Mental Contrasting and Transfer of Energization

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Abstract

Mental contrasting a desired future with present reality is a self-regulation strategy that fosters energization in line with a person's expectations of successfully attaining the desired future. We investigated whether physiological energization (measured by systolic blood pressure) elicited by mental contrasting a desired future of solving a given task transfers to effort in an unrelated task. As predicted, mental contrasting a desired future of excelling in an intelligence test (Study 1) and of writing an excellent essay (Study 2) triggered changes in energization that translated into physical effort in squeezing a handgrip (Study 1) and translated into mental effort in writing a get-well letter (Study 2). Results suggest that mental contrasting of solving one task triggers energization that may fuel effort for performing an unrelated task. Implications for intervention research are discussed.

Keywords

mental contrasting, expectations, energization, effort, performance

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A young adult is considering whether to start a career in singing. Mental contrasting the desired future of becoming a successful artist (e.g., being admired) with obstacles in the present reality that stand in the way of becoming a successful artist (e.g., not yet having performed on stage) will help her in mobilizing the necessary energy to pursue the desired future (e.g., practice singing), given that she has high expectations of attaining the desired future. Indeed, mental contrasting, a desired future with present reality, is an effective self-regulation strategy that translates high expectations of success into mobilization of energy. Energy mobilization in turn fuels effort and performance toward attaining the desired future (Oettingen, 2012; Oettingen et al., 2009).

Energy mobilization or energization, defined as "the extent to which the organism as a whole is activated or aroused" (Duffy, 1934, p. 194), can be assessed by physiological indicators of autonomic functions (e.g., blood pressure; Cannon, 1915; Wright, 1996). Energization is associated with high performance, particularly in challenging tasks (Wright, Murray, Storey, & Williams, 1997). Here, we investigated whether mental contrasting the desired future of solving a given task may lead "the organism as a whole to be activated or aroused" and whether this heightened energization would predict effort in a task unrelated to the desired future targeted by mental contrasting. With regard to our example above, suppose the student feels energized because she mental contrasted her desired and feasible future of becoming an artist with obstacles in the present reality. Would this state of heightened energization help her perform an unrelated task such as doing her homework for her English class?

Mental Contrasting

When people use the self-regulation strategy of mental contrasting, they first name an important desired future they would like to attain, such as completing one's admission application for art school. Then they imagine the best outcome of attaining the specified desired future (e.g., feeling proud), and thereafter they imagine the present reality that stands in the way of attaining the desired future (e.g., getting distracted). Imagining the desired future followed by the present reality leads people to recognize that they have not attained the desired future yet and need to overcome the reality to do so. As a consequence, expectations of success, defined here as people's judgments about how likely it is that they can attain the desired future (see, for example, Bandura, 1997), become activated. The activated expectations then inform behavior

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(Oettingen, 2012; Oettingen, Pak, & Schnetter, 2001). When expectations are high, people will vigorously try to attain the desired future. Conversely, when expectations are low, they will let go from trying to attain the desired future. Such selective effort will save resources: People who mental contrast invest their resources such as time, energy, or money in pursuing attainable futures and refrain from wasting their resources in pursuing unattainable futures.

The effects of mental contrasting are thus in line with the motivational intensity theory (Brehm & Self, 1989), which states that effort mobilization is guided by a resource conservation principle. That is, the amount of effort people are willing to spend on a given task depends on the experienced task demand as long as the task completion is possible (expectations of success) and justified (incentive value; Gendolla, Wright, & Richter, 2012; Richter, 2013; Silvestrini & Gendolla, 2013; Wright & Kirby, 2001). However, research on motivational intensity theory specifies how situational determinants such as task demand, expectations, and the incentive value to solve the task, guide effort mobilization, and research on mental contrasting focuses on the mental processes that influence how expectations are translated into selective effort mobilization and performance.

Merely elaborating the future (i.e., indulging) or the reality (i.e., dwelling) leads to effort and performance that is expectancy-independent (Oettingen, 2012; Oettingen et al., 2001). These one-sided elaborations fail to induce a perception of the reality as standing in the way of the desired future. Thus, expectations do not become activated and do not translate into effort and performance. Elaborating reality before the future (i.e., reverse contrasting) also fails to induce a perception of reality as standing in the way of the future because the future is not a reference point for the reality, and thus the reality cannot be perceived as an obstacle that needs to be overcome to attain the desired future (Oettingen et al., 2001). Therefore, after reverse contrasting, expectations do not become activated and do not translate into effort and performance.

A multitude of studies supports the effects of mental contrasting on selective effort and performance (summary by Oettingen, 2012). These studies measured various indicators of effort and performance including cognitive (e.g., making plans), affective (e.g., feelings of anticipated disappointment in case of failure), motivational (e.g., feelings of determination), and behavioral (e.g., self-reports of achievement and grades). The predicted pattern emerged whether these indicators were assessed via self-report or observations, directly after the experiment or weeks later, and whether mental contrasting was experimentally induced or unobtrusively observed (Kappes, Singmann, & Oettingen, 2012; Oettingen, 2000; Oettingen, Marquardt, & Gollwitzer, 2012; Oettingen, Mayer, & Thorpe, 2010; Oettingen, Stephens, Mayer, & Brinkmann, 2010; Oettingen et al., 2001; Sevincer & Oettingen, 2013).

Regarding the processes mediating mental contrasting effects on performance, research has identified energization as one mechanism (summary by Sevincer & Oettingen, in press). In one study (Oettingen et al., 2009, Study 1), participants either mental contrasted or indulged about solving an interpersonal task (e.g., getting to know someone). Energization was assessed by systolic blood pressure (SBP), a reliable indicator of energy mobilization (Wright, 1996), while participants engaged in the mental exercise. Participants in the mental contrasting, but not those in the indulging condition, showed expectancy-dependent changes in SBP. Of importance, the effect of mental contrasting on performance was mediated by the change in SBP. This pattern was conceptually replicated in a second study (Oettingen et al., 2009, Study 2) in which participants mental contrasted or indulged about giving an excellent fictitious job talk. Energization was assessed by self-report (e.g., "How full of energy do you feel with respect to the upcoming talk?") directly after the mental exercise. Performance in the job talk was videotaped and judged by two independent observers. In sum, mental contrasting the desired future of solving a given task elicited expectancy-dependent energization, which fueled subsequent performance in that task. On the basis that energization can be understood as a general arousal state, the present research aims to extend these findings by examining whether mental contrasting with regard to solving a given task elicits energization that fuels performance in a task, unrelated to the initial task targeted by mental contrasting.

