Motivation Science

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The Role of Utility Value in Promoting Interest Development

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An individual's initial interest in a topic may quickly fade, or it may become deeper and more enduring. One factor that may support an emerging interest is to discover utility value (or usefulness) in the topic. Instructional materials that emphasize the utility value of a topic can enhance learning and motivation, but whether these materials can foster interest development among individuals who show initial interest in a topic is uncertain. Across two studies, we tested utility-value (UV) manipulations under conditions in which we expected the manipulations to promote the development of interest. In Study 1, we manipulated whether participants received utility-value information during a learning session and found that such information triggered a state of interest for participants who had reported higher levels of interest at the outset of the session. In Study 2, we provided all participants with the same utility-value information provided to some participants in Study 1, and then manipulated whether they wrote one of three kinds of essays about the utility value of the task (or a control topic). For participants with higher interest, we found that subsequent reflection on the usefulness of the material for the distant future in a writing activity (rather than the present or near future) further promoted interest development. In addition, engaging in any type of utility-value writing improved performance on a test of the material—overall, and specifically for less confident participants—replicating previous research. Findings suggest that, under the right conditions, emphasizing utility value can catalyze the interest-development process.

Keywords: interest, intervention science, motivation, utility value, expectancy-value theory

A biology professor tells her class about Watson and Crick's discovery of the double-helix structure of DNA, explaining that "after they worked out the structure, they went to the local pub and exclaimed, 'We have discovered the secret of life.'" She is delighted to see that many students in the class perk up in response to this entertaining anecdote, knowing that she has triggered their interest. The professor has good reason to be pleased: students' interest in a subject predicts their attention, achievement, course taking, and majoring in that domain (Ainley, Hidi, & Berndorff, 2002; Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2008; Murayama, Pekrun, Lichtenfeld, & Vom Hofe, 2013). This initial spark of interest is a potential entry point to increase students' interest in a domain more broadly, but as many teachers and students know well, the spark often flickers out. The conditions required to trigger interest in the first place differ from those needed to support and deepen an emerging interest (Durik & Harackiewicz, 2007; Renninger, 2009; Renninger & Hidi, 2016). Identifying specific factors that can foster and support the development of interest is an important task for teachers and interest scholars alike. We investigate this issue in the present research, with a focus on how stimuli that highlight the usefulness of academic material can deepen initial interest in a topic.

Characterizing Interest: Psychological State and Developmental Phase

Interest has been conceptualized in two complementary ways: as a psychological state and as a motivation to reengage with a topic, which can be supported to develop (Hidi & Renninger, 2006; Renninger & Hidi, 2016). When an individual is in a state of interest, they experience heightened engagement, characterized by increased concentration, effort, and affect. Individuals have also been found to progress through *developmental phases* of interest with regard to a particular topic or domain (Harackiewicz et al., 2008). Early in interest development, individuals experience *situational interest*, which is characterized by focused attention on a particular topic and can either be short term (Phase 1: "triggered" situational interest) or longer term (Phase 2: "maintained" situational interest). These phases are situational in that they are evoked by exposure to a particular topic such as cell division, or an activity such as a pH analysis lab experiment (Hidi & Harackiewicz, 2000; Mitchell, 1993). After repeated engagement with a topic, an individual may enter a state of *individual interest*, a personal inclination to consistently return to the topic. This inclination first emerges as an early predisposition to seek out the topic (Phase 3:

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"emerging" individual interest) and develops into one that is more persistent and self-regulated (Phase 4: "well-developed" individual interest; Krapp, 2002; Renninger, 2000).

Psychological states and developmental phases of interest have been found to be reciprocally connected (Harackiewicz et al., 2008; Renninger & Hidi, 2016). A state of interest must be provoked repeatedly for individuals to progress to more developed phases of interest. Conversely, one's phase of interest development influences what kinds of environmental stimuli will trigger a psychological state of interest. For an individual whose attention has already been engaged by a topic, information that imbues the topic with greater value or meaning may be necessary to trigger subsequent states of increased interest (Hidi & Harackiewicz, 2000; Priniski, Hecht, & Harackiewicz, 2018; Renninger, 2009; Renninger & Hidi, 2019). For example, additional anecdotes about genetics may do little to reengage a student whose interest was piqued by the professor's anecdote about Watson and Crick. However, information about how knowledge of DNA has allowed researchers to engineer more durable vegetables may pull such a student back into a state of heightened interest. Highlighting the usefulness and real-world relevance of a topic may therefore be an effective strategy to support an emerging interest.

Does Providing Utility-Value Information Deepen Interest?

