. Finally, we measured students' efforts to prepare for the final exam as an indicator of goal pursuit. We predicted that students in the mental contrasting condition paired with high expectations should evaluate their reality aspect more negatively than the other participants, facilitating that they invest effort in their exam preparations. On the other hand, students in the mental contrasting condition paired with low expectations should evaluate their reality least negatively, leading them to invest little effort.

We included two control conditions, a reverse contrasting and a dwelling condition. In the reverse contrasting condition, students first mentally elaborated the reality, then the desired future. Hence, reverse contrasting students elaborated the same content as mental contrasting students but in reverse order, testing our prediction that elaborating the reality without the context of the desired future (*i.e.*, elaborating the reality first) does not highlight the obstacle character. In the dwelling condition, students only elaborated their reality. This condition tested our prediction that the meaning of the reality as an obstacle is not affected when only focusing on the reality, rather a meaningful relation needs to be made to the desired future.

Method

Participants

One hundred and thirty students (100 female, age $M = 19.5$ years, $SD = .9$) participated in return for partial credit towards a psychology course requirement. We randomly assigned students either to a mental contrasting condition ($n = 43$), a reverse contrasting condition ($n = 44$), or a dwelling condition ($n = 44$).

Procedure and materials

Students learned that the study was designed to find correlates of final exam performances and that they would complete one part in the lab and another part later *via* email. In the lab, students first named the grade they wished to receive on the final exams of the psychology course they were getting the credit for. For measuring expectations of success, students indicated how likely they thought it was that they would get the desired grade on a 7-point scale ranging from 1 (*not at likely*) to 7 (*extremely likely*). To check the incentive value of this desired future, we measured the importance of getting the desired grade, on a 7-point scale ranging from 1 (*not at all important*) to 7 (*extremely important*).

Thereafter, students listed one desired future aspect that they associated with attaining the desired grade. They named, for example, “improving the GPA”, “proud parents”, or “better chances for grad school”. Next, students read the following prompt for naming aspects of the reality:

Now, please list two aspects that stand in the way of achieving the desired grade. Please note the first two things that come to your mind! Use one or two keywords to describe each aspect!

Students named, for example, “TV shows”, “dorm parties”, or “procrastination”. All students thereafter indicated which of the two reality aspects was more important to them.

Thereafter, we established three experimental conditions: a mental contrasting condition, a reverse contrasting condition, and a dwelling condition. In the mental contrasting condition, participants imagined and wrote about their desired future and their most important reality aspect, beginning with the desired future. To elicit the intended thoughts and images, participants read the following instructions for both desired future and reality:Think about this aspect in vivid detail and write about all the thoughts and images that come to mind. Let your mind wander and allow these events and experiences to play out. Don't hesitate to give your thoughts and images free rein. Take as much time as you need.

In the reverse contrasting condition, students received the same instructions but started with writing about their most important reality aspect before writing about their future. In the dwelling condition, students received the same instructions, but wrote about both of their reality aspects, starting with the less important one.

Dependent variables

Reality evaluation. At the end of the lab session, we asked participants to evaluate the keyword they had named earlier as most important reality aspect. Students rated the pleasantness of their keyword on a 7-point scale ranging from 1 (*pleasant*) to 7 (*unpleasant*). Note that students in the dwelling condition, even though they elaborated two reality aspects, only evaluated the keyword that they had previously rated as more important. Thereby, all students rated the reality aspect that they rated as more important.

Exam preparation. Finally, we measured preparation for the final exam. Before their final exam, students received an email. Out of 131 students in our study, 92 answered. Participant who did answer the email did not differ from students who did not answer the email in expectations of success ($p = .71$), importance of getting the desired grade ($p = .98$), or the desired grade ($p = .19$). The email was sent at the end of a week, so that all students could report their preparatory activities during the week. The message arrived close enough to the final exam to be already relevant for preparing; however, the final exam was far enough away to assure that we did not measure hectic last minute activities ($M = 15.2$ days before the final exam; $SD = 2.3$). In this email, students indicated on a 7-point scale, ranging from 1 (*not at all*) to 7 (*extremely*), how intensely they studied, how much effort they invested, and how focused they were regarding their work for the final exam during the last week. These items were combined to one scale indicating exam preparation ($\alpha = .72$).

Results

Descriptive data

Ninety-two (70.2%) of the 131 students named an A as desired grade at the final exam, 11 (8.4%) students named an A−, 12 (9.2%) named a B+, 12 (9.2%) named a B, and 3 (2.4%) students named a B−. Attaining the desired grade was a high incentive for students as indicated by a mean importance above the midpoint of a 7-point scale, $M = 5.75$ ($SD = 1.26$). Students had moderate expectations of earning the desired grade, $M = 4.71$ ($SD = 1.34$).

Reality evaluation

We followed the procedures recommended by Aiken and West (1991) and West, Aiken, Wu, and Taylor (2007) (see also Kashy, Donnellan, Ackerman, & Russell, 2009) for testing the interaction effects between continuous and categorical measures. We conducted a hierarchical regression analysis predicting each dependent measure (*i.e.*, reality evaluation, exam preparation) from (a) two dummy-coded contrasts for the main effects of condition, (b) the centered main effects of expectations, and (c) two interaction terms between expectations and each condition contrast. Hierarchical analysis allowed us to test the significance of adding the interaction terms into the model *via* examining the change in R^2.

When significant, we examined the association between expectations and the dependent variable in each experimental condition. We expected that expectations would show an association to the dependent variables only in the mental contrasting condition. Finally, we assessed whether mental contrasting effects at the high end (expectations = 7) and the low end of the expectations scale (expectations = 1) differed from those in the other conditions (West et al., 2007). To do so, we computed two sets of conditional expectations x condition interaction terms, one set for high expectations and one set for low expectations and substituted these terms for the interaction terms in our original analysis. The coefficient for each condition contrast shows the difference between mental contrasting and control conditions for high and low expectations. Note that we do not provide effect size estimates for these comparisons since they are based on estimated values, rather than observed values.

Following these procedures, we tested for expectancy-dependent mental contrasting effects on reality evaluation. As predicted, adding the interaction terms to the hierarchical regression analysis improved the model, $R^2_{change} = 7\%$, $F_{change}(2,125) = 5.06$, $p = .008$ (see Fig. 1, left side).

In the mental contrasting condition, expectations predicted reality evaluation, $\beta = -.53$, $t(125) = 3.48$, $p = .001$. The higher the expectations of success were the more negative the evaluation of the reality. Expectations did not predict reality evaluation in the reverse contrasting condition, $\beta = .07$, $t(125) = .53$, $p = .60$, or in the dwelling condition, $\beta = .03$, $t(125) = .14$, $p = .90$. Furthermore, the relation between expectations and reality evaluation in the mental contrasting condition was stronger than in the reverse contrasting condition, $t(125) = 3.02$, $p = .003$, and it was stronger than in the dwelling condition, $t(125) = 2.06$, $p = .04$. The relation between expectations and reality evaluation did not differ between the reverse contrasting and the dwelling condition, $t(125) = .19$, $p = .85$. Finally, when expectations of success were high, students in the mental contrasting condition evaluated their reality aspect more negatively than students in the reverse contrasting condition, $t(125) = 2.28$, $p = .02$, and students in the dwelling condition, $t(125) = 2.33$, $p = .02$. When expectations of success were low, students in the mental contrasting condition evaluated their reality aspect less negatively than students in the reverse contrasting condition, $t(125) = 3.02$, $p = .003$, and students in the dwelling condition, $t(125) = 2.06$, $p = .04$.

Exam preparation

To examine mental contrasting effects on the preparations for the exam, we used a hierarchical regression analysis predicting exam preparation, and entered the main effects of expectation of success and two dummy codes representing the three conditions in the first step, and the two interaction terms between expectations and each condition in the second step. Again, adding the interaction terms improved the model, $R^2_{change} = 8\%$, $F_{change}(2,86) = 3.89$, $p = .02$ (see Fig. 1, right side).

