Published in final edited form as:
Motiv Sci. 2015 March 1; 1(1): 47–71. doi:10.1037/mot0000015.

Teach It, Don't Preach It: The Differential Effects of Directly-communicated and Self-generated Utility Value Information

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Abstract

Social-psychological interventions in education have used a variety of "self-persuasion" or "saying-is-believing" techniques to encourage students to articulate key intervention messages. These techniques are used in combination with more overt strategies, such as the direct communication of messages in order to promote attitude change. However, these different strategies have rarely been systematically compared, particularly in controlled laboratory settings. We focus on one intervention based in expectancy-value theory designed to promote perceptions of utility value in the classroom and test different intervention techniques to promote interest and performance. Across three laboratory studies, we used a mental math learning paradigm in which we varied whether students wrote about utility value for themselves or received different forms of directly-communicated information about the utility value of a novel mental math technique. In Study 1, we examined the difference between directly-communicated and self-generated utility-value information and found that directly-communicated utility-value information undermined performance and interest for individuals who lacked confidence, but that self-generated utility had positive effects. However, Study 2 suggests that these negative effects of directly-communicated utility value can be ameliorated when participants are also given the chance to generate their own examples of utility value, revealing a synergistic effect of directly-communicated and self-generated utility value. In Study 3, we found that individuals who lacked confidence benefited more when everyday examples of utility value were communicated, rather than career and school examples.

Keywords

utility value; task value; interest; perceived competence

> People are usually more convinced by reasons they discovered themselves than by those found out by others. -Blaise Pascal (trans. 1931)

Motivational interventions have used a combination of directly-communicated information and self-persuasion techniques that encourage students to adopt key messages in order to target students' thoughts, feeling, and beliefs about school (Walton, 2014; Yeager & Walton, 2011). For instance, many social-psychological interventions sometimes pair normative information, in the form of research articles, peer surveys or advice from older

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students, with short writing exercises, allowing students to actively participate in the success of the intervention (e.g. social-belonging, Walton & Cohen, 2007, 2011; growth-mindset, Aronson, Fried, & Good, 2002; sense-of-purpose, Yeager et al., 2014; utility value, Harackiewicz, Rozek, Hulleman, & Hyde, 2012; difference-education, Stephens, Hamedani, & Destin, 2014). Rather than delivering a message to a student who passively receives it, these intervention techniques, sometimes called "saying-is-believing" or "self-persuasion" exercises, encourage students to participate, and generate part of the intervention themselves. These techniques give students an opportunity to personalize the intervention message, potentially increasing the intervention's effectiveness and mitigating any stigmatizing effects of receiving an intervention (Alvarez & van Leeuwen, 2015).

These exercises are based on several classic lines of research, such as the power of cognitive dissonance to promote attitude change (Cooper & Fazio, 1984; Festinger, 1957), the generation effect in which students learn more when they write out the information rather than read it (Bertsch, Pesta, Wiscott, & McDaniel, 2007; Slamecka & Graf, 1978), and self-imagining or role-playing techniques (Gregory, Cialdini, & Carpenter, 1982; Janis & King, 1954). Even though these methods are widely used in motivational interventions and draw on several classic lines of research, they have rarely been systematically tested in controlled settings. It is unclear if the success of these interventions is due to the intervention message that is being communicated, the portion of the intervention that the students generate themselves, or a synergistic effect of the combination. In order to explore the independent and combined effects of these techniques, we focus on one social-psychological intervention hypothesized to promote interest and performance in the classroom by changing students' perception of the usefulness or utility value of the material.

Expectancy-Value Theory and Utility Value Interventions

Utility value interventions are based primarily in Eccles' expectancy-value model (Eccles & Wigfield, 2002), which posits that perceived expectancies for success and subjective task values together determine motivation and performance on achievement tasks. Accordingly, one way to inspire interest and motivation is to increase students' perceived expectancy of success or perceived competence, defined as an individual's belief about how well they will perform on an upcoming task. Thus, a large research literature has examined the role of self-efficacy and performance expectations in promoting interest and performance (Harter, 2006; Pajares, 1996). Other predictors of individuals' motivation and achievement are subjective task values of which Eccles (Eccles, 2009; Eccles et al., 1983) identified four types: intrinsic (the inherent enjoyment of a task), utility (the importance or usefulness for other tasks and goals), attainment (doing well at the task is important to one's self concept or identity) and cost (the negative aspects of engaging in the task, such as lost opportunities).

Of the four subjective task values, perceived utility value has been shown to be particularly effective in fostering a variety of adaptive processes and outcomes including interest (Hidi & Renninger, 2006; Wigfield & Cambria, 2010), value (Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Husman, Derryberry, Crowson, & Lomax, 2004), engagement (Husman & Lens, 1999; Raved & Assaraf, 2011), and achievement outcomes (Bong, 2001; Durik, Vida, & Eccles, 2006; Hulleman & Harackiewicz, 2009). Although most of the research on utility value has been largely correlational (Hulleman, Durik, Schweigert, & Harackiewicz, 2008; Wigfield & Cambria, 2010), recent field studies have shown that interventions designed to enhance perceptions of utility value can increase interest, course performance, and sometimes course-taking (Harackiewicz, Rozek, Hulleman, & Hyde, 2012; Hulleman & Harackiewicz, 2009; Hulleman et al., 2010).

Like many social-psychological interventions, utility value interventions have employed different strategies for communicating utility value information. For instance, researchers have begun to test utility value interventions utilizing self-persuasion methods in classrooms by having students write about utility value. In a field experiment, Hulleman and Harackiewicz (2009) implemented a utility-value intervention for high school students by having students write about the personal relevance of their science schoolwork. They found that students with less confidence in their science class reported higher interest and improved their grades in the utility-value condition, relative to a control condition, whereas confident students made no significant gains with the intervention. In addition, Hulleman et al. (2010) implemented the same intervention in a college psychology class (Study 2). They found that students who had performed poorly on an early exam and who wrote about utility value reported more interest in the course topic at the end of the semester when compared to those in the control group. Thus, utility value interventions that use self-persuasion methods have shown to be effective for students who doubt their ability to succeed.

In another field experiment, Harackiewicz et al. (2012) tested an intervention that used a combination of techniques designed to influence high-school students' perceptions of utility value and STEM (science, technology, engineering, and math) course-taking by intervening with parents. This intervention consisted of two brochures mailed to parents and a website that provided information about STEM fields and careers, and emphasized the utility value of taking math and science courses. The brochures also provided advice for parents about how to talk with their children about the utility value of mathematics and science. For instance, the brochure suggested that instead of telling teens how important math and science are to their lives and their futures, parents should encourage teens to discover the connections that are most personally meaningful to them. Thus, this intervention was designed to utilize both directly-communicated utility value information (from the parents) as well as self-generated utility value information (from the teens). The effectiveness of this intervention was therefore predicated on parents being able to effectively communicate to their children the utility value information they received via the brochures and website. Students whose parents received the intervention enrolled in significantly more math and science courses in the 11^{th} and 12^{th} grades than teens whose parents were in the control group, suggesting that parents were effective at communicating the utility value of taking these courses.

Although utility value interventions implemented in field studies have been shown to promote a number of positive academic outcomes, questions remain about how best to enhance students' perceptions of utility value and which intervention strategies are most effective. Should educators and parents tell their students that schoolwork is important and useful or do they need to help students discover this on their own? What is the best way to communicate value in order to encourage students to care about what they are learning?

Field experiments often have too many constraints prohibiting researchers from testing different intervention strategies in the same experimental design; therefore, testing utility value interventions in a controlled laboratory setting is critically important for understanding these strategies and informing the design of future interventions implemented in the field.

Testing Utility Value Interventions in the Laboratory

Laboratory studies have begun to test different strategies for communicating utility value and have found that the effectiveness of the intervention for certain students depends on the intervention strategy implemented. In one experiment, Durik and Harackiewicz (2007) tested a direct persuasion strategy by teaching participants a mental math technique and presenting information about how the technique could be useful in everyday life (e.g. "You might use mental math to figure out tips at restaurants or to manage your bank transactions"). Using Hidi and Renninger's model of interest development (2006), Durik and Harackiewicz reasoned that participants with initially high levels of math interest would find the technique inherently interesting and therefore would be ready to learn about the relevance or utility of the math technique for a variety of activities and situations. They found that participants with high initial interest reported more task interest after listening to a message with such examples. However, they also found some evidence that the utility-value manipulation undermined task interest for individuals with low initial interest. Durik, Shechter, Noh, Rozek, and Harackiewicz (2014) replicated these effects and found that perceived confidence in math was a more powerful moderator than initial interest. They found that participants with low confidence actually showed less interest in the math technique after being told about its utility value, whereas participants with high confidence showed more interest in utility-value conditions. Thus direct persuasion methods worked for confident students – information about utility value enhanced their perceptions of value and subsequent interest in the task – but did not work for others. In fact, there was some evidence that directly-communicated information about utility value had negative effects (e.g. decreased task interest) for less confident students.

In contrast, Hulleman et al. (2010) used the same mental math paradigm as Durik and Harackiewicz (2007), but instead of using direct persuasion methods, asked some participants to write about how the technique could be useful to them in their own lives, thus utilizing a self-persuasion method (Study 1). Hulleman et al. (2010) hypothesized that participants who generated their own ideas about how the technique could be useful would become more interested in the task, especially if they had low confidence. They theorized that by writing about utility, these individuals would discover their own reasons for exerting effort and thus would engage in learning, and found that less confident students were particularly likely to report more interest and inclination to use the technique in the future in the utility value condition.

We hypothesize that the different results obtained by Hulleman et al. (2010), in which a utility-value intervention using self-persuasion methods promoted interest for less confident participants, and Durik et al. (2014), in which a utility-value intervention using direct persuasion methods promoted interest for confident participants, but had a negative effect for those low in confidence, are due to the source of the utility-value information. In

Hulleman's studies, participants generated their own ideas about the relevance of a topic to their own lives, whereas participants in Durik's studies received utility-value information from an external source. It may be that self-generated utility value is especially important for less confident individuals, because they become more engaged when they participate in generating personalized relevance examples, whereas confident individuals already find the task engaging. Individuals who lack confidence in their ability may need to discover relevance information on their own before they can develop deeper interest in the material. Asking participants to write about utility value may be one way to "catch" the attention of the less confident students (Mitchell, 1993), because the students are given the chance to generate personal applications.