One promising approach to engage students with a particular topic is to emphasize the usefulness, or "utility value" of the topic. Instructional approaches that emphasize the usefulness of academic material (termed "utility-value interventions") have been found to increase perceptions of task value, interest, and performance in laboratory experiments as well as high school and college courses (e.g., Canning & Harackiewicz, 2015; Gaspard et al., 2015; Hulleman, Godes, Hendricks, & Harackiewicz, 2010; see Harackiewicz, Tibbetts, Canning, & Hyde, 2014 for a review). Highlighting the personal usefulness of a topic may increase interest and improve learning by creating a strong link between the material and the self, which heightens recruitment of the memory, emotion, and reward systems (Hidi, Renninger, & Northoff, 2019). One way to convey the utility value of a topic is to provide students with examples of how the topic can be useful (i.e., a directly-communicated approach). This approach has primarily been tested in laboratory studies in which learning materials include information about the utility value of a topic or do not (e.g., Canning & Harackiewicz, 2015; Durik & Harackiewicz, 2007; Shechter, Durik, Miyamoto, & Harackiewicz, 2011).

Durik and Harackiewicz (2007) found initial evidence that directly-communicated UV information could strengthen the task interest of individuals with higher levels of interest at baseline. Across two experiments, participants in a mental-multiplication laboratory paradigm learned a novel technique to mentally multiply two two-digit numbers (see Barron & Harackiewicz, 2001 for additional details). The researchers tested two strategies to evoke a psychological state of interest among participants. They manipulated whether the instructional text was visually stimulating (i.e., contained colorful pictures and varied fonts) and whether the text contained information about the usefulness of the technique, in a crossed design. The researchers measured interest via self-report scales pre- and postmanipulation. Use of visually stimulating materials triggered a state of interest for participants who were not initially interested in the task, whereas providing directly-communicated UV information triggered interest for students with high initial interest. These findings are consistent with the hypothesis that different stimuli are needed to trigger a psychological state of interest for individuals in different phases of interest development. Students with higher levels of initial interest in a topic may require stronger connections to the material and novel information about how it connects to their life than those with lower levels of initial interest (Renninger & Hidi, 2019).

However, subsequent research by the same authors called the interpretation of these early findings into question (Durik, Shechter, Noh, Rozek, & Harackiewicz, 2015). Confidence (i.e., one's belief in their ability to succeed) and interest in a domain are known to be highly correlated, causing difficulty in distinguishing these two characteristics as moderators (Bong, 2001; Durik, Shechter, et al., 2015; Hidi & Renninger, 2006; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005). With this in mind, the authors posited an alternative explanation for the Durik and Harackiewicz (2007) findings: the directly-communicated UV information may have actually helped more confident students (rather than more interested students), and the apparent effect for interested students may have been caused by the strong correlation between interest and confidence. Confident students may react positively to directly-communicated UV information because individuals who believe that they can successfully master material are often eager to learn about new ways to use the content. On the contrary, information about usefulness may be seen as irrelevant to individuals who do not believe they can master the content (Durik, Hulleman, & Harackiewicz, 2015; Wigfield & Eccles, 2000).

To test this possibility, Durik, Shechter, and colleagues (2015, Study 1) manipulated whether or not participants received utility-value information in the same mental-multiplication task, comparing interest and confidence (both measured via self-report scales at baseline) as moderators. When interest and confidence were tested as moderators in separate models, directly-communicated utility-value information was found to increase interest for more interested students (replicating Durik & Harackiewicz, 2007, Study 2) and for more confident students. However, when the researchers statistically removed the shared variance between interest and confidence, it was revealed that the UV information increased interest for more confident students but not for more interested students. In a second study, the researchers manipulated participants' confidence (with feedback about potential to learn the technique) and whether they received UV information in a crossed design, and they found that directly-communicated UV information increased interest for less confident students when their confidence was bolstered with an experimental manipulation. Together, these studies provide reason to rethink the original Durik and Harackiewicz (2007) findings. The finding that directly-communicated UV information increased interest for initially interested students may actually be due to these students' higher levels of confidence.

Although confidence seems to have played a more important role in the research to date, these results may be due, in part, to the nature of the learning task. Directly-communicated UV manipulations have primarily been tested in a task that requires participants to learn a new skill (i.e., a mental-multiplication technique). In such a skill-acquisition task, confidence is particularly important: the new technique will only be useful if it can be executed correctly. However, in a knowledge-acquisition task (e.g., learning a series of facts about genetics), students can find usefulness in whatever content they manage to learn. They need not master a lecture in its entirety to find usefulness in particular concepts that were taught. Confidence may play a less central role in a knowledge-acquisition task, and instead, students who begin such a task with some baseline interest in the topic might be the most responsive to communications about real-life applications of the material. Researchers have not yet compared the role of confidence and interest as moderators in a knowledge-acquisition task, and such research is necessary to inform when (and for whom) UV information might foster interest in a topic.