Energization

The concept of energization has a long tradition in motivation psychology. Hull (1943, 1952) described variations in behavior as a function of two variables, namely, direction and intensity. While direction specifies whether an organism approaches or avoids a cue (Atkinson, 1957; Elliot, 2006), intensity has been described as energization, excitation, arousal, or activation (Cannon, 1915). Traditionally, energy mobilization is assessed by indicators of autonomic function, specifically of the cardiovascular system. Because energization or effort mobilization leads to an increased bodily demand of oxygen and nutrients, and the cardiovascular system supplies tissue with energy in the form of oxygen and nutrients (Duffy, 1934; Wright, 1996), increased energization is manifested in a stronger cardiovascular response (Brownley, Hurwitz, & Schneiderman, 2000). The increased cardiovascular response is mediated by activation in the sympathetic nervous system (Obrist, 1981). Sympathetic activation (e.g., beta-adrenergic discharge) directly influences the force with which the heart pumps (i.e., myocardial contractility), which in turn systematically influences SBP—the maximum pressure exerted by the blood against the vessel walls. Therefore, SBP is a reliable (and widely used) indicator for assessing energization (Wright, 1996; Wright & Kirby, 2001). Other cardiovascular responses, such as diastolic blood pressure (DBP), the minimum pressure of the blood against the vessel walls, and heart rate (HR), the pulse or pace with which the

heart pumps, are less reliable indicators of energization because they are also heavily influenced by other parameters (e.g., DBP is strongly influenced by peripheral resistance—the diameter of the blood vessels—and HR by parasympathetic activation; Berntson, Cacioppo, & Quigley, 1993). Causes of energization can be manifold: Physical exercise, drugs, a bodily need state (hunger, thirst), threatening or novel stimuli (which may elicit a fight or flight response), stimuli that prime an action-mind-set (words such as "action," "go"; Gendolla & Silvestrini, 2010), performing difficult tasks, as well as simply thinking about upcoming challenges (e.g., when people anticipate that they will perform complex arithmetic tasks; Contrada, Wright, & Glass, 1984) have all been linked to increased energy mobilization.

Evidence for our main contention that energization triggered by mental contrasting of solving a given task may fuel performance in an unrelated task comes from Hull's drive theory (Hull, 1943, 1952). Hull (1943) conceptualized drive as an undifferentiated, universal energizer that was fueled by the sum of all current bodily deficits/needs (hunger, thirst, sex, etc.). This nonspecific drive state energized behavior, but it did not direct it. Rather, direction of behavior was determined by habit, and habit was influenced by whether the organism had learned that a particular behavior would lead to drive-reduction in a specified situation. Thus, according to Hull, there was no one-to-one linkage between a particular drive and an associated behavior. In principle, the unspecific drive state could facilitate any behavior. Hull termed this principle that energization which had not yet spurred the drive-reducing behavior, but in principle could spur an unrelated behavior, *irrelevant drive*. Following up on Hull's ideas, Zillmann (1971) contented that according to Hull's conception, irrelevant drive should function analogously to physical energization in that it "indiscriminately 'energizes' and thus facilitates enacted behavior" (p. 422).

Our research builds on Hull's and Zillmann's conception of energization as an unspecific motor-force for behavior, and at the same time goes beyond it by proposing that energization can also be triggered by mental contrasting of solving a task (rather than by physiological need states only). The elicited energization state may then fuel performance in a task unrelated to the initial task. In Study 1, we tested whether energization triggered by mental contrasting of writing an excellent essay translated into exertion of physical effort as measured by performance in squeezing a handgrip; in Study 2, we examined whether energization triggered by mental contrasting of excelling in an intelligence test translated into mental effort as measured by performance in writing a supportive get-well letter.

Study 1: Energization Transfer Into Physical Effort

We investigated whether mental contrasting of effectively solving an academic task triggers physiological energization (indicated by changes in SBP), which then would translate into physical effort in an unrelated task. To induce mental contrasting and to measure SBP, we modeled our procedure after previous research on mental contrasting and energization (Oettingen et al., 2009). That is, we first assessed participants' baseline SBP. Analogous to SBP, we also assessed DBP and HR. Thereafter, we presented participants with their task of writing an excellent fictitious graduate admission essay and asked them to indicate their expectations of writing an excellent essay. Moreover, because the incentive value of attaining a desired event may influence SBP (Wright, Shaw, & Jones, 1990), we also asked participants how important it was to them to write an excellent essay. Then participants mental contrasted the desired future of writing an excellent essay with the present reality. We included two control conditions: An indulging condition and an irrelevant content condition. In the indulging condition, participants elaborated the desired future of writing an excellent essay only. Thus, only in the mental contrasting condition participants elaborated both the desired future and the present reality. Following Kappes et al. (2012), in the irrelevant content control condition, participants elaborated an unrelated event (a positive and a negative experience with a teacher). We chose elaborating a positive experience followed by a negative experience as a control condition in addition to the indulging control condition to exclude the alternative explanation that simply thinking about something positive (such as the desired future) and then about something negative (such as the present reality) is sufficient to produce expectancy-dependent energization (Kappes et al., 2012).

After the mental exercise, we measured SBP a second time. To assess our dependent variable, physical effort in an unrelated task, we measured for how long participants could squeeze a handgrip (Muraven, Tice, & Baumeister, 1998). We chose squeezing a handgrip because performance on this task is a measurement of physical stamina, which strongly depends on the mobilization of effort and energy (Hutchinson, Sherman, Martinovic, & Tenenbaum, 2008; Krombholz, 1985).

We hypothesized that mental contrasting the desired future of writing an excellent essay with present reality mobilizes expectancy-dependent energization, indicated by changes in SBP, which in turn translates into physical effort in the handgrip task. Indulging and the control exercise, in contrast, should lead to expectancy-independent energization. Because DBP and HR are less consistently linked to energization than the SBP, we did not have specific hypotheses for DBP and HR.

Method

Participants and design. We recruited 168 undergraduate psychology students (85 females; *M* age = 19.58, *SD* = 1.34) from a large university in the United States to participate in a study on practicing to write an essay and its effects on blood pressure. Students were given course credit. To be eligible,

they had to be right-handed, free from heart disease and hypertension, and had to abstain from cigarettes, alcohol, strenuous exercise, caffeine, and medication for at least 2 hr prior to the session (Shapiro et al., 1996). They were randomly assigned to one of the three experimental conditions: Mental contrasting, indulging, and control. Students were tested individually.

Procedure. Students were seated at a table with a computer and a compressing cuff. The cuff was connected to a blood pressure monitor (Carescape V100) and placed in an adjacent room to the experimental cubicle. The apparatus used oscillometry to determine SBP in millimeters of mercury (mmHg), DBP (mmHG), and HR (beats per minute). Each individual SBP measurement period (simultaneously assessing DBP and HR) lasted approximately 30s. The experimenter gave a brief overview of the procedure and stressed that answers would remain confidential and that participation was voluntary. Students gave their written consent. Thereafter, a compressing cuff connected to a blood pressure monitor was placed over the brachial artery of their left arm: They were asked to rest quietly while five baseline SBP measurements were taken. To obtain students' baseline SBP, we averaged the five measurements ($\alpha = .98$). Moreover, after the SBP measurement, we took a baseline measurement of physical performance using the handgrip task from Muraven et al. (1998). This task involves squeezing a commercially available handgrip exerciser. The device consists of two handles connected by a metal spring. Squeezing the handles together compresses the spring. To assess for how long students were able to squeeze the handgrip, the experimenter inserted a folded paper between the two handles when students started to squeeze them together. When students released their handgrip, the paper would fall out. The experimenter used a stopwatch to measure the time from inserting the paper until it fell. Students completed the experiment on the computer.