In the mental contrasting condition, expectations of success predicted exam preparation, $\beta = .44$, $t(86) = 2.30$, $p = .02$. The higher the expectations, the more students prepared themselves for the final exam. Expectations did not predict exam preparation in the reverse contrasting condition, $\beta = -.09$, $t(86) = .66$, $p = .50$, or in the dwelling condition, $\beta = -.37$, $t(86) = 1.45$, $p = .15$. Furthermore, the relation between expectations and exam preparation in the mental contrasting condition was stronger than in the reverse contrasting condition, $t(86) = 2.2$, $p = .03$, and the dwelling condition, $t(86) = 2.6$, $p = .01$. The relation between expectations and exam preparation did not differ between the reverse contrasting and dwelling condition, $t(86) = .96$, $p = .38$. Finally, when expectations of success were high, students in the mental contrasting condition reported more exam preparation than students in the reverse contrasting condition, $t(86) = 2.8$, $p = .005$, and students in the dwelling condition,

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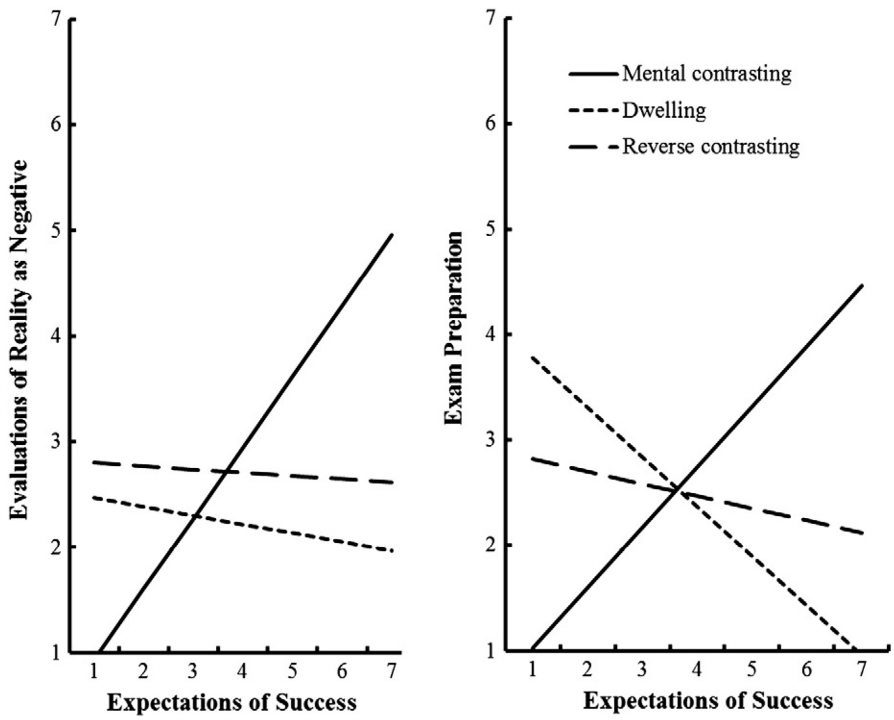

Fig. 1. Study 1: Regression lines depict the relations between expectations of success and evaluations of the reality as negative (left) and between expectations of success and exam preparation (right) as a function of condition.

$t(86) = 3.3$, p = .001. When expectations of success were low, students in the mental contrasting condition tended to report less exam preparation than students in the dwelling condition, $t(86) = 1.76$, $p = .08$, while the difference in the reverse contrasting condition pointed into the right direction, it did not research significance, $t(86) = 1.5$, $p = .13$.

Reality evaluation as mediator

So far, we found that mental contrasting (*versus* control conditions) paired with high expectations led to comparatively more negative reality evaluations and to better exam preparation. On the contrary, when paired with low expectations mental contrasting (*versus* control conditions) led to comparatively less negative reality evaluations and tended to lead to less exam preparation. In the control conditions, expectations of success did not predict the evaluation of the reality or exam preparation. In a last step, we examined whether this difference between the conditions in expectancy-dependent exam preparation was mediated by reality evaluation.

Describing the analysis of such a moderated mediation, Muller, Judd, and Yzerbyt (2005) call for predicting the dependent variable (exam preparation) with a model that includes the independent variables (conditions), the moderator (expectations), their interaction terms, the mediator (reality evaluation), and the moderator–mediator interaction term (expectations by reality evaluation). The coefficient for the condition by expectations interaction in this model should be compared to the coefficient for the condition by expectations interaction from the model without the mediator and its interactions. Note that no formal test for the difference is necessary (see also Preacher, Rucker, & Hayes, 2007).

This moderated mediation analysis yielded a smaller expectation by condition interaction effect for the comparison of the mental contrasting condition with the reverse contrasting condition, $\beta = -.24$, than that in the initial model, $\beta = -.40$, and it was not significant, $t(85) = 1.21$, $p = .23$. Comparing the mental contrasting condition to the dwelling condition showed the same results. Specifically, the expectation by condition interaction effect for the comparison of the mental contrasting condition with the dwelling condition was smaller, $\beta = -.23$, than that in the initial model, $\beta = -.32$, and it was not significant, $t(85) = 1.74$, $p = .08$. Hence, the difference between the mental contrasting condition and the reverse contrasting as well as the dwelling condition in the relation between expectations and exam preparation were at least partially mediated by reality evaluation.

Discussion

Mental contrasting (*versus* control conditions) paired with high expectations led to comparatively more negative evaluations of the reality aspect, pointing to a strengthened meaning of the reality as an obstacle. Mental contrasting (*versus* control groups) paired with low expectations led to comparatively less negative evaluations of the reality, pointing to a weakened meaning of the reality as an obstacle. Second, neither the reverse contrasting condition nor the dwelling condition affected the evaluation of the reality, supporting our notion that for comprehending the meaning of obstacles it is not sufficient to first think about the reality and then turn to the future (as in the reverse contrasting condition) nor to merely focus on the reality (as in the dwelling condition). Finally, we found that the evaluation of the reality mediated mental contrasting effects on exam preparation, pointing to the change in meaning as a trigger of efforts to attain a desired future.

Although indicative, the present findings on the evaluation of the reality aspect are just one indicator of the changed meaning of reality as obstacle. Therefore, in the next study, we sought to replicate these results with a different indicator. Specifically, we investigated whether participants implicitly categorized their reality as an obstacle.

Study 2: implicit obstacle categorization of reality aspect

We used a task-switching paradigm (Kiesel et al., 2010; Vandierendonck, Liefooghe, & Verbruggen, 2010, for overviews) to measure the implicit obstacle categorization of participants' reality. In our version, students worked on two different tasks in random order. They decided either whether a word was an obstacle-word or an aid-word (categorization task), or whether it was presented in yellow or blue (color naming task). We used the same response keys for both tasks. In particular, pressing the left key indicated an aid-word in the categorization task and yellow print in the color naming task. Pressing the right key, on the other hand, indicated an obstacle-word in the categorization task and blue print in the color naming task.

Implicit obstacle categorization of the reality was measured during color naming trials. When a participant's reality aspect, such as "party," was presented in blue, it was a compatible stimulus (*i.e.*, obstacle word and blue were indicated with the right key). The more that participants implicitly categorized the reality as obstacle, the faster they should respond during these color naming trials, because the relevant task-set (*i.e.*, name the color) and the irrelevant task-set (*i.e.*, categorize the word) activate the same responses (*i.e.*, press right key). In contrast, when the reality aspect "party" was presented in yellow, it was an incompatible stimulus (*i.e.*, obstacle word and yellow are indicated with different keys). Hence, the more that participants implicitly categorized the reality as obstacle, the slower they should respond because the relevant task-set (*i.e.*, name the color) and the irrelevant task-set (*i.e.*, categorize the word) activate different responses (press right key *versus* left). The difference in performance (*i.e.*, reaction times and errors) on compatible *versus* incompatible stimuli (*i.e.*, compatibility effect, *e.g.*, Meiran, 1996; Rogers & Monsell, 1995) for participants' reality words during color naming was therefore a measure of their implicit obstacle categorization.