Does Prompting Reflection on Utility Value Deepen Interest?

Another way to emphasize the utility value of a topic is to prompt students to write reflective essays about how the topic can be useful (i.e., a self-generated approach). This approach has been tested in both laboratory studies (e.g., Canning & Harackiewicz, 2015; Hulleman et al., 2010) and in high-school and college courses, where it is typically incorporated into the curriculum as a course assignment (e.g., Harackiewicz, Canning, Tibbetts, Priniski, & Hyde, 2016; Hulleman & Harackiewicz, 2009; Hulleman, Kosovich, Barron, & Daniel, 2017). In these studies, students who are prompted to write about the utility value of material (treatment) are compared to students who are prompted to write about something else, such as summarizing the material (control).

In contrast to directly-communicated interventions, self-generated UV interventions have been found to improve performance for students who are less confident in their ability to succeed, who have a history of poor performance, or who are underrepresented in a particular context (Canning & Harackiewicz, 2015; Harackiewicz et al., 2016; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009). Prompting students who are at risk of poor performance to generate examples of usefulness for themselves allows them to consider the utility of an academic topic for any aspect of their lives that they choose. This approach may benefit at-risk students because it provides them with the option to avoid focusing on aspects of the material they find threatening, and they may instead concentrate on more manageable connections. Some research has also found self-generated UV manipulations to increase interest for less confident students or those who perform more poorly (Hulleman et al., 2010; Hulleman & Harackiewicz, 2009). By requiring students to generate personal examples of usefulness, this approach may serve to trigger a state of interest for students who might otherwise be less engaged in a learning task.

An important question is whether a self-generated UV writing exercise can support the continued development of interest among students with some initial interest in a topic, in the same way that directly-communicated UV information can. To our knowledge, no such effects have been reported to date. One possible explanation is that more interested students are capable of making strong, personally meaningful connections to the material on their own, and more superficial connections may not suffice to further increase their interest (Hidi et al., 2019; Priniski et al., 2018; Renninger, 2009). On the other hand, prompting such students to write about how the material is instrumental to their long-term goals (such as career plans) may encourage them to move beyond more obvious connections and independently discover novel and deeper connections, providing a stronger trigger for their interest (Renninger & Hidi, 2019). Indeed, perceiving connections between academic material and the distant future is associated with perceptions of value, and has been shown to improve cognitive engagement and a variety of other academic outcomes (Husman, Hilpert, & Brem, 2016; Husman & Lens, 1999; Husman & Shell, 2008; Simons, Vansteenkiste, Lens, & Lacante, 2004). An important question is whether prompting reflection on future applications of material can serve as an interest trigger for students in a later phase of interest development.

As students engage with a topic or domain, their interest may fluctuate as they consistently encounter instructional materials and activities that can serve as on- or off-ramps to interest development (Alexander, Johnson, & Neitzel, 2019). Activities emphasizing the usefulness of academic material may serve as powerful on-ramps to strengthen students' existing interest in a topic, especially in knowledge-acquisition tasks where there are multiple opportunities to learn new things and make connections. At least two characteristics of the current body of research may explain the lack of documented effects for students with higher levels of interest: (a) research on directly-communicated UV information has primarily been conducted in the context of skill-acquisition tasks, and (b) although existing iterations of self-generated utility-value writing exercises can increase engagement for less confident students, versions that are powerful enough to trigger interest for initially interested students have not yet been tested. Directly-communicated UV manipulations have not been tested in a knowledge acquisition domain and self-generated UV exercises that manipulate temporal perspective have never been tested. These are the conditions necessary to test our hypotheses.

Current Studies

The goal of the current research is to take a first step toward examining whether, under appropriate conditions, stimuli that emphasize utility value can support students' existing interest in a topic and help them progress along the continuum of interest as they engage in a learning task. We tested this hypothesis at two different points in the learning process. In Study 1, we focused on the role of instructional materials at the outset of a knowledge-acquisition task by manipulating whether the instructional session was supplemented with directly-communicated UV information. We examined whether the manipulation triggered interest for more initially interested individuals in this context, or whether the manipulation was more powerful for more confident students, as Durik, Shechter, et al. (2015) found in a skill-acquisition task. In Study 2, we tested whether a self-generated UV activity provided after the instructional session would foster deeper levels of interest among more interested individuals when it prompted them to reflect on usefulness for their distant future. This research provides a strong empirical test of a tenet of interest theory: that individuals with more developed interest in a topic require deeper and more personal connections to the material to trigger a state of interest as they proceed through a learning experience (Renninger & Hidi, 2016; Renninger & Hidi, 2019). In addition, the present research may inform the development of interventions to promote continued interest development in learning situations.