Strategy induction: Writing an excellent essay. On the computer screen, students read that their next task was to write a fictitious graduate admission essay. The essay should involve detailing their academic achievements, study interests, educational objectives, and future career plans. Moreover, we stressed that the essays would later be evaluated by members of a graduate admission committee and that they would receive feedback on their essay. Writing the essay would thus be an excellent opportunity to prepare themselves for their graduate admissions. To measure students' expectations of writing an excellent essay, we asked: "How likely is it that you will write an excellent fictitious admission essay?" To measure the incentive value of writing an excellent essay, we asked: "How important is it to you to write an excellent fictitious admission essay?" We used 7-point scales ranging from 1 (*not at all*) to 7 (*very*).

Students then listed two aspects of the desired future they associated with writing an excellent essay (they named, for example, "feeling confident for my graduate admission"). Thereafter, they listed two aspects of the present reality standing in the way of writing an excellent essay (they named, for example, "having little experience in writing admission essays"). To prevent extensive mental elaborations at this point, we instructed students to only type in keywords.

Next, we established the three conditions (mental contrasting, indulging, and control). In the mental contrasting condition, students elaborated one aspect of the future and one aspect of the reality beginning with a future aspect. To accomplish this procedure, they saw their first keyword pertaining to the future displayed on the screen with the following instructions:

> Think about this aspect and depict the respective events or experiences in your thoughts as intensively as possible! Let the mental images pass by in your thoughts and do not hesitate to give your thoughts and images free reign. Take as much time and space as you need to describe the scenario.

For example, one student elaborated her future aspect "feeling confident": "Feeling validated in my writing abilities. Validation gives me the motivation to pursue things further with more drive and confidence. I feel a sense of pride and elation . . ."

Students then moved to the next screen on which the first keyword pertaining to the reality appeared with the same instructions as above. For example, the aforementioned student elaborated her reality aspect "little experience in writing admission essays": "I have never tried writing a practice graduate admissions essay before. It will probably take me a while to think of a topic I can expand upon . . ."

In the indulging condition, students elaborated only the two future aspects. In the control condition, they elaborated one positive and one negative experience with a teacher at their university, beginning with the positive experience.

Dependent variable: Physical performance. After the mental exercise, as an indicator of physical effort, students engaged in the handgrip task a second time. Because performance on the handgrip task strongly depends on hand strength, we controlled for within-subjects variations of hand strength. Specifically, we calculated change scores in handgrip duration from the baseline measurement to the final measurement and used these change scores as our dependent variable. After the second handgrip task, students completed a short demographic questionnaire. To conclude, they were thanked and fully debriefed.

SBP measurement. Directly before the handgrip task, we took two final SBP measurements. To control for individual differences in SBP (Wright et al., 1997), we calculated SBP

Table 1. Studies 1 and 2: Means and Standard Deviations for SBP Baseline Values in Each Condition.

Condition	*M*	*SD*
Study 1		
Mental contrasting	108.13	7.61
Indulging	111.26	10.46
Control	108.91	8.58
Study 2		
Mental contrasting	110.83	10.38
Indulging	110.96	10.45
Dwelling	106.52	10.21
Reverse contrasting	108.46	10.03

Note. SBP = systolic blood pressure.

Table 2. Studies 1 and 2: Means for Expectations and Incentive Value.

Study	Initial task	Expectations	Incentive value
1	Performance in essay writing	3.80 (1.43)	4.15 (1.88)
2	Performance in intelligence test	4.00 (1.20)	4.24 (1.47)

Note. Standard deviations in parenthesis.

change scores from baseline to directly before the handgrip task by averaging the two final SBP measurements ($r = .85$) and subtracting mean baseline SBP from the averaged score. We calculated change scores for DBP and HR in an analogous way.

Results

Eleven students (7%) were excluded from the following analyses: one for engagement in high-performance sports, two for caffeine consumption prior to the experiment, two for hypertension, and six for technical difficulties with the SBP measurement.

Descriptive analyses

Baseline SBP. Baseline SBP did not differ between conditions: $F(2, 154) = 1.81$, $p = .17$. Means and standard deviations for baseline SBP in each condition are provided in Table 1. In each condition, baseline SBP was correlated with the averaged final SBP scores (rs > .41, ps < .004).

Expectations and incentive value. Means and standard deviations for expectations and incentive value are provided in Table 2. Expectations and incentive value correlated positively ($r = .58$, $p < .001$).

Physical performance. To calculate handgrip duration change scores, we subtracted each student's initial handgrip squeeze duration time from his or her final time. The handgrip scores are based on 155 students because two (1%) students failed to squeeze the handles together during the final handgrip measurement. We then submitted the change scores to a General Linear Model (GLM) with condition (mental contrasting vs. the other two conditions combined) as a fixed between-subject factor and the continuous expectations variable as independent variables in the first step; the interaction term of condition by expectations was added as an independent variable in the second step (Aiken & West, 1991).

We observed main effects of condition and expectations, Fs > 4.24, $ps = .04$, η^2s = .03, as well as the predicted interaction effect of condition by expectations, $F(1, 151) = 4.91$, $p = .03$, $\eta^2 = .03$, indicating that the relation between expectations about performance in essay writing and performance in the handgrip task was stronger in the mental contrasting condition than in the other conditions combined (Figure 1, left graph).[1]

To investigate whether the handgrip duration time increased or decreased from baseline to the final measurement in mental contrasting students with high versus low expectations, we conducted a repeated measures GLM focusing only on the mental contrasting condition. Baseline time and final time were entered as within-subject variables and expectations as a covariate. When students who mental contrasted had high expectations about their performance in essay writing, they squeezed the handgrip for a longer period: $t(54) = 1.96$, $p = .05$, $\eta^2 = .07$; when they had low expectations, they squeezed for a shorter period: $t(54) = 4.23$, $p < .001$, $\eta^2 = .25$.

Change in SBP. We used a GLM entering the same predictors as above and selected the SBP change score as the dependent variable. There was a main effect of expectations, $F(1, 154) = 6.00$, $p = .02$, $\eta^2 = .04$, which was qualified by the predicted interaction effect of condition by expectations, $F(1, 153) = 3.93$, $p < .05$, $\eta^2 = .03$, indicating that the link between expectations and change in SBP was stronger in the mental contrasting condition than in the other conditions combined (Figure 1, right graph).[1] Moreover, in the mental contrasting condition, when expectations were high, SBP increased: $t(55) = 3.70$, $p = .001$, $\eta^2 = .20$; when expectations were low, SBP did not change: $t(55) = .31$, $p = .76$.