We administered this task switching paradigm in the context of a study about students' desired graduate schools, after inducing a mental contrasting condition and control conditions. Like in Study 1, we wanted to test whether the meaning of reality — this time, indicated by implicit obstacle categorization — supports goal pursuit. We measured goal pursuit as indicated by feelings of responsibility. Such feelings signal that a person assumes responsibility for attaining the desired future rather than leaving it up to external circumstances (Cantor, Norem, Niedenthal, Langston, & Brower, 1987; Oettingen et al., 2001). Based on Oettingen et al. (2001), we asked students to what extent they perceived external circumstances to be responsible for being accepted by the desired graduate school (Oettingen et al., 2001). Since understanding the reality as an obstacle highlights what stands in the way, it should foster goal pursuit as indicated by the feeling that success depends on one's own actions. Thus, implicit obstacle categorization should account for mental contrasting effects on feelings of responsibility.

One limitation of Study 1 is that it is not necessarily the case that mental contrasting strengthened *versus* weakened interpretations of the reality as obstacle. Instead, it could be that the dwelling and reverse contrasting conditions changed these evaluations, and the mental contrasting condition left them untouched. To address this question, in Study 2 we added a control condition in which students elaborated unrelated materials. Reality categorization and goal pursuit in this condition provide a baseline for comparison. We also included the reverse contrasting condition, to control for exposure to content.

Method

Participants

One hundred nineteen students (age $M = 20.1$ years, $SD = 1.3$, female = 70) participated in return for partial course credit. Students were randomly assigned to either a mental contrasting condition ($n = 44$), a reverse contrasting condition ($n = 38$), or an irrelevant content control ($n = 37$) condition.

Procedure and materials

We invited students to a study about undergraduates' thoughts about graduate ("grad") school. Throughout the study the term *grad school* was used to refer to law school, medical school, business school, or a graduate school of the sciences. Students then listed the graduate school they aspired to attend. To measure expectations of success, students responded to the question "How likely do you think it is that you will go to this grad school?" on a scale ranging from 1 (*not at likely*) to 7 (*extremely likely*). Next, students listed a desired outcome that they associated with the future of going to their desired graduate school (students named *e.g.*, "getting a Ph.D.", or "best law school in the nation"). Thereafter, they listed a reality aspect that might stand in the way of going to the desired graduate school. In particular, students read:What could stand in the way of going to this grad school? What could prevent you from going there? Please list one aspect that might prevent you from going to this grad school. Using keywords, please note the first thing that comes to your mind!

Students named reality aspects such as "high levels of stress", or "lack of money." In order to obtain words for use in the task switching task, students summarized their reality aspect with one word that best represented the aspect. Students summarized the reality aspect with words such as "stress" and "money." Finally, students listed one aid that might help them to go to their desired graduate school (students named *e.g.*, "getting good grades", or "gaining experience") and summarized the aid with one word that best represented the aid (*e.g.*, "grades" and "experience").

Thereafter, we established three experimental conditions: a mental contrasting condition, a reverse contrasting condition, and an irrelevant content control condition. In the mental contrasting condition, students mentally elaborated on and wrote about their desired future and their reality aspect, beginning with the desired future. In the reverse contrasting condition, students elaborated on the same content, but started with elaborating the reality aspect. Finally, in the irrelevant content control condition, students first imagined and elaborated a positive experience with one of their teachers at school and second, a recent, negative experience with one of their teachers.

Task switching paradigm

During the task switching paradigm, students performed two different tasks in random order, a categorization task and a color naming task, using the same set of response keys. Specifically, students learned that when the presented word was white, they had to categorize the word as either obstacle-related or aid-related (*i.e.*, categorization task). Students pressed the right key for obstacle-words, and the left key for aid-words. During this categorization task, we presented three obstacle-words (*i.e.*, hindrance, obstruct, barrier) and three aid-words (*i.e.*, assist, support, facilitate). When the presented word was blue or yellow, participants had to identify the color of the word (*i.e.*, color naming task). Here, they pressed the right key for blue, and the left key for yellow. During the color naming task, we presented two obstacle-words (*i.e.*, obstacle, block) as well as two aid-words (*i.e.*, aid, help) in blue and yellow. Additionally, the idiosyncratic words created by the students, representing their reality aspects and their aids, were used as well.

It is important to note that the idiosyncratic reality-words were never explicitly categorized as an obstacle. It is currently debated to what extent compatibility effects in task switching paradigms are caused by stimulus-specific practice, creating links between the stimulus and the category (Kiesel, Wendt, & Peters, 2007). In our case, such practice would mean that participants explicitly categorize their reality-word as obstacle, thereby creating mental links between the reality-word and the obstacle response. Such links, rather than the implicit categorization of the reality-word, might then cause compatibility effects during the color naming task. To avoid any influence of such stimulus-specific practice during the categorization task, students never explicitly categorized their idiosyncratic reality- and aid-words as either obstacles or aides (see Wendt & Kiesel, 2008, for a similar approach).

The whole task-switching procedure consisted of 520 trials. Participants started with 40 practice trials and then performed 480 critical trials, presented in 10 blocks with 48 trials each. In each block, participants indicated the color of the presented word on half of the trials, and categorized the presented word on the other half of the trials. The 24 color-naming trials consisted of 12 blue words and 12 yellow words. The 24 categorization trials consisted of 12 obstacle trials and 12 aid trials. On obstacle trials, three different obstacle words (*i.e.*, hindrance, obstruct, barrier) were presented four times each. The task (*i.e.*, word categorization *vs.* color naming) was chosen randomly on each trial, so that participants did not know which task was coming next, and thereby could not prepare for it. Although compatibility effects are often unaffected by task preparation — a finding referred to as one of the more surprising observations in the task-switching literature (Monsell, Sumner, & Waters, 2003, p. 338) — we tried to minimize preparatory activities for the next trial by complete randomization.

As main dependent measure, we calculated the compatibility effect on task switching trials for students' reality-words. Reaction times and error proportions were calculated by averaging across all of the color naming trials with reality-word trials that were preceded by one or more categorization trials. Error trials were excluded for reaction time analyses. To obtain a measure of implicit obstacle categorization, we subtracted reaction times and errors on compatible trials (*i.e.*, reality-words printed in blue) from reaction times and errors on incompatible trials (*i.e.*, reality-words printed in yellow). Hence, higher scores indicated stronger implicit obstacle categorization.

Note that we only used switch trials (*i.e.*, color naming trials preceded by categorization trials) to compute our implicit obstacle categorization estimates. Based on theoretical reasoning and on empirical findings, switch trials should be best suited to measure implicit obstacle categorization. First, numerous task switching studies found a larger compatibility effect on switch trials than on repetition trials (*e.g.*, Kiesel et al., 2010; Meiran, 2005); a finding we replicated with our paradigm (see below). The compatibility effect of the reality-word is driven by a) how strongly the categorization task set is active, and b) how strongly the color naming task set is active. When switching from categorization to color naming (*i.e.*, switch trials), the categorization task set should be more active than when repeating the color naming task (*i.e.*, repetition trials). Hence, the chance to observe any manipulation effects on the compatibility effects should be best on switch trials. Second, compatibility effects are decreased during task repetition when the previous trial was incompatible (Kiesel, Kunde, & Hoffmann, 2006). Applied to our paradigm, this suggests that if participants had an incompatible color naming trial (*e.g.*, the word "barrier" presented in yellow) beforehand, the compatibility effects for the reality-word on trials thereafter are reduced. Hence, half of the repetition trials (*i.e.*, the ones preceded by incompatible trials) is not well suited to measure compatibility effects for the reality-words. To summarize, switch trials, rather than repetition trials are most appropriate to measure the implicit obstacle categorization of participants' reality-words.