These studies were both approved by the institutional review board.

Study 1

In our first study, we tested a directly-communicated utility-value manipulation in a biology-learning laboratory paradigm: a session in which students learned about the biology of fungi. This learning task was designed to emphasize knowledge acquisition: participants were tasked with learning as much as they could about fungi, but they were not asked to master a skill or procedure. We reasoned that the UV manipulation might trigger a state of interest for students with higher levels of initial interest, or that it might increase interest for more confident students as has been found in previous studies employing a skill-acquisition task (Canning & Harackiewicz, 2015, Study 1; Durik, Shechter, et al., 2015, Study 2).

Method

Participants. Participants in this study were 106 female and 79 male undergraduates enrolled in an introductory psychology course at a large Midwestern university. The sample was 85% Caucasian, 13% Asian, 1% African American, and 1% Hispanic. Participants were randomly assigned to experimental condition, and they completed the session individually for course credit.

Materials and procedure. We developed a biology-learning paradigm that would enable us to test the effects of both directly-communicated and self-generated UV manipulations. Participants' primary task in this paradigm was to acquire knowledge about the biology of fungi, in contrast to previous learning tasks in the laboratory that have required participants to master a new skill (e.g., Canning & Harackiewicz, 2015; Durik & Harackiewicz, 2007; Durik, Shechter, et al., 2015). The biology-learning session included an instructional session (i.e., two video lectures in which we could manipulate the presence of directly-communicated UV information), a reflective writing task (in which we could manipulate self-generated utility value), a test on the material, and questionnaires before and after each of these components. In Study 1, we tested initial interest and confidence in biology as moderators of the effect of a directly-communicated UV manipulation on subsequent interest in the task. In Study 2, we provided all participants with directly-communicated UV information and then examined whether task interest and task confidence (now measured after the instructional session) moderated the effects of various self-generated UV exercises on subsequent outcomes. Figure 1 displays a timeline of the learning task that indicates key time points in each of the two studies.

Participants in Study 1 were randomly assigned to one of two conditions: a control condition ($n = 61$) or a directly-communicated UV condition ($n = 124$) that was identical to the control condition except that participants received UV information embedded in the instructional video lectures.[1] First, participants completed a baseline questionnaire in which they reported their confidence in the domain of biology and initial interest in the learning task. Then, the participants learned about the biology of fungi in an instructional session, consisting of two short video lectures.

The lectures provided basic information about the biology of fungi, and for participants in the directly-communicated utility-value condition, they also included information about uses of fungi. We searched the Internet for accurate information about how fungi (or knowledge about fungi) could be useful, and we chose examples about uses of fungi in everyday life (e.g., to aid composting). The first lecture covered the anatomy of fungi and their differences from plants (~1 min). Participants in the directly-communicated UV condition were also provided with a rationale for studying fungi, including their role in the food chain, antibiotics, food/drink, and leisure activities (~1 additional minute). For example, UV information was provided about the use of yeast in bread making and beer brewing, and the role of fungi in maintaining healthy soil. The second lecture provided more detail on the structure of fungi, the fungal growth process, and absorption of nutrients through parasitism, saprophytism, and symbiosis (~7 min). Participants in the directly-communicated UV condition were also provided information on the role fungi play in everyday life, such as the effects of mold in the home and their use in organic farming, medicine, and diets (~3 additional minutes). For example, UV information was provided about the use of fungi to produce antibiotics and to provide amino acids in one's diet. We did not include any future-oriented applications of the learning material (e.g., uses in a career) because of previous research findings, in which Canning and Harackiewicz (2015, Study 3) found that inclusion of future-oriented applications undermined the motivation of less confident students. To these students, being told about how a topic is instrumental to important goals may feel like pressure or may lead them to see these goals as less attainable (Lee, Lee, & Bong, 2013).

After the presentation, participants completed a questionnaire in which they reported their interest in the learning task. We also measured participants' perceived utility value at this time (i.e., perceived usefulness of knowing about fungi), expecting that positive effects on task interest would be mirrored by similar effects on utility value. We measured confidence in the task at this time as well to account for any positive or negative effects of the manipulations, such as undermining effects of directly-communicated UV information for students who were less confident in biology.