Change in SBP as a mediator. Next, we tested whether the interaction effect of condition (mental contrasting vs. the other two conditions combined) by expectations on handgrip performance was mediated by change in SBP. To test this mediated moderation, we followed a bootstrapping procedure using the SPSS PROCESS macro provided by Hayes (2012). The macro allows estimating the indirect effect of the condition by expectations on handgrip performance through change in SBP by considering the interaction effect of IV (expectations) and the moderator (condition: mental contrasting vs. other conditions combined) on the DV (handgrip performance), the interaction effect of the IV and the

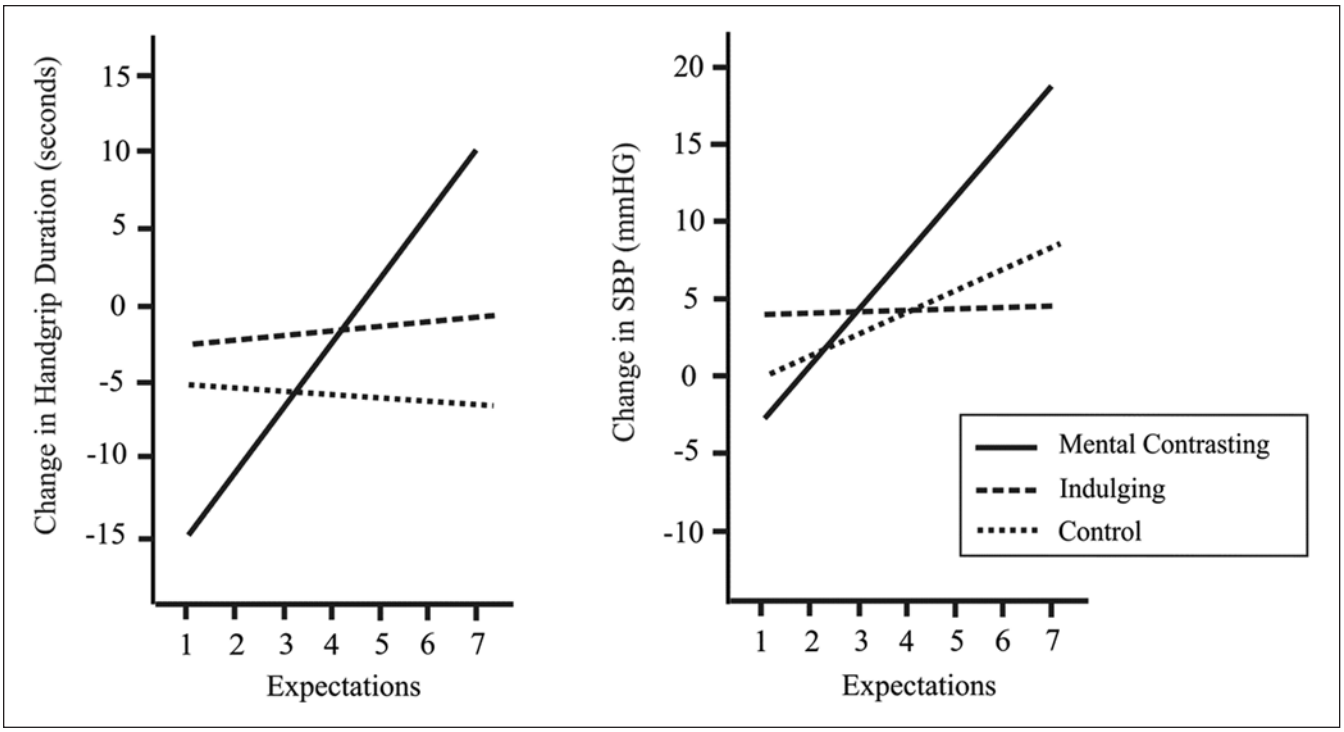

Figure 1. Study 1: Regression lines depict the link between expectations in writing an excellent essay and change in handgrip duration (left) and change in SBP from before the mental exercise to directly thereafter (right) as a function of condition.

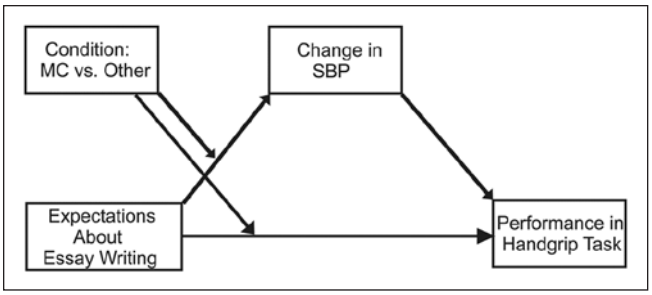

Figure 2. Study 1: Moderated mediation model (Model 8 in the PROCESS macro by Hayes, 2012).

moderator on the mediator (change in SBP), and the main effect of the mediator on the DV together in one model (Model 8 in the PROCESS macro; see also Edwards & Lambert, 2007; Preacher, Rucker, & Hayes, 2007; Figure 2).

The indirect effect of condition by expectations on handgrip performance through change in SBP was significantly different from 0, 95% CI = [−2.0238, −.0020], with 10.000 iterations. Within the mediated moderation model, the direct effect of condition by expectations on handgrip performance was not significantly different from 0, 95% CI = [−7.3638, .0864]. Finally, to investigate whether the results were due to within-subjects variations of incentive value, we repeated the analyses reported above adjusting for incentive value. The pattern of results did not change.

DBP and HR. Because DBP and HR are less consistently linked to energization than SBP, we did not predict any expectancy-dependent changes in DBP and HR by mental contrasting. Indeed, when performing analyses analogous to change in SBP, using change in DBP and HR, respectively, as dependent variables, we did not observe any interaction effects of condition by expectations, Fs < .72, ps > .40.

Discussion

Mental contrasting the desired future of writing an excellent fictitious graduate admission essay with obstacles in the present reality elicited expectancy-dependent energization that translated into physical effort as assessed by how long participants could squeeze a handgrip. Mental contrasting participants' handgrip performance depended on their expectations about writing an excellent essay, and this effect was mediated by energization assessed by the changes in SBP. In contrast, participants in the indulging condition and in the irrelevant content condition evinced expectancy-independent handgrip performance and energization. In Study 2, we were interested in whether the energization transfer by mental contrasting can also be observed with regard to mental effort rather than physical effort. Specifically, we examined whether energization triggered by mental contrasting of excelling in an intelligence test may fuel mental effort in writing a get-well letter to a friend.