Goal pursuit

Finally, we measured feelings of responsibility as indicator of goal pursuit. Students indicated to what extent they perceived external circumstances to be responsible for getting in the desired graduate school, using a 7-point scale ranging from 1(*not at all*) to 7 (*very*). The item was reverse-coded so that higher numbers indicated stronger feelings of personal responsibility (Oettingen et al., 2001, Study 1).

Results

Data of three students were not included into the analysis because the students failed to summarize either their reality aspect or their aid with one word; instead they provided several words. Hence, the final sample consisted of 115 students.

Task switching paradigm

First, we tested whether we could replicate previous findings on switch costs, which would indicate that our task switching paradigm measured the implicit categorization of the reality aspects *via* compatibility effects on color-naming trials. We expected that performance (*i.e.*, reaction times and errors) on color-naming trials would be weaker for incompatible stimuli (*i.e.*, stimuli with different responses on both tasks) compared to compatible stimuli (*i.e.*, stimuli with same responses on both tasks) for obstacle- and aid-words, thereby indicating compatibility effects of the task irrelevant dimension (*i.e.*, obstacle-related or aid-related) during the color-naming trials. Moreover, these compatibility effects should be most pronounced after task switches from the categorization task to the color-naming task.

We conducted a repeated measures analysis of variance with the factor compatibility (incompatible *versus* compatible), task sequence (repetition *versus* switch), and type of words (obstacle-words *versus* aid-words) on reaction times. The results showed the expected main effects of compatibility, $F(1,114) = 27.54$, $p < .001$, and task sequence, $F(1,114) = 164.21$, $p < .001$, as well as the expected interaction effect between compatibility and task sequence, $F(1,114) = 10.60$, $p = .004$. Specifically, students responded slower to incompatible than to compatible trials ($M = 673$ ms *versus* $M = 631$ ms) and they responded slower on switch trials than on repetition trials ($M = 710$ ms *versus* $M = 593$ ms). Importantly, we found that compatibility effects (*i.e.*, reaction times on compatible trials subtracted from reaction times on incompatible trials) were stronger on task switches ($M = 60$ ms) than on task repetition trials ($M = 25$ ms). Finally, we did not find a main effect for type of words (*i.e.*, obstacle *versus* aid) or any two-way or three-way interaction effects between type of words, sequence, and compatibility, $Fs < 1.6$, $ps > .20$.

Applying the same analysis to the error rates replicated the pattern of results. There were the expected main effects of compatibility, $F(1,114) = 82.21$, $p < .001$, and task sequence, $F(1,114) = 47.39$, $p < .001$, and the interaction effect between compatibility and task sequence, $F(1,114) = 28.85$, $p < .001$. Specifically, students generated more errors on incompatible than on compatible trials ($M = .08$ *versus* $M = .03$) and generated more errors on switch trials than on repetition trials ($M = .07$ *versus* $M = .03$). Importantly, compatibility effects (*i.e.*, error rate on compatible trials subtracted from error rate on incompatible trials) were stronger on task switches ($M = .08$) than on task repetition trials ($M = .03$). Furthermore, we did not find a main effect for type of words (*i.e.*, obstacle *versus* aid) or any two-way or three-way interaction effects between type of word, sequence, and compatibility, $Fs < .6$, $ps > .43$.

These results imply that the obstacle-words and aid-words were implicitly categorized on color naming trials, which caused compatibility effects in reaction times and errors rates, especially on task switch trials. Thus, the task switching paradigm detected whether students implicitly categorized a word as either an obstacle or an aid.

Implicit categorization of the reality as obstacle

We hypothesized that students with high expectations of success after mental contrasting would show the strongest compatibility effects for their reality-words, whereas students with low expectations of success after mental contrasting would show the weakest compatibility effects.

Compatibility effects derived from reaction times. First, we looked at compatibility scores derived from reaction times. We used hierarchical regression analysis predicting the compatibility scores of students' reality-words, and entered the main effects of expectation of success 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 improved the model, $R^2_{change} = 6\%$, $F_{change}(2,109) = 3.89$, $p = .02$ (Fig. 2, left). In the mental contrasting condition, expectations predicted compatibility scores, $\beta = .63$, $t(109) = 3.71$, $p = .001$. The higher the expectations of success, the stronger were the compatibility scores. Expectations did not predict compatibility scores in the reverse contrasting condition, $\beta = .06$, $t(109) = .42$, $p = .67$, or in the irrelevant content control condition, $\beta = .07$, $t(109) = 0.41$, $p = .89$. Furthermore, the relation between expectations and compatibility scores in the mental contrasting condition was stronger than in the reverse contrasting condition, $t(109) = 2.60$, $p = .01$, and in the irrelevant content control condition, $t(109) = 2.33$, $p = .02$. The relation between expectations and compatibility scores did not differ between the reverse contrasting and irrelevant content control condition, $t(109) = .05$, $p = .95$.

Finally, when expectations of success were high, students in the mental contrasting condition tended to show stronger compatibility effects than students in the reverse contrasting condition, $t(109) = 1.81$, $p = .07$, and had stronger compatibility effects than students in the irrelevant content control condition, $t(109) = 2.02$, $p = .04$. When expectations of success were low, students in the mental contrasting condition showed weaker compatibility effects than students in the reverse contrasting condition, $t(109) = 2.84$, $p = .005$, and students in the irrelevant content control condition, $t(109) = 2.22$, $p = .03$ (Fig. 2, left).

Compatibility effects derived from errors. We replicated this pattern of results with a compatibility measure derived from errors. Adding the interaction terms improved the model, $R^2_{change} = 9\%$, $F_{change}(2,109) = 5.83$, $p = .004$ (Fig. 2, middle). In the mental contrasting condition, expectations predicted compatibility scores, $\beta = .70$, $t(109) = 4.01$, $p < .001$. The higher the expectations of success, the stronger the compatibility scores were, indicating stronger implicit obstacle categorization. Expectations did not predict compatibility scores in the reverse contrasting condition, $\beta = .01$, $t(109) = .07$, $p = .94$, or in the irrelevant content control condition, $\beta = -.01$, $t(109) = 0.04$, $p = .97$. Also, the relation between expectations and compatibility scores in the mental contrasting condition was stronger than in the reverse contrasting condition, $t(109) = 3.15$, $p = .002$, and in the irrelevant content control condition, $t(109) = 2.90$, $p = .004$. The link between expectations and compatibility scores did not differ between the reverse contrasting and irrelevant content control condition, $t(109) = .02$, $p = .98$. When expectations of success were high, students in the mental contrasting condition showed stronger compatibility effects than students in the reverse contrasting condition, $t(109) = 3.40$, $p = .001$, and students in the irrelevant content control condition, $t(109) = 2.95$, $p = .004$. When expectations of success were low, students in the mental contrasting condition showed weaker compatibility effects than students in the reverse contrasting condition, $t(109) = 2.32$, $p = .02$, and students in the irrelevant content control condition, $t(109) = 2.38$, $p = .02$.