Measures. All self-report measures in both studies were adapted from previous UV research and customized to the biology learning task (Canning & Harackiewicz, 2015; Durik & Harackiewicz, 2007; Durik, Shechter, et al., 2015; Hulleman et al., 2010; Shechter et al., 2011). In contrast to this previous research, all questionnaire items were measured on a 1 (*Not ____ at All*) to 7 (*Very ____*) Likert-type scale in which anchors were customized for each question (e.g., *Not Prepared at All, Very Prepared*). We chose to use item-specific anchors because research indicates that such anchors yield higher quality responses than *Agree—Disagree* anchors (Saris, Revilla, Krosnick, & Shaeffer, 2010). Table 1 presents descriptive statistics, zero-order correlations, and reliabilities for all measures.

[1] Participants who received the directly-communicated UV intervention went on to respond to one of two writing prompts that were used for an unrelated project ($ns = 61$ and 63, respectively). However, we only tested effects on outcomes measured prior to engagement with these writing activities, and we therefore combined these two groups into one because they both received the same directly-communicated UV information.

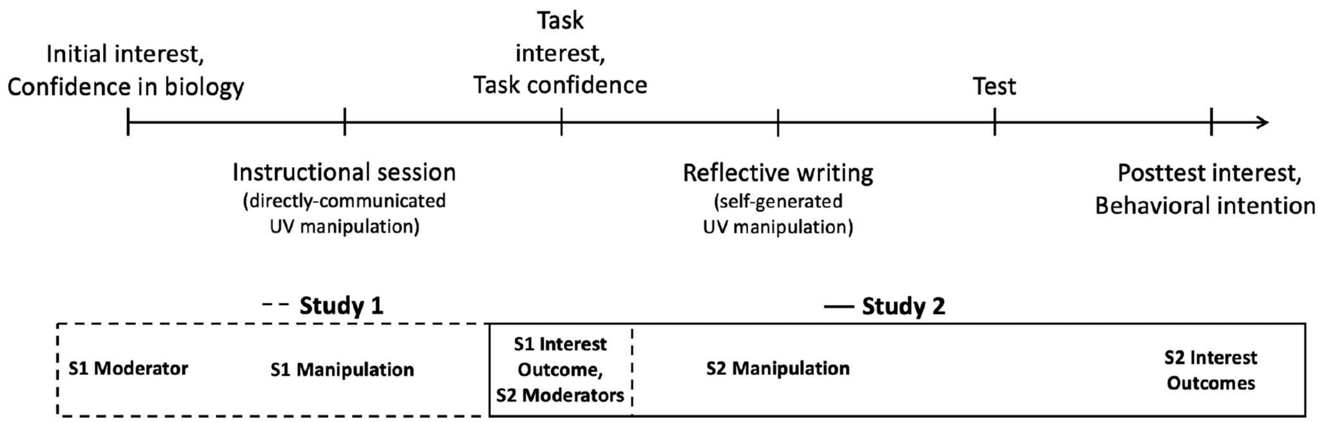

Figure 1. Timeline of the knowledge-acquisition learning task. In Study 1, we tested whether initial interest and confidence in biology moderated the effect of directly-communicated utility-value information on task interest. In Study 2, we provided all participants with directly-communicated utility-value information and tested whether task interest and task confidence moderated the effects of different self-generated utility-value manipulations on posttest interest and behavioral intentions. S = study, UV = utility-value.

Baseline moderators. We measured two moderators—confidence in biology and initial interest—prior to the instructional session. Confidence in biology was measured with a three-item scale ("How strong is your background in biology?"; "To what degree do you consider biology to be one of your best subjects?"; "To what degree do you consider yourself to be a 'biology person'?"; α = .94), as was initial interest ("How much fun do you think learning about fungi will be?"; "How interesting do you find fungi to be?"; "How much do you look forward to learning about fungi?"; α = .93).

Outcomes. We measured three outcomes—interest in the task, perceived utility value, and task confidence—immediately after the instructional session. Task interest was measured with a three-item scale ("How much fun was it to learn about the biology of fungi?"; "How interesting did you find the program to be?"; "How much did you enjoy learning about fungi?"; α = .95), as were perceived utility value ("How useful do you think understanding the biology of fungi will be to you?"; "How relevant is understanding fungi to your life?"; "How important do you think the biology of fungi is for everyone to understand?"; α = .87) and task confidence ("How easy was the learning program to understand?"; "How much did you learn from the program?"; "How prepared do you feel for the test?"; α = .81).