Study 2: Energization Transfers Into Mental Effort

Study 2 tested whether energization elicited by mental contrasting of solving an achievement-related task translates into mental effort in an unrelated task, this time from the interpersonal domain (writing a fictitious get-well letter). As an indicator for how much effort participants exerted in composing the letter, we asked them to self-evaluate their investment in writing the letter. To induce mental contrasting and to measure SBP, we used the same basic procedure as in Study 1 with the following modifications:

First, as control conditions, in Study 1, we used an indulging condition and an irrelevant content condition in which participants elaborated a positive and a negative experience with a teacher. It may be argued, however, that in the latter condition, participants did not show expectancy-dependent energization simply because they did not elaborate on solving their initial task. Therefore, in Study 2, we used a full design in which we had all participants elaborate on solving their task and in which we induced all four relevant modes of thought: mental contrasting, indulging, dwelling, and reverse contrasting (Oettingen et al., 2001, Study 3). In the indulging condition, participants were not confronted with an obstacle, and in the dwelling condition, there was no future toward which to act. Thus, participants in these conditions should not show expectancy-dependent energization. Similarly, participants in the reverse contrasting condition fail to understand the reality as an obstacle (Kappes, Wendt, Reinelt, & Oettingen, 2013), and thus participants in this condition should not show expectancy-dependent energization either.

Second, in Study 2, we again asked participants to elaborate solving a task from the achievement domain: performing well on an intelligence test. Third, we used an extended procedure for inducing the modes of thought, that is, participants listed four (rather than two) future aspects and four (rather than two) reality aspects. Then they had to elaborate four of the eight aspects (Oettingen et al., 2001). Fourth, participants' writing a get-well letter allowed us to conduct the final SBP measurements during the task itself rather than directly before the task. Finally, to increase reliability of the baseline SBP measurement before the mental exercise, we took 10 SBP measurements rather than 5 as in Study 1.

We hypothesized that mental contrasting the desired future of excelling in an intelligence test with present reality mobilizes expectancy-dependent energization, which translates into performance in the interpersonal task. Indulging, dwelling, and reverse contrasting in contrast should lead to expectancy-independent energization and performance.

Method

Participants and design. We recruited 114 undergraduate psychology students (85 females; *M* age = 19.21, *SD* = 1.15) from a large university in the United States to participate in a study on blood pressure during intelligence tests. Students were given course credit. They had to meet the same requirements as in Study 1 (being right-handed, free from heart disease and hypertension, and abstaining from cigarettes, alcohol, strenuous exercise, caffeine, and medication for at least 2 hr prior to the session). Students were randomly assigned to one of the four experimental conditions: mental contrasting, indulging, dwelling, and reverse contrasting. They were tested individually.

Procedure. Students were prepared for the experiment like in Study 1. To assess the baseline SBP, we took 10 SBP measurements and averaged them into one index (α = .98). Because mental contrasting did not affect DBP and HR in Study 1 nor in the previous research by Oettingen et al. (2009), we did not record DBP and HR.

Strategy induction: Excelling on an intelligence test. We told students that they would work on a test that measures intelligence and analytic thinking. They were informed that the test consisted of 36 items and were given five example items. The example items were taken from the revised Culture Fair Intelligence Test (CFT-20-R; Cattell, 1960). Students were asked to indicate for each item which of five presented figures correctly completed a series of geometrical figures. We told students that before they started working on the test, they would answer some questions. We measured students' expectations about their performance on the test by two items: "How likely do you think it is that you will answer 100% of the intelligence test items correctly?" and "How likely do you think it is that you will be able to perform better than the average NYU student?" Because the two items correlated positively, r = .57, we combined them into one index of expectations. Moreover, we assessed students' incentive value about performing well on the test by asking: "How important is it to you that you will perform well on the intelligence test?" For all items, we used 7-point scales ranging from 1 (*not at all*) to 7 (*very*).

Students then listed four aspects of the desired future they associated with performing well on the intelligence test (they named, for example, feeling self-assured). Thereafter, they listed four aspects of the present reality standing in the way of performing well on the test (they named, for example, feeling distracted).

Next, we established the four conditions (mental contrasting, indulging, dwelling, and reverse contrasting). In the mental contrasting condition, students elaborated two future aspects and two reality aspects in alternating order beginning with a future aspect. In the indulging condition, they elaborated only the four future aspects, and in the dwelling condition, they elaborated only the four reality aspects. Finally, in the reverse contrasting condition, as in the mental contrasting condition, students also elaborated two future aspects and two reality aspects in alternating order, but this time, they began with a reality aspect.

Dependent variable: Performance in letter writing. After students had finished their mental exercise, we simulated a computer breakdown to make them believe that the mental exercise was not connected to the following letter writing task. Specifically, the screen went black and white, with symbols appearing on various points of the screen. Thereupon, the experimenter entered the experimental cubicle and explained:

> Apparently, we have a computer problem. It looks like we can't continue with this experiment. Would you be willing to continue with a different experiment? This way we could still use the time. The new experiment will take about 15 minutes. It also involves blood pressure measurements.

All students agreed to take part in the second experiment. The experimenter explained that the new experiment was about cardiovascular reactivity to interpersonal tasks and that students' new task was to write a fictitious get-well letter to a friend while SBP measurements would be taken. The experimenter then started a new computer program. Students read the following instructions on the screen:

> Your best friend had a car accident and has to stay at the hospital for a few weeks. Please write an authentic letter and send him your best wishes for a speedy recovery. You have 10 minutes to complete the task.

Students wrote the letter in the designated space. After 10 min, the program automatically proceeded to the next screen.

Self-rated performance.
On the next screen, students evaluated their letter. They indicated for each of the following four statements the extent to which they thought the statement held true on a 7-point scale from 1 (*not at all true*) to 7 (*very true*): "My get-well letter was meaningful," "I used inappropriate language" (reverse coded), "I honestly stated my best wishes for a speedy recovery," "The get-well letter would be greatly appreciated by my friend." To obtain an index of self-rated performance in letter writing, we combined the four items. Because reliability of the scale was only moderate ($\alpha = .60$), we dropped one item ("I used inappropriate language") from the final index. Dropping the item improved reliability to $\alpha = .77$.

Other-rated performance.
In addition to self-rated performance, we also obtained a measure of other-rated performance in writing the letter. Two independent raters coded the quality of the letters based on Oettingen et al. (2009) and Sevincer and Oettingen (2013). The raters employed a 7-point scale ranging from 1 (*very poor performance*) to 4 (*moderate performance*) to 7 (*excellent performance*). Specifically, a "1" meant that students failed to write about their friends' recovery, used inappropriate language, and did not display empathy for their friend. For example, they wrote primarily about themselves, used slang or swear words, and made indifferent remarks about their friends' recovery. A "4" meant that students partly wrote about their friends' recovery, chose moderately appropriate language, and displayed empathy to some extent. For example, they mentioned their friends' recovery but also extensively elaborated on unrelated topics, used slang words only rarely, and formally expressed concern about their friends' accident. Finally, a "7" meant that students focused on their friends' recovery, chose appropriate language, and seemed to honestly display empathy. For example, they inquired in detail about their friends' accident and current condition, used warm and cordial language, expressed great concern, and promised to visit. Interrater reliability was $\alpha = .66$. Disagreements were resolved through discussion between the two raters. If agreement could not be reached, the mean between the two ratings was given.