In contrast, directly-communicated utility value may be effective for confident individuals, because it reinforces the importance of competence (Durik, Hulleman, & Harackiewicz, in press). That is, if the task is presented as meaningful and useful, then succeeding at the task may become particularly important. For individuals who have confidence in their ability to succeed, directly-communicated utility value can act as a catalyst for continued interest through competence valuation, a process hypothesized to promote interest and motivation when individuals care about doing well (Harackiewicz & Sansone, 1991). For instance, Durik et al. (2014) found that directly-communicated information about utility value increased competence valuation for confident participants compared to a control condition.

On the other hand, reinforcing the importance of competence can be detrimental if an individual doubts his or her ability to succeed. Messages from others about the importance of a task can create feelings of pressure for individuals who are unsure if they can succeed at the task by increasing the incentives for doing well (Deci & Ryan, 1985; Ryan & Connell, 1989). When incentives for performing well are high, individuals can "choke under pressure" and perform more poorly than when the importance of performing well is not as salient (Beilock & Carr, 2001; Beilock, Kulp, Holt, & Carr, 2004). In other words, directly-communicated utility value may be particularly harmful for participants who lack confidence because it adds pressure, causing them to disengage from the task.

The literature suggests that self-generated and directly-communicated utility value may work differently: self-generated utility value seems optimal for individuals with low confidence because the personal application of utility value promotes task engagement and can spark interest development. Thinking about personal applications makes the material more appealing and engaging, leading these individuals to become more interested. In contrast, directly-communicated utility value seems optimal for confident individuals because the introduction of novel examples of utility increases the importance of doing well, and fosters the deepening of interest. However, prior research has only examined directly-communicated utility-value information against a no information control (Durik & Harackiewicz, 2007; Durik et al., 2014; Schechter, Durik, Miyamoto, & Harackiewicz, 2011) or self-generated utility value against a control writing exercise (Hulleman et al., 2010; Hulleman & Harackiewicz, 2009). In other words, no study has compared these two different utility-value communication strategies directly. Given that these studies have found differential results for individuals with high and low confidence, it is critical to test these two forms of utility-value interventions in the same experimental design and compare their effects directly.

The purpose of the current research is to systematically compare these two different utility-value communication strategies, understand their differences, and identify how utility value is best communicated for individuals with different levels of confidence. To examine these issues, we conducted three experiments using a mental math paradigm in which we varied whether students wrote about utility value for themselves or received different forms of directly-communicated information about utility value. In Studies 1 and 2 we compared self-generated utility value with directly-communicated utility-value information, and in Study 3 we examined different types of directly-communicated utility-value information to identify the most effective methods for communicating utility value to confident individuals and to those who lack confidence in their math ability.

Study 1

In this study, we examined two different utility-value (UV) interventions by manipulating the source of UV information. We compared directly-communicated UV information about a novel math technique with a self-generated UV intervention and tested whether perceived confidence in math moderated the effects on perceived utility value, task interest and performance. We hypothesize that the directly-communicated UV intervention will be beneficial for participants with high confidence and have negative effects for participants who lack confidence, replicating previous research (Durik & Harackiewicz, 2007; Durik et al., 2014). We also hypothesize that the self-generated UV intervention will be effective for participants with low confidence as in previous research (Hulleman et al., 2010; Hulleman & Harackiewicz, 2009).

Method

Participants—The participants in this study were 46 male and 42 female undergraduate students enrolled in the introductory psychology course at a large Midwestern university. Participants were 92% Caucasian, 5% Hispanic, 2% Asian, and 1% African American. Participants in all studies were blocked on gender before random assignment and completed the experimental session individually and in exchange for course extra credit.

Materials and Procedure—Participants were randomly assigned to either the self-generated UV condition, in which individuals were asked to generate examples of how the math technique was relevant to their own life, the directly-communicated UV condition, in which individuals were given utility-value information within the context of a PowerPoint instructional presentation, or the control condition, in which individuals did not receive or generate utility-value information.

First, participants were given two minutes to solve as many multiplication problems as they could, using their usual method of multiplication. The number of problems solved correctly was used as a baseline measure of math performance. Next, participants learned a mental math technique for solving 2-digit multiplication problems without using paper and pencil (adapted from Flansburg, 1996). This technique teaches students to multiply from left-to-right, making it easier to compute mental math problems quickly. Students are typically taught to compute complex multiplication problems from right to left, which involves multiplying and adding separate numbers several times over the course of one problem (and these problems often require pencil and paper). This particular math technique was chosen in order to teach participants something novel that is not taught in typical math classes and is independent from math ability. This short learning paradigm was designed to simulate a single, lecture-based classroom experience in which an instructor uses a PowerPoint presentation to teach a lesson (see Barron & Harackiewicz, 2001, for a more detailed description of the learning paradigm). Participants were guided through a PowerPoint instructional program teaching the left-to-right multiplication technique, while listening to an audio recording, in order to standardize the amount of time each participant spent learning the technique.

Participants assigned to the directly-communicated UV condition saw a presentation in which information about the general relevance of the technique was integrated into the learning program. The presentation emphasized how the technique could be used for everyday tasks, such as shopping or getting gas, as well as how mental math could be useful in different careers. Both present and future examples were presented. For example, participants were told, “you might use mental math to calculate your GPA or figure out tips at restaurants” or “as an adult, you might use mental math when shopping for your family or in your future career” (see Appendix A for complete materials). Participants assigned to the control and self-generated UV conditions were given the same instructional program, but without any utility information.

After learning the multiplication technique, participants were given 3 minutes to practice the technique on a sample problem set. Following the practice period, participants reported their confidence for doing well on the upcoming testing period. All participants then completed a brief writing exercise. The writing exercise was included in all conditions to control for the experience of writing. In order to remain blind to experimental condition, the experimenter handed the participant a folded sheet of paper containing the writing exercise instructions. Participants had 8 minutes to type their essay on a laptop that was placed in front of them. Participants in the self-generated UV condition were asked to:

> type a short essay (1 – 3 paragraphs in length) briefly describing the potential relevance of this technique to your own life. Of course, you’ll probably need more practice with the technique to really appreciate its personal relevance, but for purposes of this short essay, please focus on how this technique could be useful to you in your own life, and give examples.

Participants in the directly-communicated UV and control conditions were asked to describe two pictures hanging on the wall in front of them. The pictures were of math-related scenes (i.e., a picture of a man examining charts and figures and a picture of several different colored and shaped dice).

All participants then solved two sets of 30 multiplication problems using the new technique. Finally, participants reported their perceptions of utility value and task interest.

Measures—Each questionnaire contained items used in previous studies of utility value (Durik & Harackiewicz, 2007; Hulleman et al., 2010; Shechter et al., 2011). Questionnaire items were on a 1 (strongly disagree) to 7 (strongly agree) Likert scale, unless otherwise noted. See Table 1 for descriptive statistics, zero-order correlations, and reliabilities for all measures.

Baseline Performance: Performance was measured by the total number of problems participants solved correctly using their usual method of solving multiplication problems; this score ranged from 0 to 9. This measure was used as a covariate in all analyses.

Perceived Confidence: Perceived confidence was measured with a three-item scale (“I felt that I was using the technique correctly,” “I felt confident using the technique,” “I felt that I was doing poorly on these problems” reversed; α= .79). This measure was taken after participants learned the multiplication technique and had the opportunity to practice using the technique on sample problems. This measure was used as the moderator for analyses in Study 1 and Study 2[1].

Perceived Utility Value: At the end of the experimental session, perceptions of utility value were measured using a five-item scale (“This technique could be useful to me in my future career,” “This technique could be useful to me in my future classes,” “This technique could be useful to me in daily life,” “The left to right technique is valuable,” “This technique isn't very useful to me” reversed; α= .88). This measure was intended to capture participants’ attitudes about utility value at the end of the session and thus could not be tested as a mediator of intervention effects. Rather, it is one of the primary dependent measures across studies, allowing us to determine which interventions are most effective in promoting perceived utility value.

Task Interest: Task interest was measured with a four-item scale (“The left to right technique is interesting,” “Using this multiplication technique is fun,” “I enjoyed using the left to right technique,” “Learning the left to right technique was a waste of time” reversed; α= .90).

Task Performance: Performance was measured by the total number of problems participants solved correctly on the two problem sets; this score ranged from 0 to 60. Participants were given 3 minutes on each problem set, for a total of 6 minutes.

Results

Regression Model—Multiple regression was used to investigate the effects of the two UV interventions on perceived utility value, performance and task interest. Perceived confidence, measured continuously, was included as a moderator and standardized to compute two-way interactions. We tested two orthogonal contrasts to compare the two

[1]The timing of this measure aligns with previous research on self-generated utility value, and captures students’ self-perceptions of competence after learning the technique (Hulleman et al., 2010). Since this measure occurs after the directly-communicated UV information manipulation, we compared whether those who received the directly-communicated UV intervention and those who did not, differed in their reports of perceived confidence. We found that perceived confidence was unaffected by the manipulation in Study 1, $t(85)= 1.28$, $p = .21$, $\beta = 0.14$, and in Study 2, $t(103)= .09$, $p = .93$, $\beta = 0.00$.

interventions directly, and to test both interventions against the control condition. The UV Type contrast compared the two interventions directly (Self-generated UV, +1, Directly-Communicated UV, −1, Control, 0), and the UV versus No UV contrast compared the two UV interventions to the control condition (Self-generated UV, +1, Directly-communicated UV, +1, Control, −2). Our final model contained seven terms: two orthogonal contrasts, perceived confidence in math, two interactions between the contrasts and perceived confidence, and two covariates: baseline performance and gender (included as covariates in all studies). We report significant effects on each of the three primary dependent variables: perceived utility value, task performance, and interest (see Table 2 for results from the full regression model used in each study for each dependent variable). To interpret significant interactions in all studies, predicted values were generated for individuals one standard deviation below and above the mean on perceived confidence.