Table 1
Zero-Order Correlations and Descriptive Statistics for Major Variables in Study 1

Variable	1	2	3	4	5
1. Confidence in biology					
2. Initial interest	.57***				
3. Task interest	.43***	.71***			
4. Perceived utility value	.44***	.64***	.73***		
5. Task confidence	.42***	.43***	.66***	.39***	
M	3.43	3.11	3.45	3.42	4.64
SD	1.55	1.39	1.57	1.38	1.14
Cronbach's α	.92	.93	.87	.94	.79

Note. Values ranged from 1 (*low*) to 7 (*high*).
*** $p < .001$.

Results

Analysis plan.

Two-moderator regression models. We tested effects of the directly-communicated UV manipulation on task interest, perceived utility value, and task confidence using multiple regression. We included initial interest and confidence in biology as moderators in a single model; these variables were standardized to compute two-way interactions. This model included five terms: a Directly-Communicated UV contrast (directly-communicated UV, +1, control, −1), initial interest, the Directly-Communicated UV × Initial Interest interaction, confidence in biology, and the Directly-Communicated UV × Confidence in Biology interaction. Effects on each of the three outcomes are reported in Table 2.

Residualized models. A disadvantage of this initial approach is that interest and confidence are highly correlated variables (initial interest and confidence in biology were correlated .57 in the present sample), and this presents a challenge for understanding the unique contribution of each moderator. We therefore conducted another set of analyses in which we tested each moderator in its own model using residualized scores, statistically removing shared variance with the other moderator. Consistent with the approach implemented by Durik, Shechter, and colleagues (2015), we regressed initial interest on confidence in biology, saving the unstandardized residuals as a residualized measure of initial interest. We then repeated this procedure with a model regressing confidence in biology on initial interest. Next, we tested models including only one moderator at a time, each containing three terms: the Directly-Communicated UV contrast, a moderator (residualized measures of initial interest or confidence in biology), and the Directly-Communicated UV × Moderator interaction. The findings from these residualized models were similar to those found in the two-moderator regression models, and we present the effects of the residualized models below because they are superior

Table 2
Two-Moderator Regression Models for Perceived Utility Value, Task Interest, and Task Confidence in Study 1

Predictor	Task interest			Perceived utility value			Task confidence		
	β	$t(179)$	p	β	$t(179)$	p	β	$t(179)$	p
Directly-Communicated UV	.06	1.20	.234	.20	3.80	<.001	.10	1.58	.115
Initial interest	.65	10.11	<.001	.52	7.86	<.001	.28	3.49	.001
Directly-Communicated UV × Initial Interest	.18	2.85	.005	.24	3.67	<.001	.01	0.08	.937
Confidence in biology	.07	1.12	.265	.16	2.39	.018	.28	3.34	.001
Directly-Communicated UV × Confidence in Biology	−.13	−1.99	.048	−.12	−1.85	.067	−.02	−0.22	.827

Note. Standardized coefficients (betas), t statistics, and p values are reported.

in accounting for the shared variance between initial interest and confidence in biology. Effects from these models are reported in Table 3.

Effects on outcomes in residualized initial interest model. Because there were no significant interactions with the residualized baseline confidence measure, we discuss results from the residualized interest moderation model. However, we also note any significant effects of the residualized confidence measure for each outcome.

Task interest. There was not a significant main effect of the Directly-Communicated UV contrast on task interest (β = .01, p = .877). However, there was a significant Directly-Communicated UV × Initial Interest interaction (β = .16, p = .010), indicating that directly-communicated UV had a more positive effect on task interest for participants with higher levels of initial interest (Figure 2A). There was also a significant main effect of initial interest (β = .53, $p < .001$) indicating that participants with higher initial interest reported more task interest than participants with lower initial interest.

Perceived utility value. There was a significant main effect of the Directly-Communicated UV contrast on perceived utility value (β = .15, p = .017), indicating that, on average, participants who received directly-communicated UV information reported higher levels of perceived utility value. This main effect was qualified by a significant Directly-Communicated UV × Initial Interest interaction (β = .21, p = .001) indicating that the directly-communicated UV manipulation increased perceived utility value for participants with high levels of initial interest, but it did not influence perceived utility value for less interested participants (see Figure 2B). There was also a significant effect of initial interest (β = .43, $p < .001$) indicating that more initially interested participants reported more perceived utility value than participants with lower initial interest.

Task confidence. There was no significant main effect of the Directly-Communicated UV contrast (β = .05, p = .470), nor was there a significant interaction between the Directly-Communicated UV contrast and initial interest on task confidence (β = .02, p = .838). There was a significant main effect of initial interest (β = .23, p = .002), indicating that participants with higher initial interest reported higher levels of task confidence than those with lower initial interest. There was also a significant effect of confidence in biology (β = .22, p = .005), indicating that participants with higher levels of confidence in biology reported more task confidence than participants with lower confidence in biology.