Control analyses

One feature of students' reality-words was that they were generated by the participants. Thus one might argue that mental contrasting effects on categorization of reality-words were observed because

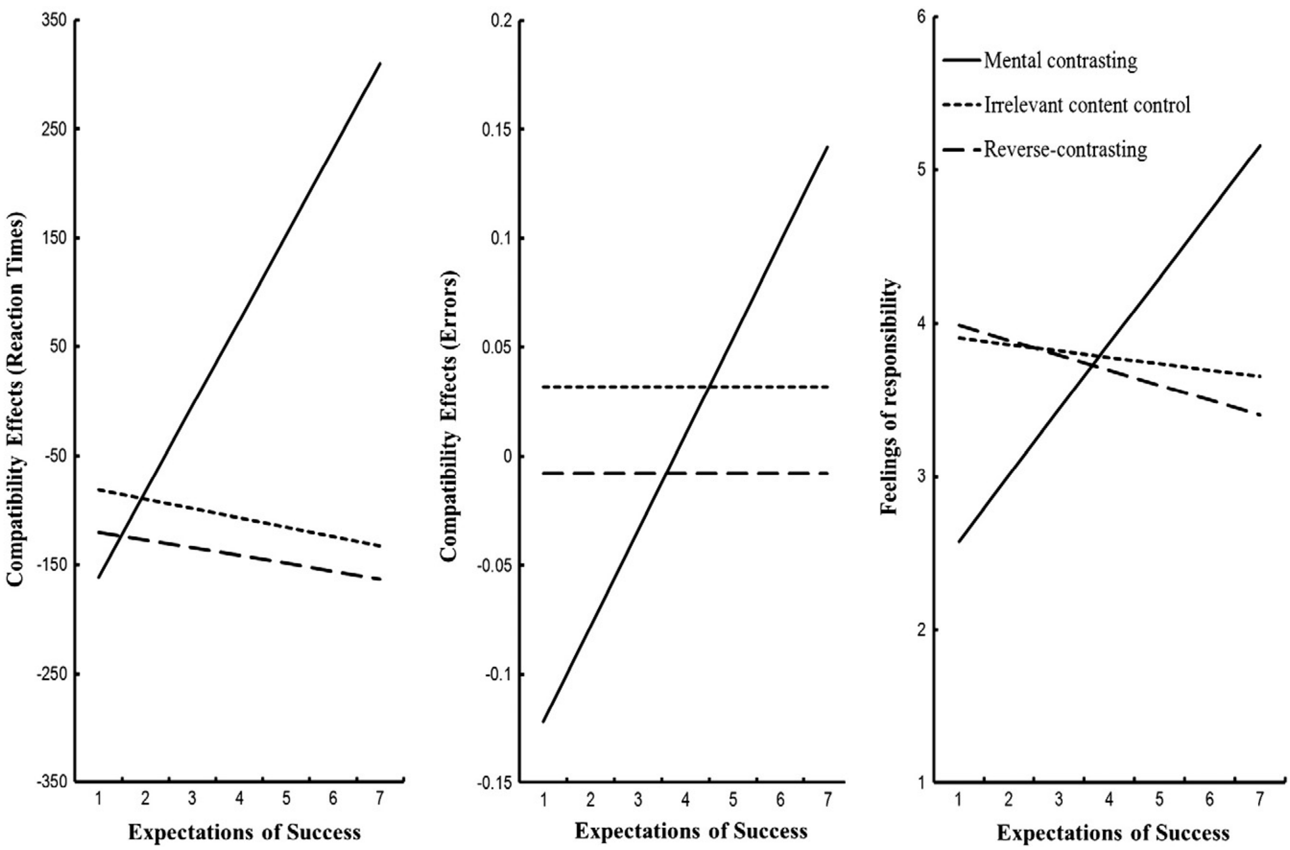

Fig. 2. Study 2: Regression lines depict the relations between expectations of success and compatibility effects derived from reaction times (left), compatibility effects derived from errors (middle), and feelings of responsibility (right) as a function of condition.

these words were self-generated. Though this explanation is unlikely (reality-words were also self-generated in the control conditions), we tried to exclude this alternative interpretation. Specifically, we tested the effects of expectations, conditions, and their interaction on the compatibility scores of the idiosyncratic help words. As expected, none of the main effects or interaction effects neither for compatibility scores derived from reaction times nor derived from errors reached significance, βs < .13, *ps* < .50.

But maybe not only students' idiosyncratic reality-words were categorized as obstacles, but the category of obstacles in general was differentially affected by the mental contrasting *vs.* control conditions. We predicted that mental contrasting changes the meaning of a specific aspect of reality, but does not affect the category *obstacles* in general. For example, when students think about the reality that stands in the way of being admitted to their desired graduate school such as having not quite the GPA yet, students should ready themselves to invest resources whenever GPA-related thoughts are triggered. They should not ready themselves to invest resources when they see the word "obstacle" written on a blackboard. Hence, we only expected mental contrasting effects on the idiosyncratic word, not on the word for the category of obstacle (*i.e.*, the words barrier, obstacle) in the color naming task. We tested the effects of expectations, conditions, and their interaction on the compatibility scores derived from the words for the category of obstacle (*i.e.*, barrier, obstacle) in the color naming task. Again, none of the main effects or interaction effects reached significance, βs < .19, *ps* < .29. To summarize, mental contrasting seems to affect the categorization of students' idiosyncratic reality aspects rather than making the category of obstacles more accessible.

Feelings of responsibility

Next, we tested whether mental contrasting affected feelings of responsibility in line with expectations of success. Applying the same set of analysis as before showed the predicted pattern of results. Specifically, adding the interaction terms improved the model, $R^2_{\text{change}} = 5\%$, $F_{\text{change}}(2,111) = 3.26$, $p = .04$ (Fig. 2, right side). In the mental contrasting condition, expectations predicted feelings of responsibility, $\beta = .46$, $t(111) = 2.49$ $p = .01$. Expectations did not predict feelings of responsibility in the reverse contrasting condition, $\beta = .10$, $t(111) = .77$, $p = .43$, or in the irrelevant content control condition, $\beta = .04$, $t(111) = .30$, $p = .80$. Furthermore, the relation between expectations and feelings of responsibility in the mental contrasting condition was stronger than in the reverse contrasting condition, $t(111) = 2.46$, $p = .02$, and in the irrelevant content control condition, $t(111) = 1.99$, $p = .05$. The relation between expectations and feelings of responsibility did not differ between the reverse contrasting and irrelevant content control condition, $t(111) = .28$, $p = .78$. When expectations of success were high, students in the mental contrasting condition had stronger feelings of responsibility than students in the reverse contrasting condition, $t(111) = 1.62$, $p = .01$, but not than students in the irrelevant content control condition, $t(111) = 1.36$, $p = .17$. When expectations of success were low, students in the mental contrasting condition showed weaker feelings of responsibility than students in the reverse contrasting condition, $t(111) = 2.86$, $p = .005$, and weaker feelings of responsibility than students in the irrelevant content control condition, $t(111) = 2.33$, $p = .02$. To summarize, we replicated past research (Oettingen et al., 2001) showing that mental contrasting fosters feelings of responsibility when expectations of success are high, and weakens feelings of responsibility when expectations of success are low.

Implicit categorization of reality as obstacle: mediator analyses

In the last step, we tested whether mental contrasting effects on feelings of responsibility were mediated by implicit obstacle categorization. We applied the same analysis to test the mediated moderation as in Study 1. We started by using the compatibility scores derived from reaction times. This analysis had yielded a smaller expectation by condition interaction effect for the comparison with the reverse contrasting condition, $\beta = .38$ (compared to $\beta = .70$), and a smaller interaction effect for the comparison with the irrelevant content control condition, $\beta = .28$ (compared to $\beta = .66$). Both interaction terms stayed significant, $t(110) = 2.40$, $p = .02$, and, $t(110) = 2.04$, $p = .04$, respectively. These results indicate that the difference between the mental contrasting condition and the reverse contrasting condition as well as between the mental contrasting condition and the irrelevant content control condition in the relation between expectations and feelings of responsibility was partially mediated by implicit categorization of reality as obstacle, measured by the compatibility scores derived from reaction times.