In this study, we were particularly interested in the UV type contrast and its interaction with confidence, in order to compare the two intervention types directly against each other and to determine their effects for individuals with different levels of perceived confidence. Later we report ancillary simple slope analyses (each intervention tested separately against the control group) in order to test for replication with previous research (e.g., Durik & Harackiewicz, 2007; Hulleman et al., 2010).

Effects on Dependent Variables

Perceived utility value: There was a significant two-way interaction between the UV versus No UV contrast and confidence on perceived utility value, $p = .03$, $\beta = 0.23$. This indicates that both self-generated UV and directly-communicated UV increased perceptions of utility value for participants with high confidence ($\hat{Y} = 6.12$) compared to the control condition ($\hat{Y} = 5.63$), but that neither intervention influenced perceived utility value for less confident participants ($\hat{Y} = 5.22$) compared to the control condition ($\hat{Y} = 5.37$). Notably, there was not a significant interaction between the UV Type contrast and perceived confidence, indicating that directly-communicated UV and self-generated UV were equally effective at increasing perceived utility value for participants with high confidence and equally ineffective for participants with low confidence. There was also a significant main effect of perceived confidence $p = .01$, $\beta = 0.28$, indicating that participants with higher confidence reported more perceived utility value than those with lower confidence.

Task performance: We observed a significant main effect of UV Type on performance $p = .04$, $\beta = 0.20$, indicating that self-generated UV increased performance on math problems for all participants ($M = 30.36$, $SD = 8.96$) relative to directly-communicated UV ($M = 26.48$, $SD = 9.271$). However, this main effect was qualified by a significant two-way interaction between UV Type and perceived confidence, $p = .04$, $\beta = -0.21$ (see Figure 1). This indicates that self-generated UV information particularly enhanced performance for students who lacked confidence, compared to the directly-communicated UV condition, whereas confident students did well with both types of UV. There was also a significant main effect of perceived confidence $p < .01$, $\beta = 0.38$, and baseline performance $p = .03$, $\beta = 0.21$, indicating that participants with higher confidence and higher baseline performance scores solved more problems than those with lower confidence and lower baseline performance scores. Finally, a main effect of gender emerged indicating that males obtained higher scores on the problem sets than females $p = .02$, $\beta = 0.23$.

Interest: There was a nearly significant interaction between UV Type and perceived confidence, $p = .07$, $\beta = -0.20$ (see Figure 1). This suggests that self-generated UV information enhanced interest to some degree for participants with low confidence compared to directly-communicated UV, and that directly-communicated UV enhanced interest to some degree for confident individuals, relative to self-generated UV. In other words, telling participants about the relevance of the math technique made the task somewhat less interesting for students who lacked confidence, but had a positive effect for confident individuals. There was also a significant main effect of perceived confidence $p < .01$, $\beta =$ 0.31, indicating that participants with higher confidence reported more interest in the task than those with lower confidence.

Replication Analyses—Because our analytic model focused on direct comparisons of the two types of utility-value interventions, it was not possible to compare each UV condition against the control group in the primary analyses. However, we conducted ancillary simple slope analyses to test for replication of previous laboratory studies that examined directly-communicated utility-value information against a no information control (Durik & Harackiewicz, 2007; Durik et al., 2014; Schechter, Durik, Miyamoto, & Harackiewicz, 2011) or self-generated utility value against a control writing exercise (Hulleman et al., 2010). Specially, we tested the effect of the UV interventions against the control condition among individuals one standard deviation below and above the mean on perceived confidence.

In their laboratory studies, Durik and colleagues and Hulleman et al. (2010) found significant effects on perceived utility value and interest, but not on performance. Across several laboratory studies, Durik and colleagues found positive effects of directly-communicated UV on perceived utility value and interest for confident participants, and some negative effects for less confident participants. Like Durik and colleagues, we found positive effects of directly-communicated UV relative to control for confident individuals on perceived utility value, $t(80) = 3.15$, $p < .01$, $\beta = .43$, but no effects for less confident individuals, $t(80) = 0.58$, $p = .56$, $\beta = .09$. We also found positive effects of directly-communicated UV on interest for confident individuals, and negative effects of directly-communicated UV for less confident individuals, but neither of these effects were significant relative to control, $t(80) = 1.18$ and .90, respectively, $p > .20$. Consistent with Durik and colleagues, we found no effects of directly-communicated UV relative to control on performance for confident individuals, $t(80) = 1.10$, $p = .30$, $\beta = -.13$, or less confident individuals, $t(80) = 0.82$, $p = .41$, $\beta = .12$.

In contrast, Hulleman et al. (2010) found positive effects of self-generated UV on perceived utility value and interest for less confident participants, and no effects for confident students. Like Hulleman et al., we found a positive effect of self-generated UV for less confident individuals on interest, but it was not significant relative to the control group, $t(80) = .45$, $p = .66$, $\beta = .06$. In contrast to Hulleman et al, we found a small negative effect on perceived utility value, but it was not significant. Unlike Hulleman et al. (2010), but consistent with their field study in high school science classes (Hulleman & Harackiewicz, 2009), we found that the self-generated UV intervention promoted performance for less confident individuals relative to the control condition, $t(80) = 2.62$, $p = .01$, $\beta = .34$, but did not affect performance for confident individuals, $t(80) = 0.73$, $p = .47$.

Table 3 presents these comparisons with the control group in terms of the effect size for each test (*d*). Our results indicate a pattern of partial replication of both programs of research, though the results were not as strong as the original studies when compared against control conditions. By comparing the interventions against each other, however, we can explore how they work differently for individuals who vary in their level of confidence.

Discussion

We found that both interventions were effective in promoting perceived utility value for confident individuals, suggesting that both interventions successfully persuaded confident individuals that the mental math technique was relevant to their lives. However, neither intervention was effective in persuading individuals who doubted their math ability. Our results suggest that these individuals, who are the most in most need of intervention, did not internalize the utility of the mental math technique, even when they generated their own examples of relevance. Thus the self-generated UV intervention by itself was not effective in changing the perception of value for individuals who lacked confidence. Perhaps less confident individuals cannot see the value of the technique if they doubt their ability to master the math technique. It may be that in order for less confident individuals to internalize the utility of the math technique, they first need to believe they can succeed at the task.

Consistent with our hypothesis, we found very different effects for the two interventions on performance and interest when we compared them directly to each other. Directly-communicated UV information undermined performance and interest, compared to self-generated UV, for individuals who lacked confidence. Not only was directly-communicated UV information not helpful for participants with lower confidence, it actually seemed to lead these participants to react negatively to the information. Telling participants about the usefulness of the material during the learning process may hinder interest development and inhibit performance for students who doubt their abilities. Directly-communicated UV information may add more pressure for mastering the technique, which could be one reason why less confident individuals do not respond positively to relevance information coming from someone else (Durik, Hulleman, & Harackiewicz, in press). Information about the utility of the technique coupled with a lack of confidence may put too much pressure on these individuals, without giving them a chance to process or cope with the utility value information by putting it in their own words.

In contrast, we found that self-generated UV was more effective than directly-communicated UV at promoting performance for all participants, and was particularly beneficial for individuals who doubted their ability. Ancillary analyses revealed that self-generated UV was effective at promoting performance for less confident participants compared to the control group as well, replicating Hulleman & Harackiewicz (2009). Perhaps self-generated UV alleviates some of the pressure associated with performing well by giving participants a chance to picture themselves using the technique in the future, once they have mastered it.

Expectancy-value theory hypothesizes that task values have the most influence on attitudes and behavior when perceived competence is high (Eccles & Wigfield, 2002). Therefore, self-generated utility value may be helpful for individuals who doubt their ability to succeed because it increases individuals' perceptions of competence. If individuals with low confidence can picture themselves succeeding at the task, they may come to believe that they are capable of success, leading to attitude change, continued interest, and performance; and the self-generated utility value intervention may facilitate this process. For instance, the instructions for the writing exercise highlight the potential relevance of the technique after practicing it: "Of course, you'll probably need more practice with the technique to really appreciate its personal relevance, but for purposes of this short essay, please focus on how this technique could be useful to you in your own life, and give examples." This statement encourages individuals to look past their present abilities and think about the relevance of the technique once they have mastered it. The self-generated UV intervention may actually increase perceptions of mastering the technique, by encouraging individuals to think about instances in which they would actually use the technique, thereby alleviating pressure to perform well and increasing their subsequent performance.

Given the strong effect of self-generated UV on performance, it is surprising that we found no effects on perceived utility value or interest for less confident individuals. These individuals may need more information about possible uses of the technique while learning about it in order for a self-generated UV intervention to affect perceived task values and influence task interest. For instance, providing utility value information during the learning process might spark more ideas for the individuals to write about that they would have otherwise considered (Renninger & Hidi, 2011). This suggests that the combination of directly-communicated and self-generated UV might be particularly beneficial for those who lack confidence. Perhaps students first need to hear about some examples of utility value from someone else and then be given the chance to come up with their own personalized examples. Directly-communicated UV information might be too threatening by itself for individuals who lack confidence (Durik et al., 2014), but once these individuals are given the chance to process the information in their own words, directly-communicated UV might actually be helpful. This suggests that directly-communicated UV information may be more beneficial for students who lack confidence if it occurs in combination with an opportunity to write a UV essay. Giving students a chance to generate their own personal examples of UV after receiving UV information from an external source might give these students the chance to process the material before putting it in their own words.

Study 2

In Study 2 we tested whether the combination of both self-generated and directly-communicated UV might have a synergistic effect for perceptions of utility value, interest and performance, and hypothesized that this combination might be most effective for individuals low in perceived confidence. We also explored perceived confidence measured after the interventions as a possible mechanism as to how self-generated and directly-communicated UV information might work together. If the combination of UV interventions helps participants feel more confident they might become more engaged in the task and perform well when tested on their learning of the technique (Dweck, 2007; Harackiewicz & Sansone, 1991; White, 1959). We explored whether self-generated or directly-communicated UV, or both in combination, led to more perceived confidence after the interventions, and whether this process measure of confidence then mediated the effects of UV interventions on interest and performance.