Discussion

We found that providing directly-communicated UV information increased task interest and perceived utility value for participants with higher levels of initial interest. These findings replicate previous research indicating that directly-communicated utility-value information can trigger interest for students who are high in initial interest and/or confidence (e.g., Canning & Harackiewicz, 2015; Durik & Harackiewicz, 2007; Shechter et al., 2011). However, whereas confidence has generally been found to be the more powerful moderator in a skill-acquisition task (i.e., learning a mental-multiplication technique; Durik, Shechter, et al., 2015), we

Table 3
Residualized Models for Perceived Utility Value, Task Interest, and Task Confidence in Study 1

Predictor	Task interest			Perceived utility value			Task confidence		
	β	$t(181)$	p	β	$t(181)$	p	β	$t(181)$	p
Moderator: Initial interest (residualized)									
Directly-Communicated UV	.01	0.16	.877	.15	2.41	.017	.05	0.73	.470
Initial interest	.53	8.61	<.001	.43	6.64	<.001	.23	3.13	.002
Directly-Communicated UV × Initial Interest	.16	2.60	.010	.21	3.27	.001	.02	0.21	.838
Moderator: Confidence in biology (residualized)									
Directly-Communicated UV	.02	0.31	.755	.17	2.34	.020	.08	1.06	.290
Confidence in biology	.05	0.67	.506	.13	1.72	.088	.22	2.87	.005
Directly-Communicated UV × Confidence in Biology	−.06	−.81	.418	−.06	−0.86	.392	.02	0.20	.841

Note. Standardized coefficients (betas), t statistics, and p values are reported. Each moderator (initial interest and confidence in biology) is residualized, with shared variance with the other moderator statistically removed.

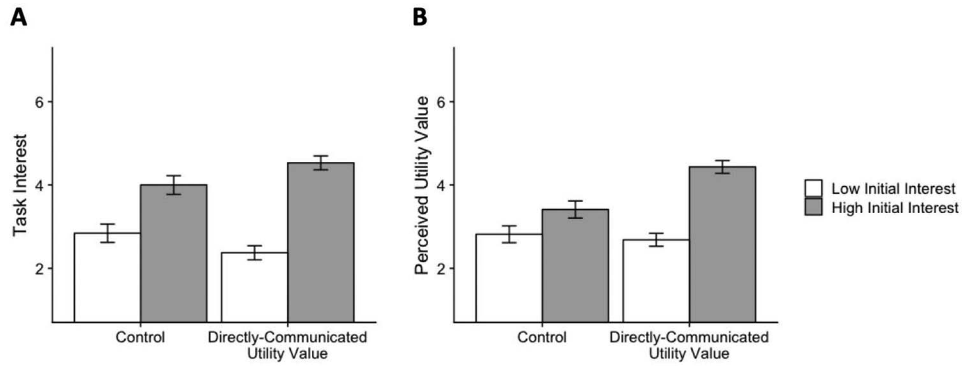

Figure 2. Task interest (A) and perceived utility value (B) as a function of experimental condition and initial interest (residualized on confidence in biology). Predicted values from the regression equations are graphed at ±1 standard deviation of initial interest, and error bars represent ±1 standard error of the estimate.

found that initial interest was the more powerful moderator in the present knowledge-acquisition task.

These different results may be a function of the different types of tasks. Confidence may play a particularly important role as students consider the usefulness of a procedure (such as a mental-multiplication technique) because the procedure cannot be useful if not executed correctly. In contrast, participants can find particular facts about a topic (such as fungi) to be useful (e.g., how to keep mold out of the home) without memorizing every detail of the material, and confidence may be less relevant to this process. In this learning context, interest development may play a more prominent role: individuals whose interest is already engaged at the outset of a learning task may benefit from a strong trigger, such as information about the value of the topic, which then promotes subsequent states of interest (Hidi & Harackiewicz, 2000; Renninger, 2000). Indeed, Renninger and Hidi (2016) argue that the development of perceived task values is an important component of interest development. We found these effects after statistically removing the shared variance between initial interest and confidence in biology in residualized models, suggesting that these effects did not depend upon overlap between interest and confidence.