We observed the same pattern of results using the compatibility effect scores derived from errors. There was a smaller expectation by condition interaction effect for the comparison with the reverse contrasting condition, $\beta = .28$, than that in the initial model, $\beta = .83$, and the adjusted effect did not reach significance, $t(110) = 1.80$, $p = .08$. Furthermore, the condition by interaction effect for the comparison with the irrelevant content control condition was smaller, $\beta = .20$, than that in the initial model, $\beta = .80$, and also was not significant, $t(110) = 1.21$, $p = .15$. Hence, the difference between the mental contrasting condition and the reverse contrasting condition as well as between the mental contrasting condition and the irrelevant content control condition in the relation between expectations and feelings of responsibility was at least partially mediated by the implicit categorization of reality as obstacle, measured *via* compatibility scores derived from errors.

Discussion

In the mental contrasting condition, students with high expectations of success showed the strongest compatibility effects upon seeing their reality aspects, and those with low expectations of success showed the weakest. We found these mental contrasting effects on implicit categorization of reality as obstacle when compatibility effects were measured *via* reaction times or errors. In contrast, students in the control conditions (*i.e.*, reverse contrasting and irrelevant content control condition) showed intermediate compatibility effects independent of their expectations of success. Finally, interaction effects of conditions with expectations on feelings of responsibility were mediated by implicit categorizations of reality as obstacle. This pattern of results supports our notion that mental contrasting changes the meaning of the reality, which in turn modulates goal pursuit.

Our control analyses in Study 2 confirmed that mental contrasting did not shape implicit categorization of obstacles in general (*i.e.*, the words obstacle, barrier). Rather, mental contrasting modulated the meaning of participants' own reality as to whether it signaled to them as an obstacle or not. However, seeing one's own reality aspect as an obstacle should affect the detection of potential new obstacles. When people understand the role an object plays in relation to others, they are prone to discover other objects with a similar role (*e.g.*, Gentner & Markman, 1997). Thus, in the final study, we tested whether mental contrasting with high expectations of success facilitates the identification of new obstacles.

Study 3: detecting new obstacles

To test whether mental contrasting affects the readiness to detect new obstacles that stand in the way of reaching the desired future, we examined the performance of children on two chess tasks, an obstacle task and a non-obstacle task. In chess, players sometimes have to detect a piece (*e.g.*, a queen) that is, physically, an obstacle on the way to capture the opponents' king (*i.e.*, checkmate). Whereas more often than not one's opponent's pieces such as the queen are obstacles because they are protecting squares important for checkmate,

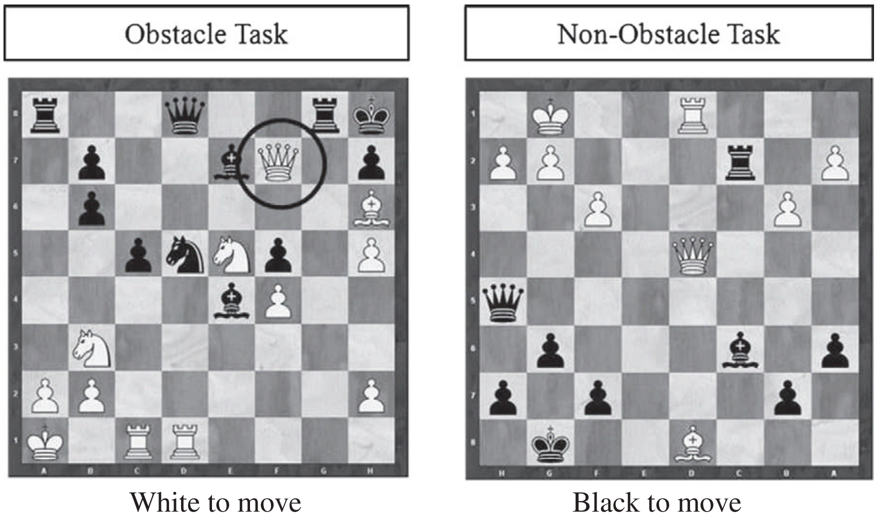

Fig. 3. On the obstacle task (left), children had to identify that their own queen (circled) stands in the way of the checkmate, on the non-obstacle task (right), the solution required a series of clever moves trapping the king, unrelated to seeing something standing in the way.

sometimes one's own pieces may stand in the way. Even one's queen, the most powerful piece a player has, might physically obstruct capturing the opposing king. In these cases, the queen needs to be removed in order to win, a situation called clearance (Neistadt, 1987; Polgar, 1998) or clearing the space (Blokh, 1994). In our obstacle task, children had to detect their queen as an obstacle towards checkmate (Fig. 3, left side). In contrast, in the non-obstacle task, none of the pieces — neither one's own nor the opposing ones — was an obstacle physically standing in the way or an obstacle because it protected important squares. Rather, the non-obstacle task required the children to detect a trap for capturing the king (Fig. 3, right side).

Pilot testing found that the selected chess tasks were equally difficult for children about 10 to 12 years old, who had received formal chess education, and whose performance level did not exceed 1300 points on the *Deutsche Wertungszahl*, the German equivalent of the *Elo* system (*i.e.*, an objective standard to measure the performance level of chess players, Elo, 1978). We preselected children accordingly. We hypothesized that children in the mental contrasting condition with high expectations should most readily detect the queen as a physical obstacle towards the desired checkmate and thus should perform best of all children on the obstacle task, while they should not show a different performance than the other children on the non-obstacle task.

Method

Participants

Children were recruited from six chess clubs in Germany. The coaches of each of these chess clubs preselected the children based on the following criteria: a) about 10 to 12 years old, b) received formal chess education, and c) performance level did not exceed 1300 points on the *Deutsche Wertungszahl*. A total of 65 children (13 female, age $M = 11.5$ years, $SD = 1.2$) participated.

Procedure and measures

Children learned that the objective of the study was to discover more about what children who play chess think and feel. A lottery in which they could win chess computer programs was included. We then measured children's chess skills. We assessed the time period they had been in a chess club and their performance on two baseline chess tasks mirroring the experimental chess tasks. These baseline tasks enabled us to use actual performance as a baseline measure and helped the children to form accurate expectations of solving the critical chess tasks. Also, we wanted to familiarize the children with the procedure of working on the experimental chess tasks. Specifically, experimenters first arranged the chess pieces on the board to ensure correct positioning of every piece, handed the children the task sheet, and then each child had a maximum of 8 min to solve the baseline task.

Children then learned that they could participate in a lottery to win chess computer programs. For this lottery, they could win tickets according to their performance on two further chess tasks. When they solved one of these tasks in less than 2 min, they would get 5 tickets; in less than 4 min, they would get 4 tickets, in less than 6 min they would get 3 tickets, and in less than 8 min, they would get 2 tickets. Next, children were told that before starting the two chess tasks, we wanted to know more about their thoughts and feelings about these tasks and the lottery. Children first indicated how many tickets they would like to win, ranging from 1 to 10, and then, to measure expectations, we asked the children how likely it was that they would win the desired number of tickets on a scale ranging from 1 (*not at all*) to 7 (*very likely*).

Thereafter, we established two experimental conditions, a mental contrasting and a reverse contrasting condition. In the mental contrasting condition, children named a desired future they associated with winning the desired number of tickets. They read: “Imagine you would win the desired number of tickets — what would be the very best thing about winning? Please write down this very best thing.” Then, children wrote down their corresponding thoughts and images. They read:

> “Now, try to imagine this very best thing. What does it mean to you? Try first to depict this very best thing by using your fantasies and imagination. Then, try to describe these fantasies and images as vividly as possible. Use the provided space.”