Method

Participants—The participants in this study were 33 male and 80 female undergraduate students enrolled in the introductory psychology course at a large Midwestern university. Participants were 94% Caucasian, 1% Hispanic, 2% Asian, and 3% African American.

Materials and Procedure—Participants were randomly assigned to a condition within a 2 (no directly-communicated UV vs. directly-communicated UV) x 2 (no self-generated UV vs. self-generated UV) between-participants design. The procedure for Study 2 was similar to that of Study 1, but with one additional condition. In the combined UV condition, participants were given relevance information within the PowerPoint instructional program and then generated their own examples of relevance during the writing task. An additional change was that we added a process measure of perceived confidence, measured after the writing exercise and before the two problems sets, in order to assess whether changes in perceived competence might account for the effects of the UV interventions. Perceived confidence after the interventions was measured with a two-item scale ("I feel that I am making good progress with this technique," "I feel confident about using the technique on the upcoming problem sets").[2] This measure assesses confidence after learning the mental math technique and after both UV manipulations. We hypothesized that the combination of directly-communicated UV information and self-generated UV would increase confidence for participants who initially doubt their ability to succeed.

Results

Regression Model—Multiple regression was used to investigate the effects of our interventions on perceived utility value, task interest and performance, as well as perceived confidence after the interventions, the hypothesized mediator. The experimental design was a 2 × 2, crossing self-generated and directly-communicated utility value interventions. Three terms in the model were contrast codes designed to test the independent and interactive effects of the experimental manipulations. These included two main effects (directly-communicated UV, +1, no directly-communicated UV, −1; self-generated UV, +1, no self-generated UV, −1) and the product of these terms to test the experimental interaction. Initial perceived confidence in math ability, measured continuously at baseline, was included as a moderator and standardized to compute interaction terms with the contrast codes. Our final model contained nine terms: three contrast codes, initial perceived confidence in math ability, two two-way interactions (between each of the two UV main effect contrasts and initial perceived confidence), one three-way interaction (between the two UV contrasts and

[2]Three participants had missing data for perceived mastery and therefore were excluded from analyses on this variable.

perceived confidence), and two covariates. See Table 4 for descriptive statistics, zero-order correlations, and reliabilities for all measures.

Effects on Dependent Variables

Perceived utility value: There was a significant main effect of self-generated UV, $p = .03$, $\beta = 0.19$, indicating that writing about the relevance of the math technique increased perceptions of the utility of the technique for all participants. This effect was qualified by a significant three-way interaction between directly-communicated UV, self-generated UV and perceived confidence in math, $p = .03$, $\beta = -0.21$ (see Figure 2). Self-generated UV was most effective when paired with directly-communicated UV in increasing perceptions of utility value for participants who lacked confidence and had no effect for participants with high confidence. Participants with high initial confidence reported more overall perceptions of utility value than participants with low initial confidence $p < .01$, $\beta = 0.40$.

Task performance: We observed a significant three-way interaction between directly-communicated UV, self-generated UV, and perceived confidence in math on performance, $p = .02$, $\beta = -0.21$ (see Figure 2). This indicates that the combination of directly-communicated UV information and self-generated UV was particularly effective for less confident participants and had no effect for participants with high confidence. There was also a significant main effect of perceived confidence, $p < .01$, $\beta = 0.43$, and baseline performance, $p < .01$, $\beta = 0.31$, indicating that participants with higher confidence and baseline performance obtained higher scores on the problem sets than those with lower confidence and baseline performance.

Interest: There was a significant main effect of self-generated UV, $p = .02$, $\beta = 0.20$, such that participants who wrote about the relevance of the math technique reported more interest in the task than those who wrote a control essay; however, this was qualified by a significant three-way interaction between directly-communicated UV, self-generated UV and perceived confidence in math on task interest, $p = .02$, $\beta = -0.23$ (see Figure 2). The combination of directly-communicated UV information and self-generated UV increased interest for individuals low in confidence. In other words, self-generated UV was most effective for less confident participants when paired with directly-communicated UV and had no effect for high confident participants. There was also a significant main effect of perceived confidence, $p < .01$, $\beta = 0.43$, indicating that participants with higher confidence reported more interest in the task overall than participants with low confidence.

Mediation Analyses: Perceived Confidence After the Interventions—We found a significant two-way interaction between directly-communicated UV and self-generated UV on perceived confidence measured after the interventions and before the multiplication problem sets, $t(99) = 2.52$, $p = .01$, $\beta = 0.17$. Participants who received directly-communicated UV combined with self-generated UV reported higher perceived confidence after the interventions ($M = 5.85$, $SD = .96$) than participants in the control condition ($M = 5.23$, $SD = 1.35$), directly-communicated UV condition ($M = 5.00$, $SD = 1.14$), and self-generated UV condition ($M = 5.23$, $SD = 1.18$). This indicates that the combination of directly-communicated UV and self-generated UV increased perceptions of mastering the mental math technique for all participants, regardless of initial confidence level.

We used Preacher and Hayes's (2004) bootstrapping procedure to test whether perceived confidence after the interventions mediated the combined intervention effect for initially less confident participants on perceived utility value, performance, and task interest. We found evidence for partial mediation of all three effects, such that the combination of self-generated UV and directly-communicated UV increased perceived utility value, performance, and interest by increasing perceived confidence. Results based on 5,000 bootstrapped samples indicate that the indirect effect via perceived confidence equaled .12 for perceived utility value, 95% CI [.0253, .2410], .35 for performance on the multiplication problems, 95% CI [.0070, .9216], and .12 for task interest, 95% CI [.0282, .2418]. The fact that zero falls outside these intervals indicates significant mediation for each dependent variable, $ps < .05$.

Content Analyses of UV Essays—One reason that self-generated UV might be more effective when paired with directly-communicated UV is that participants might generate more examples of relevance in their UV essays after first receiving UV information from the instructional program. For instance, participants in the combined UV condition could repeat some of the directly-communicated UV examples from the instructional program in their essay in addition to generating their own personal examples of relevance. Likewise, participants who are generating their own examples of relevance without any UV information in the program may not think of as many examples on their own.

To test this, we first coded for the total number of utility connections made in each essay. We counted each example that the participant listed of how the technique could be used in real life as one utility value connection (e.g., "I am studying nursing and I feel that this technique will be helpful when working with patients and getting them the best care as fast as possible," "This [technique] is especially relevant if you were buying an item in bulk, for example buying t-shirts or sweaters for a club or organization," "Soon I'll have to begin paying my own rent for an apartment, and techniques like this one could help me with the calculations involved in paying monthly fees"). We next coded for whether the connections were non-PowerPoint examples (i.e., different from the examples provided in the program) or the same as the examples used in the program (in directly-communicated UV conditions). All examples in the self-generated UV only condition were considered non-PowerPoint examples, except for examples of efficiency of the technique (e.g., "I'll use this technique because it's quicker and easier than my usual method and I don't need pencil or paper"), because efficiency was mentioned in all versions of the instructional program. Coders were blind to condition and inter-rater reliability was high, with two independent coders providing the same scores approximately 90% of the time. Disagreements were resolved by discussion.

We used multiple regression to compare the two experimental conditions that included UV writing in terms of the number of connections generated. A contrast code compared the self-generated UV only condition (−1) with the combined self-generated and directly-communicated UV condition (+1). Perceived confidence in math, measured continuously, was included as a moderator and standardized to compute the interaction with the contrast code. The final model contained five terms: one contrast code, initial perceived confidence in math, one interaction (between the contrast code and initial perceived confidence), and two covariates (baseline performance and gender).

As expected, we found that participants who received directly-communicated UV information in addition to the self-generated UV prompt generated more examples in their essays ($M = 3.96$, $SD = 1.60$), than participants who did not receive directly-communicated UV ($M = 2.71$ $SD = 1.08$), $t(48) = 3.57$, $p < .01$, $\beta = 0.47$. However, there were no differences between conditions in the number of non-PowerPoint examples that were generated in the essays $t(48) = 0.83$, $p = .41$, $\beta = 0.12$, suggesting that participants in the combined UV condition came up with as many non-PowerPoint, personally generated examples ($M = 1.81$ $SD = 1.33$) as did participants who were not provided with directly-communicated UV information ($M = 1.64$ $SD = 1.10$). There were no main effects or interactions with initial perceived confidence on the total number of utility connections or the number of non-PowerPoint examples, $p > .10$, indicating that participants with low confidence generated the same amount of utility connections as participants with high confidence across conditions.

We also examined the content of the self-generated UV essays using LIWC (Linguistic Inquiry and Word Count) text analysis. LIWC is a software program that calculates the degree to which people use different categories of words across multiple text files (Pennebaker, Booth, & Francis, 2007). LIWC contains dictionaries that correspond to different categories of words (i.e. positive words, negative words, pronouns, leisure words, etc.) and calculates how many words in each of the pre-determined LIWC dictionaries appear in each essay.

We hypothesized that participants who lacked confidence might express their doubt or uncertainty about the usefulness of technique in their essays. We also wanted to test if the content of the essays differed between conditions and between participants with different levels of confidence. We chose LIWC dictionaries that might pick up participants' doubt or uncertainty when writing about the relevance of the math technique as well as dictionaries that could pinpoint different topics that were discussed in the essays. Out of the 80 LIWC categories, we chose 5 dictionaries that we thought might capture these constructs: 1) Negation words (e.g. no, never, can't), 2) Anxiety words (e.g. worried, nervous, uncertain, struggle), 3) Tentative words (e.g. guess, kind of, maybe, perhaps) 4) Work-school words (e.g. job, boss, major, homework, GPA), and 5) Leisure words (e.g. cook, party, restaurant, shop).

We found a significant main effect of confidence on negation words, $t(48) = 2.35$, $p = .02$, $\beta = -0.34$, such that participants with low confidence used more negation words in their essays than those with higher confidence in their math ability. We also found a main effect of condition on anxiety words, $t(48) = 2.40$, $p = .02$, $\beta = -0.33$, suggesting that those who received both directly-communicated UV information and self-generated UV used fewer anxiety words than those who did not receive directly-communicated UV information. Finally, we found a main effect of condition on leisure words, $t(48) = 4.50$, $p < .01$, $\beta = 0.56$, that was qualified by the interaction with confidence, $t(48) = 2.17$, $p = .04$, $\beta = -0.26$, suggesting that participants who were lower in confidence used more leisure words when they also received directly-communicated UV information. Notably, there were no significant differences in tentative language or work-school related word use.