To check whether students guessed the hypotheses, we used a funnel debriefing procedure, in which we asked students to indicate in an open-ended questionnaire what they thought the hypotheses of the study were, whether they thought the two experiments were related, and if so, in what way the two experiments were related. No one correctly guessed the hypotheses or how the two experiments were related. After completing a short demographic questionnaire, students were thanked and fully debriefed.

SBP measurement. While students wrote the letter, we conducted five final SBP measurements. The first measurement was initiated 2 min after students read the instructions. The other four measurements followed in 2-min intervals. To calculate SBP change scores from baseline to during letter writing, we averaged the five final SBP scores ($r = .93$) and subtracted students' mean baseline SBP score from their averaged final score.

Results

Five students (6%) were excluded from the following analyses: two because they reported having engaged in high-performance sports, one because of having consumed caffeine, and two because of hypertension.

Descriptive analyses

Baseline SBP. Baseline SBP did not differ between conditions: $F(3, 105) = 2.02$, $p = .11$ (Table 1). In each condition, baseline SBP was correlated with the averaged final SBP score (rs $> .67$, ps $< .001$).

Expectations and incentive value. Means and standard deviations for expectations and incentive value are provided in Table 2. Expectations and incentive value correlated positively ($r = .51$, $p < .001$).

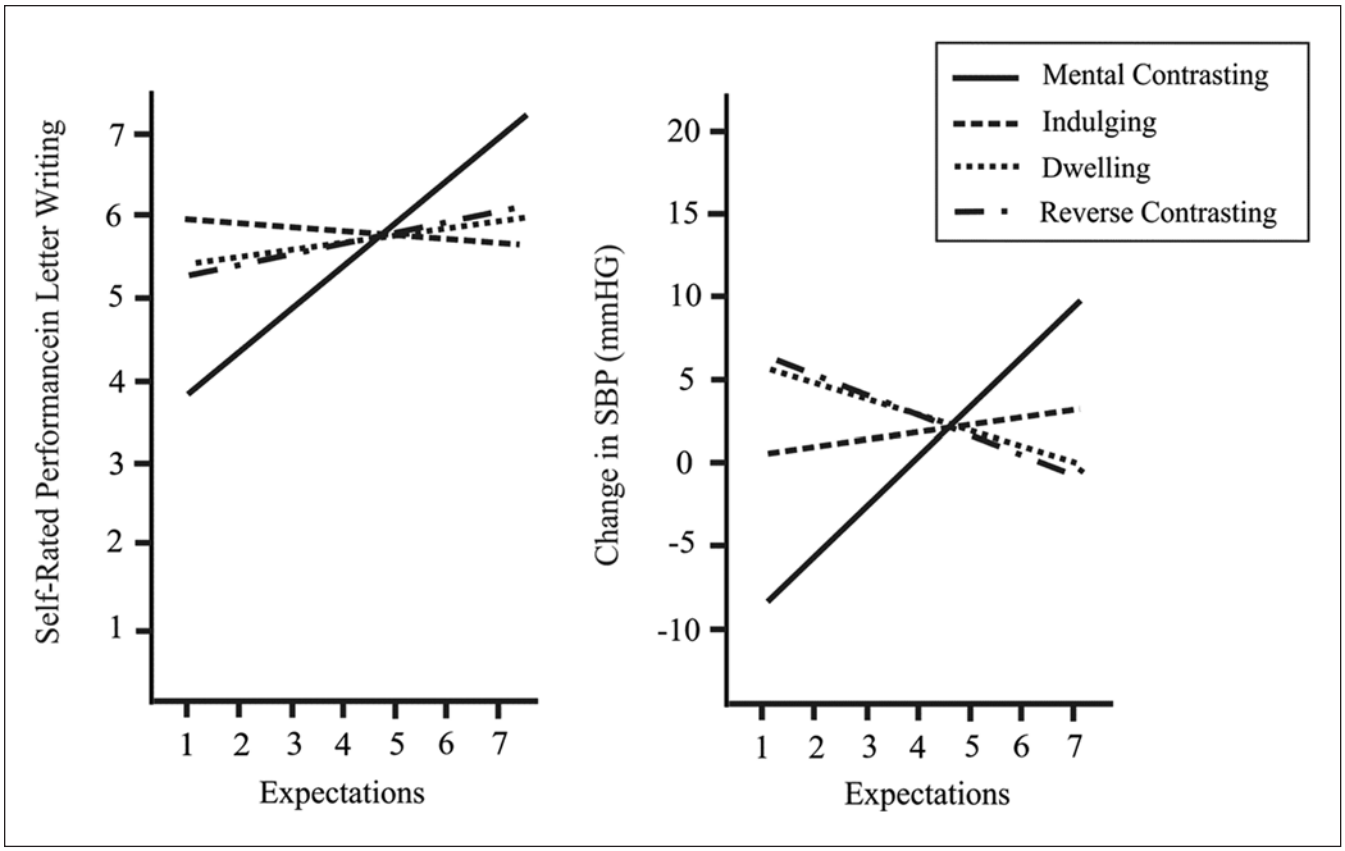

Figure 3. Study 2: Regression lines depict the link between expectations about performance in the intelligence test and self-rated performance in letter writing (left), and change in SBP from before the mental exercise to during letter writing (right) as a function of condition.

Performance in letter writing

Self-rated performance. We used a GLM with self-rated performance in letter writing as the dependent variable. We entered condition (mental contrasting condition vs. the other three conditions combined) as a fixed between-subject factor and the continuous expectations variable as an independent variable in the first step. The interaction term of condition by expectations was added as an independent variable in the second step. We observed main effects of condition and expectations, Fs > 5.61, ps < .02, η^2s > .05, as well as the predicted interaction effect of condition by expectations, $F(1, 105) = 5.42$, $p = .02$, $\eta^2 = .05$, indicating that the relation between expectations and performance was stronger in the mental contrasting condition than in the other conditions combined (Figure 3, left graph).[2] When expectations were high, mental contrasting students rated their performance as stronger than those in the other conditions: $t(105) = 2.05$, $p = .04$, $\eta^2 = .04$; when expectations were low, they rated their performance as less strong: $t(105) = 2.36$, $p < .02$, $\eta^2 = .05$.

Other-rated performance. Other-rated performance in letter writing correlated only moderately positively with self-rated performance: $r = .20$, $p = .04$. We estimated an analogous GLM as reported above using other-rated performance as the dependent variable. We observed marginally significant main effects of condition and expectations: Fs > 2.93, ps < .09, η^2s > .02. The expectations by condition (mental contrasting vs. the other three conditions combined) interaction effect in predicting other-rated performance, however, did not reach significance: $F(1, 105) = 2.00$, $p = .16$. We will return to this point in the Discussion.