In the next step, they were asked to imagine a reality aspect that could hinder them winning the desired number of tickets. First they read: “What could hinder you from winning the desired number of tickets? What could stand in your way? Please write down this obstacle.” Children were then led to write down their corresponding thoughts and images. They read:

> “Now, try to imagine this obstacle. What does it mean to you? Try first to depict this obstacle by using your fantasies and imagination. Then, try to describe these fantasies and images as vividly as possible. Use the provided space.”

In the reverse contrasting condition, children elaborated the same content with the same instructions, but in reverse order.

Please cite this article as: Kappes, A., et al., Mental contrasting changes the meaning of reality, *Journal of Experimental Social Psychology* (2013), http://dx.doi.org/10.1016/j.jesp.2013.03.010

Dependent variables

Finally, the children worked on the two experimental chess tasks, the obstacle and the non-obstacle task, in randomized order. On the obstacle task, to attain checkmate, children had to detect that their own queen stood in the way of the checkmate (Fig. 3, left side). They were given the white pieces, and the solution to checkmate required two moves with the first being moving one's own queen. Following the notation of the World Chess Federation, the solution for the obstacle task was:

1. Qf6 + Bxf6
2. Nf7#

In the non-obstacle task, to attain checkmate, children had to detect a series of moves trapping the opposing king, unrelated to seeing something standing in the way. Importantly, in the non-obstacle task neither one's own nor the opposing pieces were obstacles physically standing in the way to checkmate, nor were obstacles protecting important squares (Fig. 3, right side). The children had the black pieces, and the solution required three moves. In the notation of the World Chess Federation, the solution for the non-obstacle task was:

1. …Rxg2 +
2. Kxg2 Qxf3 +
3. Kg1 Qf2#

Note that in the obstacle task the player's color is white and the solution for attaining checkmate in the obstacle task involves two moves; in the non-obstacle task the player's color is black and the solution involves three moves. However, the tasks do not differ in difficulty, as we had pretested and as it is described in chess text books. Therefore, we assume that neither the color of pieces nor the number of moves to reach checkmate affects performance on these tasks. As our dependent variables, we recorded whether the child discovered the right solution to each problem (coded 1) or not (coded 0). We used the same procedure that we used for the baseline tasks, described above.

Results

In all of the subsequent analyses, we adjusted for skill level by including the performance on the control chess tasks as well as years of practicing chess as control variables.

Obstacle versus non-obstacle task performance

We first tested whether the effects of the self-regulatory strategies differed for the performance on the obstacle and the non-obstacle tasks. Using generalized estimating equations (Schafer, 2006) to account for within-subject correlations between the performance on both tasks, we specified a model including as independent variables, condition, the continuous expectation measure, type of task (*i.e.*, non-obstacle *versus* obstacle) and the control variables (*i.e.*, performance on the baseline chess tasks and years of practicing chess), all two-way interactions as well as the three-way interaction between condition, the continuous expectation measure, and type of task; dependent variable was performance on the tasks. As predicted, we found the significant three-way interaction effect, $\chi^2(1) = 4.22$, $p = .04$, indicating that the expectancy-dependent effects of condition differed for performance on the obstacle and on the non-obstacle tasks. Consequently, we analyzed the performance for both tasks independently.

Performance on obstacle task

We performed a logistic regression analysis with performance on the obstacle task (*i.e.*, solving the task or not) as dependent variable, and expectations, condition, and the interaction between expectations and condition as independent variables. As hypothesized, there was an interaction effect between condition and expectations in predicting the likelihood of solving the obstacle task, $\chi^2(1,\ N = 65) = 4.94$, $p = .02$, Nagelkerke $R^2_{\text{change}} = .09$. As depicted in Fig. 4, in children with high expectations, mental contrasting led to a higher probability of solving the chess task than reverse contrasting, $\chi^2(1, N = 65) = 6.32$, $p = .01$, whereas in children with low expectations mental contrasting condition tended to lead to a lower probability of solving the task than children in the reverse contrasting condition, $\chi^2(1, N = 65) = 2.90$, $p = .08$.

Performance on non-obstacle task

We then looked at children's performance at the non-obstacle task. A logistic regression analysis was performed with expectations, condition, and the interaction between expectations and condition. We did not find a main effect of condition, $\chi^2(1, N = 65) = .81$, $p = .37$, a main effect for expectations, $\chi^2(1, N = 65) = .87$, $p = .35$, or an interaction effect between condition and expectations on the performance on the task, $\chi^2(1, N = 65) = .01$, $p = .99$ (see Fig. 4).

Discussion

We found that mental contrasting paired with high expectations led children to detect an obstacle standing in the way of solving a chess task more readily than in the reverse contrasting control condition. This finding suggests that mental contrasting paired with high expectations readies participants to detect new obstacles which stand in the way of achieving their desired future. Once participants understand the meaning of the reality aspect as an obstacle towards attaining the desired future, they more easily detect new aspects in their environment with a similar function. Mental contrasting paired with low expectations had the opposite effect: Children were less likely to detect the obstacle to solving the chess task than in the reverse contrasting control condition. This finding suggests that mental contrasting with low expectations inhibits the detection of relevant obstacles. As predicted, in the reverse contrasting condition, there was no indication of either facilitated obstacle detection when paired with high expectations or of inhibited obstacle detection when paired with low expectations of success.

These results expand recent findings on how mental contrasting facilitates effective goal pursuit. Kappes, Singmann, and Oettingen (2012), for instance, found that mentally contrasting with high expectations of success prepared participants for overcoming their reality aspects when actually encountering them. Specifically, mental contrasting with high expectations led participants to form strong mental associations between their reality aspect (*i.e.*, elevator when the desired future was fitness) and a behavior instrumental for overcoming the reality aspect (*i.e.*, exercise; Study 2). When participants stepped out of the lab and encountered their reality aspect, the strongly formed mental associations elicited the instrumental behavior (*i.e.*, participants took the stairs despite the elevator being right in front of them; Study 2). Expanding these results, the present research showed that mental contrasting with high expectations also readies participants to detect new obstacles standing in the way, thereby providing additional preparation for goal pursuit that goes beyond the mentally elaborated reality aspect.

General discussion

Three studies support our notion that mental contrasting a desired future paired with high expectations strengthens the meaning of the present reality as an obstacle. Specifically, after mental contrasting paired with high expectations, participants evaluated their reality aspect more negatively (Study 1) and categorized their reality more as an obstacle (Study 2) than respective participants in the control conditions. The results also showed that the effects of mental contrasting on goal pursuit (exam preparation in Study 1, feelings of

Please cite this article as: Kappes, A., et al., Mental contrasting changes the meaning of reality, *Journal of Experimental Social Psychology* (2013), http://dx.doi.org/10.1016/j.jesp.2013.03.010

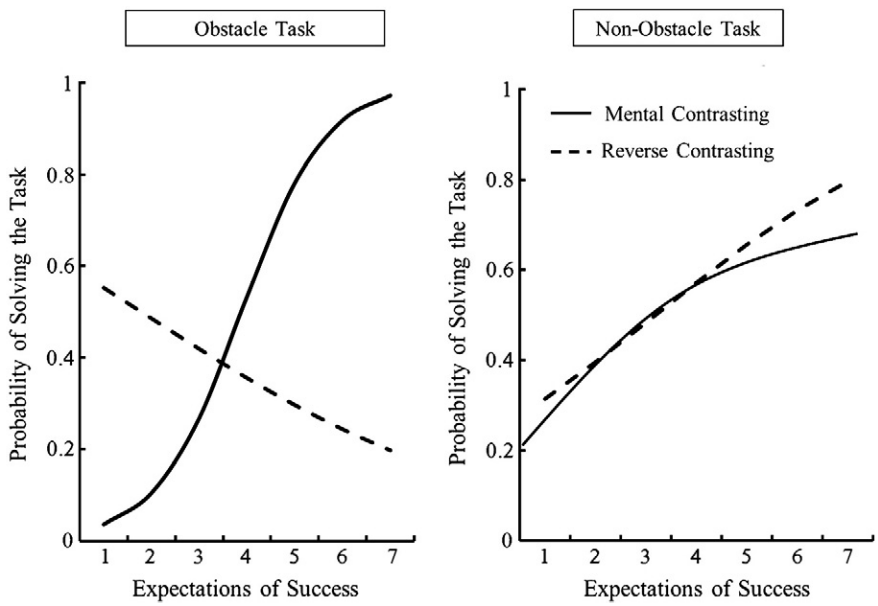

Fig. 4. Study 3: Logistic regression lines depict the relation between expectations of success and probability of solving the obstacle task (left) and between expectations of success and probability of solving the non-obstacles task (right) as a function of condition.