Discussion

In Study 1 we found that directly-communicated UV information can undermine performance and interest for participants with low confidence compared to self-generated UV, but Study 2 shows that directly-communicated UV can actually help these participants when combined with self-generated UV. We found that the synergistic effect of self-generated and directly-communicated UV was particularly powerful for those with low confidence, increasing perceived utility value, performance, and interest, by giving participants confidence in their ability to succeed. Perhaps participants who are initially unsure of their ability can benefit from directly-communicated UV information, but need the opportunity to reflect on what they’ve learned. Giving these participants a chance to generate their own personal examples of UV after receiving some UV information from an external source might help them digest the material and put it in their own words. Our process analysis shows that all participants experienced a boost in perceived confidence after receiving directly-communicated UV information and then generating their own examples of how the technique relates to them. Perhaps this confidence boost was sufficient to counteract any negative effects of directly-communicated UV information.

Content analyses offer some insight into how students think about utility value. Our results suggest that participants who lacked confidence tended to include more negative statements in their essays. For example, one participant wrote: “I guess it’s kind of a stretch, but I can use the new technique to figure out how many credits per semester I need to take in order to graduate in 4 years. Other than that I can’t think of any more personal uses I have for using mental math in my life right now.” Even though this participant generates a possible situation in which the math technique could be useful, he or she admits that the new technique might not be entirely useful in their daily life. Participants who doubt their ability to do well are more likely to use words like “won’t” and “can’t” to express their doubts about the utility of the math technique.

However, we found that participants were less likely to use anxiety words such as “struggle” or “doubt” in their UV essays when they also received directly-communicated UV information. This suggests that when participants were able to write about the relevance of the math technique after first receiving some general relevance information in the program, they used fewer statements such as “I struggle with math in general” or “I had doubts about whether [the technique] would be useful in my everyday life.” This suggests that participants may need the chance to generate their own examples of UV after receiving directly-communicated UV. It might be reassuring to first receive UV examples from someone else and then have the opportunity to generate your own personalized examples.

Finally, our content analyses revealed one clue as to why the combination of self-generated and directly-communicated UV was particularly powerful for those with low confidence. This combination seemed to help participants who lacked confidence to write more about leisure activities such as shopping and eating out in restaurants, rather than how mental math can be useful in their career. Perhaps participants who are unsure of their ability relate more to the everyday-leisure examples of utility that emphasize fun and enjoyable activities and then write more about these types of activities when given the opportunity to generate their own examples. In contrast, directly-communicated career examples may be experienced as threatening if participants doubt their ability to master the technique. Thus, students who lack confidence may ignore any threatening information and instead focus on less intimidating examples of directly communicated UV.

Study 3

In Study 3, we focused on reducing the threat of directly-communicated utility-value information for individuals who lack confidence. One way to reduce threat is to change the content of the information. The content analyses from Study 2 indicate that participants who doubted their ability were more likely to write about using mental math in their everyday life (e.g., figuring out tips and shopping) after receiving directly-communicated utility value information, and they also reported more perceived confidence after doing so. Perhaps relevance information that emphasizes different careers and more long-term goals can be somewhat threatening for students who doubt their abilities (Durik, Hulleman, & Harackiewicz, in press). Students may be better able to imagine using mental math when it is presented with everyday examples. Therefore, in Study 3 we manipulated the content of directly-communicated value, by removing examples of career-related UV from our directly-communicated UV intervention, in order to test whether information that only includes examples of the relevance of mental math to everyday-leisure activities was more effective for individuals who doubt their ability to succeed.

Method

Participants—The participants in this study were 42 male and 92 female undergraduate students enrolled in the introductory psychology course at a large Midwestern University. Participants were 94% Caucasian, 2% Hispanic, 3% Asian, and 1% African American.

Materials and Procedure—We tested a three-cell design in which we manipulated the content of directly-communicated relevance information (everyday-leisure UV vs. standard UV vs. no UV). We created the everyday-leisure UV materials by removing career-related examples from the standard directly-communicated UV materials used in Study 1 and Study 2 (see Appendix B for complete materials). For example, phrases such as, "most college graduates enter professions that require math, so mental math can be useful in your future career" were removed from the standard materials, leaving only examples of everyday or leisure activities. Additionally, career-related pictures were removed from the standard UV materials, such as that of a nurse caring for a patient and a chemist mixing chemicals. Therefore, the remaining information emphasized connections to a participant's daily life, such as telling students they might use mental math at a restaurant or while shopping. As in Study 1 and Study 2, the standard UV information emphasized career choices and different professions, in addition to everyday examples.

The procedure for Study 3 was identical to that of Study 1, with three exceptions. First, participants were guided through one of three different presentations teaching the left-to-right multiplication technique. Participants assigned to the everyday-leisure UV condition were given a presentation in which information about the everyday relevance of the technique was integrated into the learning program. Participants assigned to the standard UV condition were given a presentation that included examples of how the technique was relevant to different career paths, as well as everyday examples (identical to that used in Studies 1 and 2). Participants assigned to the control condition were given the same instructional program, but without any relevance information. Second, because this study only involved directly-communicated UV, it was particularly important to measure perceived confidence earlier in the learning process. Perceived confidence was measured before participants learned the math technique with a two-item scale ("I think that I'll be able to learn the new technique taught in this session," "I'm confident that I can learn this new math technique"). Finally, we added a baseline measure of interest and also included the same process measure of perceived confidence after the interventions measured in Study 2.

Results

Regression Model—Multiple regression was used to investigate the effects of everyday-leisure UV and standard UV on task interest and performance, as well as the hypothesize mediator, perceived mastery. Two orthogonal contrast codes were created to test differences between the three conditions. The UV Type contrast compared the two different directly-communicated UV interventions (everyday-leisure UV, +1, standard UV, −1, Control, 0), and the UV versus No UV contrast compared the two directly-communicated UV interventions to the control condition (everyday-leisure UV, +1, standard UV, +1, Control, −2). Baseline performance, baseline task interest, and gender were included as covariates. Initial perceived confidence, measured continuously, was included as a moderator and standardized to compute two-way interactions. Our final model contained eight terms: two orthogonal contrasts, perceived confidence, two interactions between each of the UV contrasts and perceived confidence, and three covariates. See Table 5 for descriptive statistics, zero-order correlations, and reliabilities for all measures.

Effects on Dependent Variables

Perceived utility value: We found a nearly significant interaction between UV Type and confidence, $t(125) = 1.94$, $p = .06$, $\beta = -0.14$, suggesting that everyday-leisure utility examples increased perceptions of utility value, relative to the standard directly-communicated utility examples, for less confident individuals (see Figure 3). We also found a significant main effect of baseline interest, $t(125) = 7.66$, $p < .01$, $\beta = 0.54$, and perceived confidence, $t(125) = 2.96$, $p < .01$, $\beta = 0.23$, indicating that participants with initially high levels of task interest and perceived confidence reported more utility value in the technique after the program.

Task performance: There were no experimental effects on performance. There was a significant main effect of baseline performance, $t(125) = 4.79$, $p < .01$, $\beta = 0.39$, indicating that participants with higher baseline performance scored higher on the problem sets than those with lower baseline performance.

Interest: We found a main effect of UV Type, $t(125) = 2.22$, $p = .03$, $\beta = 0.14$, that was qualified by a significant interaction with confidence, $t(125) = 2.61$, $p = .01$, $\beta = -0.16$, showing that participants with low confidence reported more interest in everyday-leisure UV conditions, compared to the standard UV condition (see Figure 3). This suggests that utility-value information that only emphasized everyday activities was more effective in promoting interest than information that emphasized utility for future careers, for those with low confidence. For those with high confidence, the content didn't matter; both kinds of UV information were equally effective. We also found a significant main effect of baseline interest, $t(125) = 11.00$, $p < .01$, $\beta = 0.70$, indicating that participants with initially high levels of task interest reported more interest in the technique after the program.

Mediation Analyses: Perceived Confidence After the Interventions—We found a significant interaction between UV Type and confidence on perceived confidence measured after the interventions, indicating that everyday-leisure utility examples increased confidence for those with low initial confidence, relative to standard UV examples, whereas the standard UV examples increased confidence for confident individuals, relative to everyday-leisure activities, $t(125) = 2.33$, $p = .02$, $\beta = -0.19$ (see Figure 3). Using the same bootstrapping procedure as in Study 2 (Preacher & Hayes, 2004), we tested whether perceived confidence measured after the interventions mediated the UV Type effect for initially confident and less confident individuals on perceived utility value and interest. We found that the test of moderated mediation was significant for perceived UV, −.13, 95% CI [−.2971, −.0353], and task interest, −.15, 95% CI [−.3805, −.0353], and that the indirect effect of UV Type via perceived confidence differed for initially confident and less confident students. The indirect effect of everyday-leisure UV was positive for initially less confident individuals (1 SD below mean); the indirect effect was .13 for perceived utility value, 95% CI [.0155, .3340], and .15 for task interest, 95% CI [.0142, .3843], showing that everyday-leisure UV increased perceived utility value and interest by promoting perceived confidence, relative to the standard UV intervention. In contrast, the indirect effect of everyday-leisure UV for confident individuals (1 SD above the mean) was negative, and equaled −.14 for perceived utility value, 95% CI [−.3941, −.0053], and −.16 for task interest, 95% CI [−.4590, −.0029], indicating that the standard UV intervention (which included career examples as well as everyday utility value) promoted perceived utility value and interest via perceived confidence for these individuals. The fact that zero falls outside these intervals indicates significant mediation for each dependent variable, *p*s < .05.