Change in SBP. We used a GLM with SBP change score as the dependent variable. We observed the predicted interaction effect of condition (mental contrasting condition vs. the other three conditions combined) by expectations, $F(1, 105) = 5.95$, $p = .02$, $\eta^2 = .05$, indicating that the link between expectations and change in SBP was stronger in the mental contrasting condition than in the other conditions combined (Figure 3, right graph).[2] Moreover, in the mental contrasting condition, when expectations were high, SBP increased: $t(24) = 2.09$, $p < .05$, $\eta^2 = .15$; when expectations were low, SBP decreased: $t(24) = 2.22$, $p = .04$, $\eta^2 = .17$.

Change in SBP as a mediator. We tested whether the interaction effect of condition (mental contrasting condition vs. the

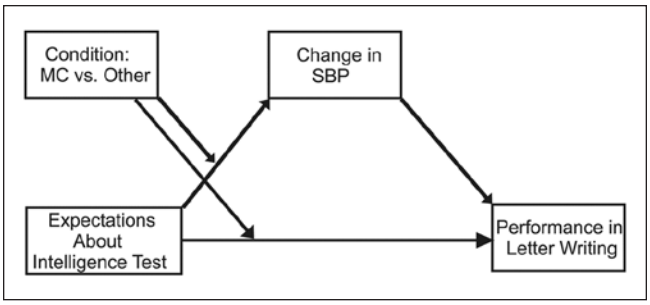

Figure 4. Study 2: Moderated mediation model (Model 8 in the PROCESS macro by Hayes, 2012).

other three conditions combined) by expectations about performance in the intelligence test on self-rated performance in letter writing was mediated by change in SBP. We performed an analogous analysis as in Study 1 using the SPSS PROCESS macro by Hayes (2012; Figure 4). The indirect effect of condition by expectations on performance in letter writing through change in SBP was significantly different from 0, 95% CI = [−.2887, −.0018], with 10,000 iterations. Within the mediated moderation model, the direct effect of condition by expectations on performance was not significantly different from 0, 95% CI = [−.9127, .0245]. Because the interaction effect of condition by expectations on other-rated performance in letter writing did not reach significance, we did not conduct respective mediation analyses. Finally, to investigate whether the results were due to within-subjects variations of incentive value, we repeated the analyses reported above adjusting for incentive value. The pattern of results did not change.

Discussion

Mental contrasting the desired future of excelling in an intelligence test with obstacles in the present reality elicited expectancy-dependent energization that fueled mental effort in an unrelated task as measured by the self-rated performance in writing a get-well letter: Mental contrasting participants' self-evaluated performance in letter writing depended on their expectations to perform well in the intelligence test, and this effect was mediated by the changes in SBP. In contrast, participants in the indulging, dwelling, and reverse contrasting condition evinced expectancy-independent energization and performance in letter writing.

In explaining why we found the predicted pattern for self-rated rather than for other-rated performance, we suspect that, because we did not assess change in writing performance, our other-rated performance measure may have been more influenced by the individual differences in writing ability than self-rated performance. That is, self-rated but not other-rated writing performance can be based on one's past performance history. In addition, interrater reliability for the performance rating was acceptable ($\alpha = .66$) but not high. Participants' felt empathy that was rated as one criterion of writing performance may have been difficult to judge from an outside perspective.

Study 2 conceptually replicated and extended the findings of Study 1 in several ways: Specifically, in Study 2, we (a) used mental effort rather than physical effort as our dependent variable, (b) used an unrelated task in the interpersonal domain (writing the letter) rather than in the domain of physical performance (squeezing a handgrip), (c) added a dwelling and a reverse contrasting condition to the mental contrasting and indulging conditions, (d) asked participants to elaborate four rather than only two aspects, and (e) conducted the final SBP measurements during rather than before participants engaged in the unrelated task.

General Discussion

We investigated whether physiological energization (assessed by changes in SBP) triggered by mental contrasting of one task transferred to an unrelated task. Mental contrasting about successfully solving an achievement-related task (writing an excellent essay, excelling in an intelligence test) elicited energization that translated into physical effort (Study 1) and mental effort (Study 2) in an unrelated task (measured by performance in a handgrip exercise and in writing a get-well letter, respectively). Participants' performance in the unrelated tasks depended on their expectations of success regarding the initial tasks, and this effect was mediated by energization.

We found energy transfer effects of mental contrasting across different domains (interpersonal and physical), across different initial tasks (writing an essay; performing an intelligence test), using various control conditions (indulging, dwelling, reverse contrasting, and an irrelevant content condition), using a short and an extended procedure of mental elaborations (elaborating two aspects and elaborating four aspects), and measuring participants' final SBP directly before and while they engaged in the unrelated task. Effect sizes for changes in energization and performance were typical for the behavioral sciences (Cohen, 1988). Our findings have theoretical implications for research on energization and applied implications for developing interventions geared at improving people's self-regulation of effort.

Implications for Research on Energization

We found that mental contrasting about successfully solving a task triggered energization that fueled behavior in an unrelated task. Assuming that mental contrasting participants with high expectations had committed to the goal of solving their task, research on intergoal inhibition becomes relevant. The latter research suggests that when people commit to a goal, that goal becomes activated and guides subsequent behavior. That is, it inhibits the activation of and mobilization of resources for competing goals (Bargh & Huang, 2009;

Kruglanski et al., 2002). How can these seemingly conflicting findings be reconciled? In our studies, mental contrasting with high expectations to solve a given task led to increased energization. However, once energization was established, participants did not have the opportunity to act on their task and were presented with an unrelated task instead. In Study 1, rather than writing the called for essay, they were asked to squeeze a handgrip. In Study 2, rather than working on the intelligence test, they were informed that due to a computer breakdown, they would write a get-well letter. Future research may test this contention that goal inhibition may be limited by whether there are opportunities to act on the original goal.

Future research should also investigate energization transfer effects by mental contrasting over time (weeks and months). Because physiological energization decays relatively quickly (Cantor, Zillmann, & Bryant, 1975; Wright, Weeks, Burch, & Hernandez, 1990), energization effects may reoccur if people mental contrast about solving their initial task again. Thus, it may be that although transfer effects of mental contrasting appear in the short term, they only can be sustained if people further engage in mental contrasting about resolving the initial task.

Implications for the Self-Regulation of Effort

Our findings may have implications for helping people to translate their energization resulting from mental contrasting a particular desired future to bolster effortful or unpleasant behaviors. Future research may be targeted at developing interventions in an academic context: A student who has high expectations of becoming an outstanding athlete, for example, may mental contrast the desired future of becoming an athlete to mobilize the energy needed to study history or clean up her room. In this vein, people may even use mental contrasting targeted at solving a task for which they have high expectations (e.g., winning a tennis match) to energize themselves for behavior for which they have low expectations (e.g., excelling in math).