responsibility in Study 2) were mediated by the change in meaning of present reality. Moreover, children after mental contrasting paired with high expectations were more ready to detect a chess piece as an obstacle to achieve checkmate and winning a desired prize compared to the control condition (Study 3), further suggesting that mental contrasting paired with high expectations promotes the meaning of the present reality as an obstacle. On the other hand, mental contrasting paired with low expectations weakened the meaning of reality aspects as obstacles. Participants evaluated their reality aspect less negatively than respective participants in the control conditions (Study 1), and implicitly categorized their reality aspect less as an obstacle (Study 2). This lack of obstacle understanding translated into the suspension of efforts to attain the desired future (Studies 1, 2). Finally, participants with low expectations in the mental contrasting condition were less ready than control participants to detect a chess piece as an obstacle (Study 3), suggesting that mental contrasting paired with low expectations inhibits subsequent obstacle detection.

Alternative explanations

One might argue that not only mental contrasting, but any elaboration of both the desired future and the reality would lead to the understanding of one's reality as an obstacle in line with one's expectations of success. The results of the reverse contrasting condition do not support this prediction. Elaborating the reality first without the desired future as a context did not influence the meaning of the reality as an obstacle, and it did not match the meaning of reality as an obstacle to people's expectations of success (Studies 1, 2, and 3). However, one might argue that any elaboration ending with the reality (as in mental contrasting) affects the meaning of reality as an obstacle. The results of the dwelling condition do not support this argument (Study 1). Elaborating the reality without beforehand elaborating the desired future did not affect the meaning of reality. Finally, one might argue that conditions such as the reverse contrasting and dwelling conditions obscured the meaning of reality, not mental contrasting changing it. The results of the irrelevant content control condition in which participants elaborated content unrelated to the desired future or the present reality, suggest otherwise. Here, participants showed the same pattern of results as the participants in the reverse contrasting condition (Study 2).

Another concern might relate to the use of idiosyncratic words. In Studies 1 and 2, participants evaluated and implicitly categorized obstacle words that they had previously named. Hence, maybe systematic differences in the idiosyncratic reality words between the conditions could explain effects. Yet, since participants were randomly assigned to the different conditions *after* they named their idiosyncratic obstacle words, potential differences in these words such as word length and word frequency cannot explain the results.

Finally, we measured rather than manipulated expectations. However, past research showed that mental contrasting has the same effects on goal pursuit independent on whether the expectation where measured or manipulated. Oettingen, Marquardt, and Gollwitzer (2012), for instance, first manipulated participants' expectations about their creative potential, then induced a mental contrasting condition (*versus* control conditions), and finally observed creative performance. In two experiments, they found that participants in the mental contrasting condition with experimentally manipulated high expectations outperformed participants with experimentally manipulated high expectations in the control conditions. They also outperformed all other participants who were induced moderate expectations. These results suggest that mental contrasting effects are not due to confounding variables associated with measured expectations, but rather that mental contrasting renders expectations relevant for goal pursuit. Furthermore, in our studies, the relationships between expectations and the dependent variables in the mental contrasting condition are unlikely to reflect preexisting associations between the variables since they only emerged in the mental contrasting condition, but not in the control conditions.

Theoretical implications

According to fantasy realization theory (Oettingen, 2000; Oettingen et al., 2001; summary by Oettingen, 2012), mental contrasting helps people to understand that the reality is an obstacle standing in the way of the desired future, and thereby exerts its influence on goal pursuit. The present findings underscore this notion and thereby help to interpret previous findings of mental contrasting effects. Perceiving the reality as an obstacle standing in the way of the desired future should mobilize goal-directed effort (Oettingen et al., 2009), spur forming plans to overcome the obstacle (Oettingen et al., 2001, Study 1), increase feelings of responsibility for the attainment of the desired future (Study 2; Oettingen et al., 2001, Study 3), and further insights into what it takes to attain to overcome the obstacle and to attain the desired future (Adriaanse et al., 2010; Kirk, Oettingen, & Gollwitzer, in press). On the other hand, the present results also shed light on why previous research repeatedly found that mental contrasting, when expectations are low, led to decreased efforts towards attaining the desired future. Once the reality is understood as being unlikely to be overcome, it is not an obstacle anymore, and hence people no longer muster effort or make plans to attain the desired future.

By helping people to understand the reality as an obstacle, mental contrasting paired with high expectations should also help people to recognize behaviors instrumental in overcoming the obstacle. In line with this argument, recent studies found that mental contrasting paired with high expectations established strong associations between the reality and instrumental behaviors which in turn instigated the behavior when the reality aspects were actually encountered (Kappes, Singmann, & Oettingen, 2012). Furthermore, such mental contrasting effects should be rendered even more powerful, if participants are given effective strategies to handle their reality aspects. And indeed, giving participants implementation intentions (Gollwitzer, 1999), an effective self-regulatory strategy to address obstacles, amplified the effects of mental contrasting on successfully changing one's behavior (Adriaanse et al., 2010; Kirk et al., in press). Additionally, mental contrasting rendered implementation intentions more effective than implementation intentions alone (Adriaanse et al., 2010; Kirk et al., in press). These results underscore that the combination of understanding the reality as an obstacle and effective strategies to overcome the obstacles should ensure self-regulation success.

The meaning of reality and goal pursuit

The results of Studies 1 and 2 stress the importance of the meaning of the reality as an obstacle for goal pursuit. In both studies, we found that understanding the reality as obstacle facilitated the beneficial effects of mental contrasting on goal pursuit. These findings are in line with the assumption that self-regulatory efforts critically hinge on the identification of the relevant obstacles that then can be addressed (Gollwitzer et al., 2005; Oettingen, 1996; Zhang & Fishbach, 2010). This notion also implies that a lack of the meaning of the reality as an obstacle should lead to the cessation of efforts. The findings in the mental contrasting condition paired with low expectations support this implication. Here, participants' lack of seeing the reality as an obstacle led to reduced effort to attain the desired future even when compared to the control groups.

In Study 1, participants in the control conditions did not invest the amount of effort that would have been adequate based on participants' expectations of success. We assume that the inadequate investment was not due to lack of capability, as students' counterparts in the mental contrasting conditions did invest the requested effort. Similarly, in Study 2, students in the control conditions did not feel that it is their responsibility to get into their desired graduate school, even when their expectations of success were high. It seems that the understanding of the relevant reality aspects as obstacle was missing to trigger efforts and feelings of responsibility. Taken together, our results speak to the importance of assigning the meaning of obstacles to relevant aspects of reality for successful goal pursuit.

Conclusion

The country singer Dolly Parton once said in an interview: "The way I see it, if you want the rainbow, you gotta put up with the rain." In a similar vein, research on mental contrasting suggests that in order to attain a desired future, people should not exclude the reality from their thinking. Rather, after dreaming about the desired future, people should turn to mentally elaborating the reality. Only then will they discover whether the reality constitutes an obstacle that can be overcome towards reaching the desired future. Once the reality acquires the meaning of an obstacle, solutions might reveal themselves, such as simply bringing an umbrella along the way.

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