Discussion

In this study, we found that we could reduce the threat of directly-communicated relevance information by removing career-related content. We found that directly-communicated UV information that only emphasized everyday-leisure activities actually increased task interest and perceptions of utility value by increasing confidence for participants who initially doubted their ability. Thus we found a way to offset the negative effects of directly-communicated relevance information seen in previous research (Durik & Harackiewicz, 2007; Durik et al., 2014), by focusing on less threatening information about the utility value of mental math. Perhaps participants can actually imagine using mental math when the instructional program provides everyday examples. Less confident individuals may be more receptive to utility information that concerns activities already integrated into their life, such as shopping for groceries, but might be especially sensitive to utility information that emphasizes loftier goals, such as using mental math to do well in their future career. In other words, it might be easier for students to think about using mental math in their daily life, whether in a restaurant or when getting gas, rather than thinking about the math that they'll need for their future career.

It is possible that the type of math required for everyday-leisure activities is less complex than the math that is needed for future careers, thus making the message less threatening and the possibility of actually using the technique more realistic. It might also be the case that less confident individuals have chosen future careers that do not involve math, so information about the utility value of mental math for different careers may seem irrelevant to them. For example, individuals who doubt their math ability may be less likely to pursue careers such as nursing, accounting, or chemistry, which require math competency. Perhaps this kind of career-related utility-value information only confirmed initial attitudes about the lack of relevance for these individuals. We may have unknowingly reinforced irrelevancy for individuals who have chosen less math-oriented fields of study. Instead, information about math in everyday tasks, which could apply to anyone, was more effective in promoting perceived utility value, interest, and confidence. In sum, it isn't the case that directly-communicated relevance is always threatening for less confident individuals, but rather that UV information needs to be tailored to the characteristics and needs of the individual, and accommodate those who have trouble imagining themselves succeeding at the task.

General Discussion

Across three laboratory studies we examined the difference between directly-communicated and self-generated relevance information for confident individuals and for those who doubt their ability. In Study 1, we found that we could change attitudes about perceived utility value for confident individuals, but not for less confident individuals. Furthermore, we found that directly-communicated utility-value information can undermine performance and interest for individuals who lack confidence, compared to self-generated utility value. However, in Study 2, our results indicated that the negative effects of directly-communicated utility-value information can be ameliorated when participants are also given the chance to generate their own examples of personal uses for the technique. Providing utility-value information in combination with the opportunity to generate personalized examples was necessary for less confident individuals to internalize the value of the task, increasing perceived utility value, performance and interest. Finally, in Study 3, we found that individuals who lack confidence benefit more when directly-communicated utility-value information only includes examples of everyday-leisure connections, rather than career and school examples. Utility-value information may be threatening if presented in a way that impacts life goals such as career plans and school, rather than everyday tasks.

These three studies show that intervening to persuade individuals to value a task can be difficult, especially because the individuals who most need intervention are the ones most reluctant to embrace information about utility value. As classic studies in social psychology have shown (Janis & King, 1954; Lewin, 1947), there is rarely meaningful change in attitudes and behaviors when we simply provide individuals with important information. We found this to be true, especially for individuals who lack confidence in their ability to succeed. In fact, Studies 1 and 2 show that telling less confident individuals about utility value can even be detrimental for performance and interfere with interest development, compared to encouraging individuals to generate utility value on their own. Indeed, it wasn't until we varied the content of the information being communicated in Study 3, that we discovered any type of directly-communicated utility-value information that was effective for less confident individuals, without combining it with self-generated UV. Information about everyday utility value may have worked for these individuals because it was less threatening, and did not invoke concerns about competence, or because it was more tailored to their characteristics and needs.

Our research is consistent with previous research that shows that intervention strategies such as "self-persuasion" and "saying-is-believing" can be powerful tools for changing attitudes (Aronson, 1999; Janis & King, 1954; Pratkanis & Aronson, 1992). However, our data also suggest that some degree of external guidance is needed to strengthen utility value interventions that use self-persuasion strategies in order for less confident individuals to make substantial gains. For instance, in Study 2, we found that the combination of directly-communicated and self-generated utility-value interventions was more effective than the self-generated utility value intervention alone. Even though directly-communicated utility-value information had negative effects compared to self-generated UV when tested alone, pairing it with self-generated utility value revealed positive synergistic effects. Utility-value information communicated by others was likely harmful by itself because it created pressure for individuals who doubted their competence, without an opportunity to reflect on or integrate the information. The same information, coupled with the opportunity to write about utility value, proved more effective than simply writing about personal uses for the technique, suggesting that the combination of the two interventions was uniquely powerful in promoting interest and performance for these individuals. Our research suggests that direct-communication strategies, especially those that present non-threatening information, combined with self-persuasion strategies may be the best way to change attitudes and behaviors for individuals who are not easily persuaded.

Expectancy-value theory suggests that individuals are more motivated when they value the task and expect that they can succeed at the task (Eccles & Wigfield, 2002). Therefore it isn't surprising that the way in which utility value information is communicated has differing effects for individuals who doubt that they can succeed at the task. Utility value information is only beneficial when the individual expects to be successful. For instance, previous research has shown that directly-communicated utility value information is only beneficial for individuals who are confident (Durik & Harakiewicz, 2007; Durik et al., 2014). We found that it was only when students developed confidence that directly-communicated utility value information helped students who initially doubted that they could succeed. Our process analyses revealed two ways of increasing confidence through intervention: 1) pairing directly-communicated utility value information with self-generated utility value, and 2) providing directly-communicated utility value information that is relevant to all students regardless of ability. Study 2 and 3 show that by boosting confidence participants can benefit from utility value information in a way that is consistent with expectancy-value theory. Therefore, when designing utility value interventions, it is important to consider how the intervention strategies (whether directly-communicated or self-generated) affect students with different levels of confidence. We found that it is possible with certain intervention strategies to boost confidence, allowing students to benefit from utility value information, especially for students who initially doubt that they can succeed.

Limitations

There are a several noteworthy limitations to our research. First, each study used the same mental math learning paradigm in a laboratory setting, making it difficult to generalize to other domains beyond math instruction or to more long-term learning contexts, such as semester-long college courses. The paradigm we used involved teaching participants a novel mental math technique and then testing their ability to solve multiplication problems using the new method, all within a 1-hour experimental session. This short learning experience was designed to simulate a single, lecture-based classroom experience (Barron & Harackiewicz, 2001); however, it is difficult to assess long-term interest development over the course of one hour and generalize findings to the development of interest within college courses.

Additionally, a major challenge with comparing the directly-communicated and self-generated UV interventions using this particular learning paradigm is that the interventions occurred at two different points in time in the original studies that we were trying to replicate. For instance, the directly-communicated UV intervention occurs in conjunction with learning the math technique, while the self-generated UV intervention occurs after the students have already learned the technique and have had some practice with it. It is unclear whether the differential results are due to the nature of the interventions themselves or due to the timing of those interventions. For example, it may be that fully understanding and practicing the material is necessary before students can fully appreciate and internalize utility value when asked to write about it. Becoming familiar with the technique and having experience using the technique may prepare students to think about how they could use the technique in their own lives. Thus the timing of these interventions may be one reason why we see positive effects when they are combined in Study 2 (i.e., providing directly-communicated UV information before giving students the opportunity to generate their own examples) and these effects may not hold when the interventions are reversed (i.e., self-generated UV before directly-communicated UV information). This will be an important issue to explore in further research.

Despite these limitations, the paradigm used in the present study provided the opportunity to test for replication of previous research examining directly-communicated utility value (Durik & Harackiewicz, 2007; Durik et al., 2014) and self-generated utility value (Hulleman et al., 2010). Although we replicated the general pattern of results found by both research teams, our results were somewhat weaker than those found in the original studies, which may indicate another limitation of our work. Even though we followed the methods of the original studies as closely as possible, we could not reproduce all of the results originally obtained. It is unclear whether our differential results are due to small differences in methods or measures, participant sample, cohort differences, or whether the effects of these interventions are more variable than originally thought.

The importance of replication studies has received considerable attention in psychology and in the social sciences more generally (Makel & Plucker, 2014; Ritchie, Wiseman, & French, 2012; Schmidt, 2009). Some argue that large initial findings published in the literature seem to diminish with time, known as the decline effect (e.g., Ioannidis, 2005; Schooler, 2011). The decline effect is based on the statistical principle of regression to the mean, the self-correction of exceptionally large effects, and the file drawer effect, in which negative or null findings are less likely to be published in top-tier journals. The decline effect could be one reason why our effects are somewhat weaker in magnitude compared to the original studies. Replication studies along with meta-analytic techniques are essential in order to better understand how social-psychological interventions work for different groups of individuals.

Finally, another limitation to this research is the lack of power in these studies to test gender effects and the interaction of gender with the interventions. There are long-standing gender differences in math, particularly with women reporting lower expectancies for success and less perceived value than men in math domains (Eccles, 2009; Gaspard et al., 2014; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Smith, 2006; Watt, 2004). In our studies, we found limited evidence for gender differences on our dependent measures. Study 1 was the only sample in which there was a significant effect of gender and we found that males obtained higher scores on the multiplication problem sets than females. This effect was not significant in Study 2 or Study 3. This could be the case because females were overrepresented in these samples (females represented approximately 80% of the sample in Study 2 and 70% of the sample in Study 3). Due to the predominantly female samples in Studies 2 and 3, we lack adequate power to detect gender differences in these studies. In all of our studies we blocked participants on gender before randomly assigning participants to condition, therefore, it is unlikely that our experimental effects are driven by an overrepresentation of female participants.

Implications

This research contributes to our understanding of how to communicate important information in order to change attitudes and increase performance and interest with social-psychological interventions in education. Motivational interventions typically use a combination of directly-communicated and self-generated persuasion techniques in order to target students’ thoughts, feeling, and beliefs about school (Yeager & Walton, 2011). The combination of different persuasion techniques, such as having students read quotes from older students or having students take on the role of mentor, writing letters to younger students that convey the treatment message, may be especially helpful for some students (Walton, 2014; Yeager & Walton, 2011). Our research suggests that this combination of receiving information from someone else and then writing about it in your own words can be particularly effective for some students.