We should note that people may not always estimate their expectations accurately. That is, people's expectations may paint the facts too optimistically or too pessimistically. In the case of unrealistically high expectations, expectancy-dependent energization elicited by mental contrasting may lead to an unjustified high level of energization. For example, a middle-aged English teacher who believes he still will be discovered as an outstanding actor even though he has little experience in acting may use mental contrasting to translate the energy of becoming an actor into excelling in his teaching. The present results thus suggest that mental contrasting combined with unrealistically high expectations, by leading to "unjustified" energization, may benefit performance on unrelated tasks.

Finally, some tasks may require decreased rather than increased energization, for instance, progressive muscle relaxation or escalation of commitment tasks. With regard to such tasks, mental contrasting of solving a task for which one has low rather than high expectations should facilitate performance. Future research may even explore whether mental contrasting of futile endeavors may be used as a useful relaxation exercise.

Relation to Excitation-Transfer Theory

The present research relates to findings on the transfer of excitation. According to excitation-transfer theory (Zillmann, 1971), residual excitation (defined as nonspecific emotional arousal) triggered by one stimulus may potentiate people's responses to another stimulus. In a series of studies (summaries by Bryant & Miron, 2003; Zillmann, 1983), participants were either exposed to an arousing stimulus (e.g., pedaling an exercise bicycle, an erotic movie) or to a nonarousing stimulus (e.g., an agility task, a neutral movie). Thereafter, participants' arousal was assessed by a number of physiological indicators (SBP, DBP, HR, and skin temperature). Before the physiological arousal from the first stimulus decayed, participants were exposed to a second stimulus unrelated to the first stimulus (a funny cartoon, a hostile provocation). Participants in the arousing (vs. nonarousing) condition showed a more intense response to the second stimulus (i.e., they judged the cartoons to be funnier or reacted more aggressively, respectively), but only when they could not attribute their arousal to the first stimulus. However, rather than investigating whether residual arousal (or energization) emerging in reaction to one stimulus may intensify people's reaction to another stimulus, our studies show that the self-regulatory strategy of mental contrasting produces selective energization that then translates into effort and performance in an unrelated task.

Other Types of Mental Simulations

Our research relates to other types of mental simulations such as fantasies about the future, outcome versus process simulations, counterfactual thinking, and mind wandering. Positive (vs. questioning, neutral, or negative) future fantasies led to low effort and poor performance in solving challenging tasks, and this effect was mediated by decreased energization, assessed by SBP (Kappes & Oettingen, 2011). Relatedly, mentally simulating having attained a desired outcome (outcome simulation) led to worse academic performance and problem solving than mentally simulating a cumbersome path toward attaining the outcome (process simulation; Taylor, Pham, Rivkin, & Armor, 1998; see also Zimmerman & Kitsantas, 1999). In contrast to future fantasies and outcome versus process simulations, which both focus on the future, counterfactual thinking refers to mental simulations of alternatives to *past* events, that is, people imagine "what might have been" (Roese, 1997). Counterfactual thinking most often occurs in the presence of a failed goal (e.g., having failed a test). It serves a corrective function and facilitates

future performance by mechanisms such as the formation of behavioral intentions (e.g., next time I study harder), or the instigation of negative affect which in turn motivates behavior change (Epstude & Roese, 2007). Finally, mind wandering occurs when one's attention shifts away from a primary task toward internal thoughts and images. Although mind wandering may impair performance on the primary task, it can promote the solving of personal concerns and the initiation of behavior change (Oettingen & Schwörer, 2013; Smallwood & Schooler, 2006). However, in distinction from research on mental contrasting, none of the above approaches consider the contrasting of a desired future with obstacles in the present reality and its consequences for energization and performance.

Other Indicators of Energization

We measured energization by SBP, a reliable and widely used indicator of energization (Wright, 1996). As mentioned before, energy mobilization can be most directly quantified by beta-adrenergic sympathetic nervous system discharge to the heart. Beta-adrenergic discharge directly determines the force with which the heart contracts, which systematically influences SBP. SBP may, however, also be influenced by other factors (e.g., the diameter of the arteries). A more direct indicator of the force with which the heart contracts is the cardiac preejection period (PEP), which refers to the time interval that starts from the beginning of the left ventricular contraction and ends with the opening of the heart's aortic valve (Berntson, Lozano, Chen, & Cacioppo, 2004). In sum, whereas SBP is systematically influenced by beta-adrenergic discharge to the heart, PEP more directly measures it. Therefore, PEP is a more reliable indicator of resource mobilization (Gendolla et al., 2012; Richter & Gendolla, 2009). To explore mental contrasting effects on energization, future research may use PEP as well as nonphysiological ways of assessing energization (e.g., unobtrusive behavioral observations, reaction time paradigms, self-reported emotions).

Conclusion

Mental contrasting a specified desired future with present reality selectively mobilizes or demobilizes the energy needed to actually attain the desired future, depending on a person's expectations of success (Oettingen, 2012; Oettingen et al., 2009). The present research suggests that the mobilized versus demobilized energy, as manifested in an increased or decreased cardiovascular response, fueled physical and mental effort in a task unrelated to the desired future targeted by mental contrasting. The findings imply that mental contrasting a desired and feasible future, such as becoming a successful singer, may be used as a strategy to mobilize the energy needed to fuel goal-directed behaviors in other areas, such as doing one's homework for English class.

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Notes

1. We also compared the mental contrasting condition with each of the other two conditions (indulging and control). The results for the expectations by condition interaction effect were as follows: regarding handgrip performance as dependent variable, mental contrasting versus indulging: $F(1, 105) = 3.39$, $p = .07$; mental contrasting versus control: $F(1, 98) = 4.21$, $p = .04$. Regarding change in systolic blood pressure (SBP): mental contrasting versus indulging: $F(1, 107) = 5.31$, $p = .02$; mental contrasting versus control: $F(1, 99) = 1.17$, $p = .28$.
2. We also compared the mental contrasting condition with each of the other three conditions (indulging, dwelling, and reverse contrasting). The results for the expectations by condition interaction effect were as follows: regarding self-rated performance in letter writing as dependent variable, mental contrasting versus indulging: $F(1, 48) = 6.29$, $p = .02$; mental contrasting versus dwelling: $F(1, 51) = 3.34$, $p = .07$; mental contrasting versus reverse contrasting: $F(1, 50) = 3.69$, $p = .06$. Regarding change in SBP: mental contrasting versus indulging: $F(1, 48) = 2.66$, $p = .11$; mental contrasting versus dwelling: $F(1, 51) = 6.35$, $p = .02$; mental contrasting versus reverse contrasting: $F(1, 50) = 5.14$, $p = .03$. Moreover, when we used the full set of four items ($\alpha = .60$) rather than the set of three items ($\alpha = .77$) for self-rated performance, the expectations by condition (mental contrasting vs. the other three conditions combined) interaction effect did not reach significance $p = .21$.

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