We tested different intervention strategies for one intervention designed to enhance perceptions of utility value, but these strategies should also be tested more systematically with interventions designed to address identity-relevant processes (e.g., Stephens et al., 2014; Walton & Cohen, 2007, 2011). Intervention messages that target an individual's identity may be even more susceptible to variations in intervention strategies and this can be easily tested in controlled laboratory settings. For instance, varying the source of the directly-communicated information could change the way the same information is perceived. Information communicated by an older student might be less threatening than the same information from a teacher or parent. Likewise, interventions that use writing assignments to convey key messages could be more powerful when the assignment is written for younger students, instead of written for the self. More research is needed to understand the different components of these interventions in order to pinpoint why they are so successful in promoting motivation and performance.

Our results demonstrate that utility value interventions can change attitudes about value, improve performance, and support interest development. Importantly, we found that individuals with low confidence are particularly sensitive to information that accentuates competency and value or importance. Therefore, educators, parents, and researchers designing interventions should consider how different intervention strategies can impact individuals with different expectancies, in order to produce meaningful change in attitudes and behaviors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This research is based on work supported by the National Science Foundation Graduate Research Fellowship Program under Grant DGE-1256259. This research was also supported by National Institutes of Health Grant R01GM102703 and the Institute of Education Sciences, U.S. Department of Education, through Award R305B090009 to the University of Wisconsin–Madison. We thank Chris Hulleman, Amanda Durik, Yoi Tibbetts, and Stacy Priniski for their helpful feedback and all the research assistants who helped to implement these studies. The opinions expressed are those of the authors and do not represent views of the National Science Foundation, the U.S. Department of Education, or the National Institutes of Health.

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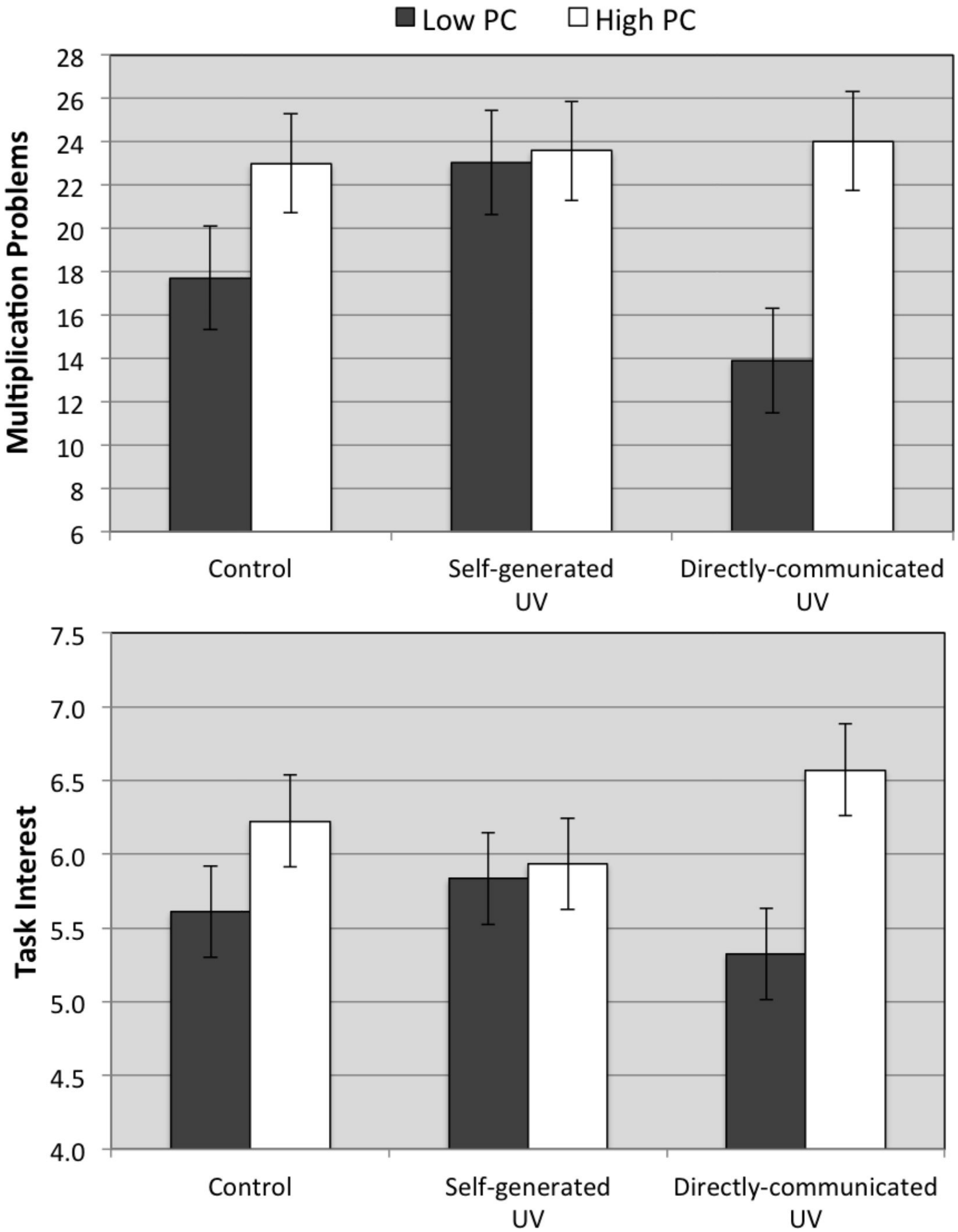

Figure 1.

Number of math problems solved and task interest as a function of experimental condition and initial perceived confidence (PC) in Study 1. Values are based on 1 SD above and below the mean of PC. Error bars represent +/−1 standard error. UV = Utility Value

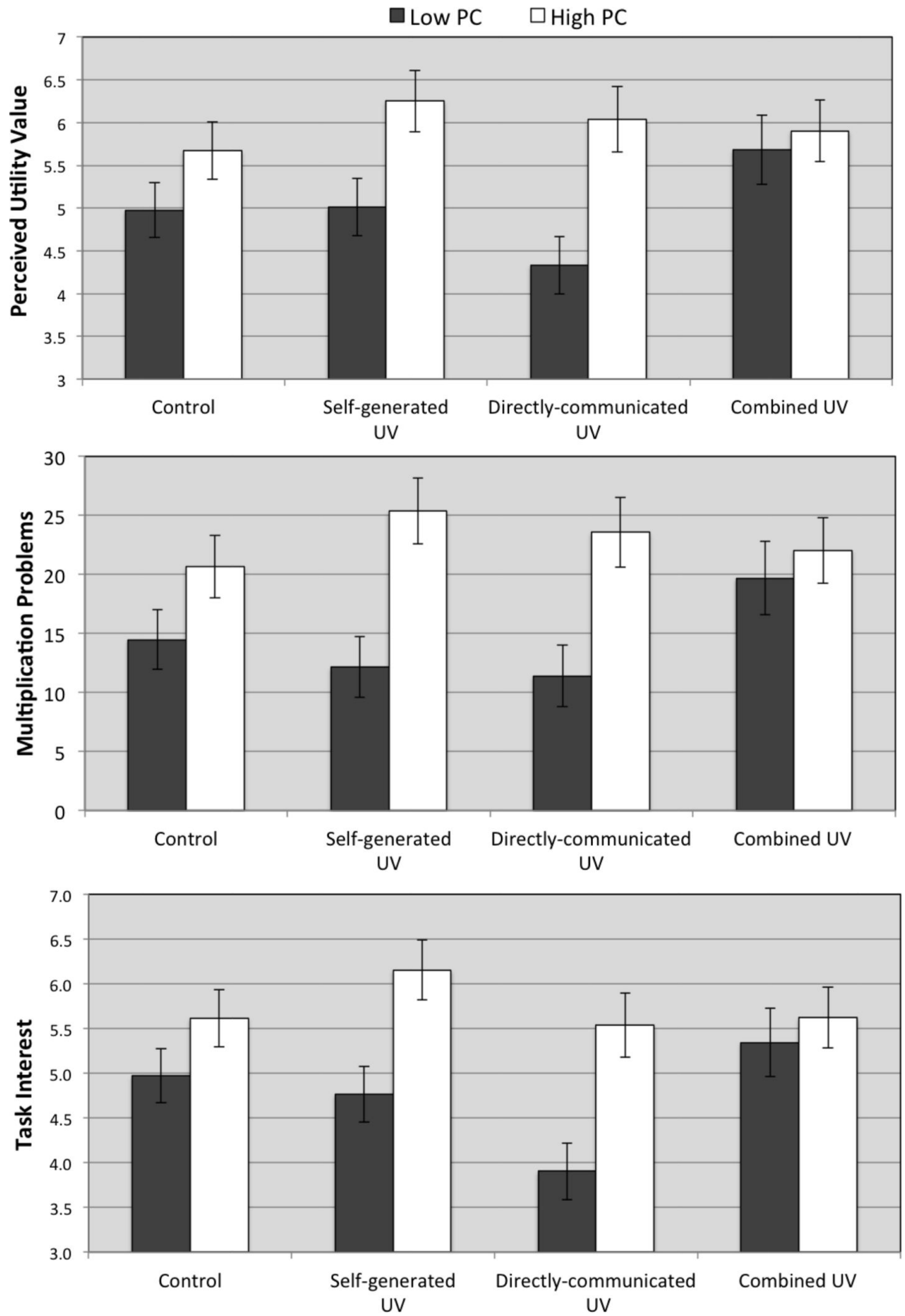

Figure 2.

Perceived utility value, number of math problems solved, and task interest as a function of experimental condition and initial perceived confidence (PC) in Study 2. Values are based on 1 SD above and below the mean of PC. Error bars represent +/−1 standard error. UV = Utility Value

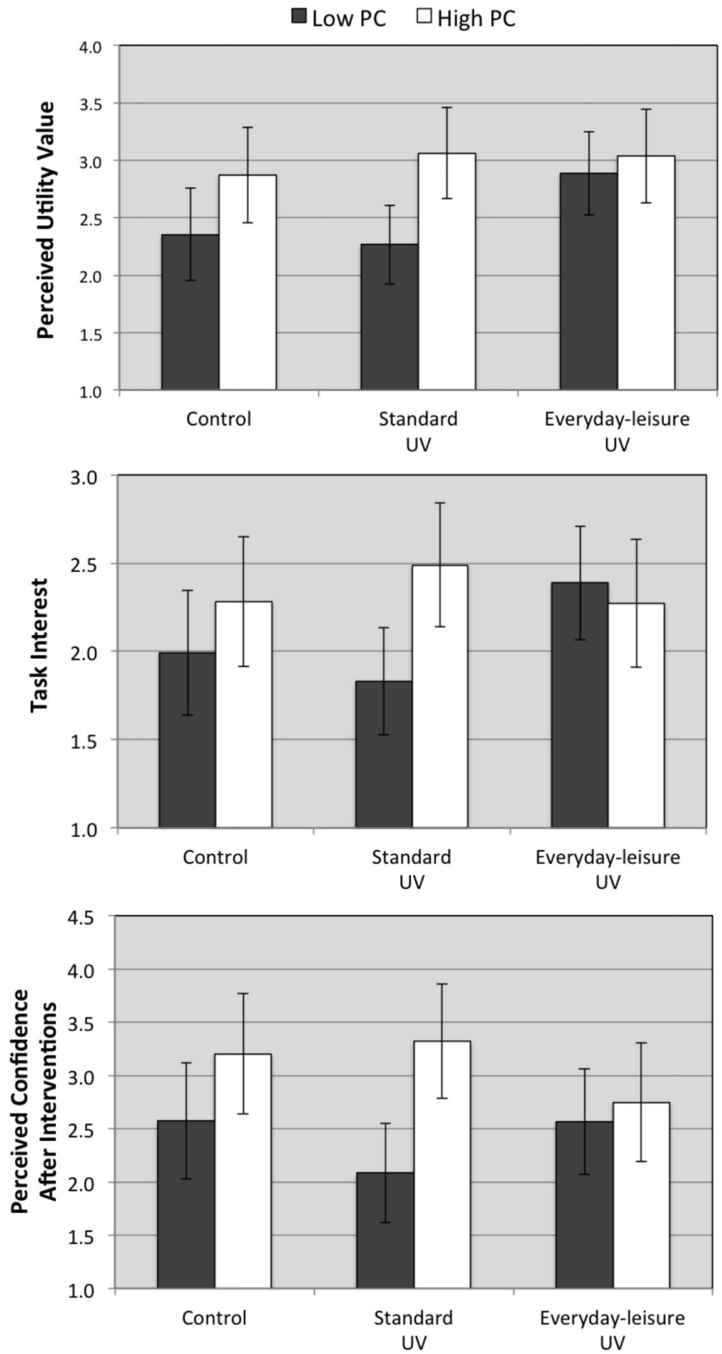

Figure 3.

Perceived utility value, task interest, and perceived mastery as a function of experimental condition and initial perceived confidence (PC) in Study 3. Values are based on 1 SD above and below the mean of PC. Error bars represent +/−1 standard error. UV = Utility Value

Table 1

Zero-order correlations and descriptive statistics for major variables in Study 1

Variable	1	2	3	4	5	6
1. Baseline Performance	--					
2. Gender	−.07	--				
3. Initial Perceived Confidence	−.17	.18	--			
4. Perceived Utility Value	−.15	.08	.28**	--		
5. Task Performance	.21*	.26*	.30**	.14	--	
6. Interest	−.19	.16	.37**	.74**	.26*	--
M	5.44	.52	5.08	5.41	27.33	5.64
SD	2.41	.50	1.17	1.06	8.44	1.07
Cronbach's α			.79	.88		.90

Note. Values ranged from 1 (low) to 7 (high) except for gender (0 for females, 1 for males), baseline performance (from 0 to 9 problems) and task performance (from 2 to 48 problems).

* $p < .05$.

** $p < .01$.

Table 2

Regression Models for perceived utility value, task performance, and interest across studies

	Study 1								
	Perceived Utility Value			**Task Performance**			**Interest**		
Predictor	***β***	***t*(80)**	***p***	***β***	***t*(80)**	***p***	***β***	***t*(80)**	***p***
UV Type Contrast	−.12	1.17	.246	.20	2.09	.040	−.02	0.22	.826
UV vs. No UV Contrast	.12	1.16	.248	.14	1.45	.151	−.00	0.03	.974
Initial Perceived Confidence (PC)	.28	2.51	.014	.38	3.13	.002	.31	2.87	.005
UV Type x PC	−.11	1.03	.304	−.21	2.15	.035	−.20	1.87	.065
UV x PC	.23	2.22	.029	.01	0.05	.963	.04	0.41	.685
Gender	.05	0.45	.654	.23	2.43	.018	.10	0.99	.326
Baseline Performance	−.10	0.93	.353	.21	2.19	.032	−.17	1.65	.103
	Study 2								
	Perceived Utility Value			Task Performance			Interest		
Predictor	*β*	*t*(*120*)	*p*	*β*	*t*(*120*)	*p*	*β*	*t*(*120*)	*p*
Directly-communicated (DC) UV	.00	0.05	.960	.05	0.63	.532	−.12	1.39	.168
Self-generated (SG) UV	.19	2.19	.031	.12	1.41	.162	.20	2.36	.020
DC x SG	.06	0.71	.477	.06	0.67	.503	.13	1.50	.136
Initial Perceived Confidence (PC)	.40	4.13	.000	.43	4.67	.000	.43	4.48	.000
DC x PC	−.00	0.01	.991	−.06	0.68	.496	−.01	0.14	.891
SG x PC	−.10	1.04	.300	−.04	0.40	.692	−.07	0.72	.476
DC x SG x PC	−.21	2.25	.027	−.21	2.40	.018	−.23	2.48	.015
Gender	.04	0.43	.672	.14	1.64	.104	.03	0.37	.710
Baseline Performance	−.09	0.99	.323	.31	3.74	.000	−.01	0.15	.880
	Study 3								
	Perceived Utility Value			Task Performance			Interest		
Predictor	*β*	*t*(*120*)	*p*	*β*	*t*(*120*)	*p*	*β*	*t*(*120*)	*p*

	Study 1								
	Perceived Utility Value			Task Performance			Interest		
Predictor	β	$t(80)$	p	β	$t(80)$	p	β	$t(80)$	p
UV Type Contrast	.20	1.76	.081	.02	0.22	.828	.07	1.14	.257
UV vs. No UV Contrast	.26	3.66	.000	−.10	1.28	.203	.14	2.22	.028
Initial Perceived Confidence (PC)	.23	2.96	.004	.14	1.53	.128	.13	1.93	.056
UV Type x PC	−.14	1.94	.055	−.02	0.24	.807	−.16	2.61	.010
UV x PC	−.03	0.40	.693	.05	0.66	.513	−.01	0.18	.855
Gender	.09	1.21	.229	.16	1.90	.060	.07	1.09	.277
Baseline Performance	−.06	0.87	.387	.39	4.79	.000	−.05	0.80	.426
Baseline Task Interest	.54	7.66	.000	.02	0.23	.816	.70	11.00	.000

Note. UV = Utility Value. UV Type Contrast in Study 1 (Self-generated UV = +1, Directly-communicated UV = −1, Control = 0), UV vs. No UV Contrast in Study 1 (Self-generated UV = +1, Directly-communicated UV = +1, Control = −2), UV Type Contrast in Study 3 (Everyday-leisure UV = +1, Standard UV = −1, Control = 0), UV vs. No UV Contrast in Study 3 (Everyday-leisure UV = +1, Standard UV = +1, Control = −2), Gender (Male = +1, Female = −1).

Table 3

Replication of Previous Findings

	Directly-Communication UV vs. Control			Self-generated UV vs. Control		
	Perceived utility value	**Performance**	**Interest**	**Perceived utility value**	**Performance**	**Interest**
Low PC	−.13	−.18	−.20	−.15	.59	.10
High PC	.70	.24	.26	.23	.16	−.13

Note. Values are d’s, reflecting the size of the effect relative to control group, for each of three dependent measures, for individuals one standard deviation below and above the mean of Perceived Confidence (PC). Durik and colleagues (Durik & Harackiewicz, 2007, Durik et al., 2014) have found positive effects of directly-communicated utility value (UV) for confident (High PC) participants and negative effects for less confident (Low PC) participants whereas Hulleman and colleagues (Hulleman et al., 2010) have found positive effects of self-generated UV for less confident participants, and no effects for confident participants.

Table 4

Zero-order correlations and descriptive statistics for major variables in Study 2

Variable	1	2	3	4	5	6	7
1. Baseline Performance	--						
2. Gender	−.04	--					
3. Initial Perceived Confidence	−.12	.16	--				
4. Perceived Utility Value	−.14	.09	.41**	--			
5. Task Performance	.26**	.18	.42**	.35**	--		
6. Interest	−.08	.08	.41**	.73**	.42**	--	
7. Perceived Confidence After the Interventions	−.08	.22*	.73**	.58**	.44**	.62**	--
M	4.74	.29	4.94	5.28	25.04	5.21	5.33
SD	2.55	.46	1.20	1.20	9.86	1.15	1.20
Cronbach's α			.76	.92		.90	.89

Note. Values ranged from 1 (low) to 7 (high) except for gender (0 for females, 1 for males), baseline performance (from 0 to 9 problems) and task performance (from 0 to 48 problems).

* $p < .05$.

** $p < .01$.

Table 5

Zero-order correlations and descriptive statistics for major variables in Study 3

Variable	1	2	3	4	5	6	7
1. Baseline Performance	--						
2. Gender	−.10	--					
3. Initial Perceived Confidence	.14	.30**	--				
4. Perceived Utility Value	.01	.19*	.31**	--			
5. Task Performance	.41**	.17*	.27**	.27**	--		
6. Interest	.05	.17	.27**	.84**	.27**	--	
7. Perceived Confidence After the Interventions	.10	.19*	.35**	.53**	.31**	.43**	--
M	4.89	.31	5.16	5.25	23.66	5.35	4.47
SD	2.50	.47	.97	1.06	8.53	1.05	1.26
Cronbach's α			.86	.95		.92	.94

Note. Values ranged from 1 (low) to 7 (high) except for gender (0 for females, 1 for males), baseline performance (from 0 to 9 problems) and task performance (from 0 to 50 problems).

* $p < .05$.

** $p < .01$.