As a next step, we tested the effects of a self-generated utility-value manipulation in this biology-learning paradigm, provided in combination with the directly-communicated UV information tested in Study 1. Previous research indicates that self-generated UV exercises can improve outcomes for students with low confidence or poor prior performance (e.g., Hulleman et al., 2010; Hulleman & Harackiewicz, 2009). Furthermore, Canning and Harackiewicz (2015, Study 2) combined directly-communicated and self-generated UV manipulations and found that the combination was particularly effective in enhancing perceptions of utility value, interest, and performance on a math test for less confident students. We hypothesized that combining a self-generated UV exercise with the directly-communicated UV information from Study 1 should work similarly and produce positive effects for these students in our biology-learning paradigm.

Self-generated UV writing prompts are typically open-ended and allow students to choose how to connect the material to their own lives. However, altering the temporal perspective of reflection on utility value could influence the effectiveness of self-generated UV exercises for students with different levels of initial interest. Reflecting on how a topic could be useful in the distant future (e.g., for career plans) may be challenging for individuals who are less interested in the material, but for those who are more interested, this may serve as a valuable exercise to deepen their appreciation of the content. Indeed, when individuals perceive strong connections between an academic topic and their long-term goals, they tend to be more engaged and perceive greater importance in the material (Husman & Lens, 1999; Simons et al., 2004). One process by which writing about future usefulness may help to develop interest is by increasing competence valuation, the degree to which individuals care about doing well on a learning task (Harackiewicz & Sansone, 1991). As individuals reflect on how learning the material could facilitate their future goals, they may come to care more about mastering the material, and consequently find the material more interesting and valuable. To examine this possibility, we tested self-generated utility-value manipulations in Study 2 that varied in temporal framing and examined the motivational processes that might account for their effects.

Study 2

In this study, we extended our test of UV manipulations by adding a self-generated UV component (provided after the instructional session) to the directly-communicated manipulation tested in Study 1. We compared three types of self-generated UV exercises. We provided all participants with directly-communicated UV information during the instructional session and then manipulated whether participants were prompted to write about the utility value of the material with no temporal frame specified (consistent with previous research), framed specifically for the distant future (e.g., in relation to careers), framed specifically for the present/near future (e.g., in daily life), or to complete a control writing exercise. We tested both future- and present-oriented UV manipulations so that we could differentiate the effect of reflecting on future usefulness from the more general effect of reflecting on utility value within any specific temporal frame.

We measured outcome variables at three time points in the study. Immediately after the reflective writing activity, we assessed the degree to which students cared about doing well on the upcoming test (i.e., competence valuation) and how confident they were that they would succeed on the test. Second, we measured performance on the test. Finally, after the test, we collected two measures of interest: self-reported interest in the material (to examine whether the manipulations triggered a state of interest), and a measure of behavioral intentions to learn about similar topics or use information about fungi in the future. The behavioral intentions measure assesses the degree to which the manipulations supported interest development, because individuals in more developed phases of interest express their interest behaviorally, engaging with a topic frequently, voluntarily, and independently (Renninger & Hidi, 2016; Renninger & Pozos-Brewer, 2015). We also measured perceptions of utility value at this final time point, expecting effects on utility value to mirror those on interest. By collecting these six measures, we were able to (a) test effects on analogous measures to those collected in Study 1 (i.e., confidence, interest, and utility value), (b) test competence valuation as a mediator, and (c) test for replication of previous findings on test performance.

We hypothesized that, consistent with previous research, receiving any type of self-generated UV exercise would increase test performance for all participants, on average (e.g., Harackiewicz et al., 2016), and that because this exercise was combined with directly-communicated UV information, it would particularly increase performance for less confident participants, replicating the results of Canning and Harackiewicz (2015). Although interest was the more powerful moderator of effects in Study 1, confidence has been found to moderate UV intervention effects on performance, and thus it was important to continue to test both interest and confidence as moderators.

We did not predict that interest would moderate the effects of receiving any self-generated UV exercise compared to control in the biology-learning paradigm because previous research has not provided any evidence of interest as a moderator of self-generated UV manipulations. However, we hypothesized that being prompted to write specifically about the utility value of the material for the distant future would make this intervention particularly powerful for participants with higher levels of interest. We reasoned that a focus on the future would be a strong interest trigger and would increase competence valuation, interest, perceptions of utility, and behavioral intentions for these participants, compared to writing about the utility value of the material for the present or near future (Renninger & Hidi, 2016; Renninger & Hidi, 2019). Reflecting on the future usefulness of the material might lead more interested students to care more about succeeding at the learning task and this, in turn, might increase their interest, value perceptions, and behavioral intentions. Therefore, we examined the potential mediating role of competence valuation.

Method

Participants. Participants in this study were 253 female and 155 male undergraduates enrolled in an introductory psychology course at a large Midwestern university. The sample was 85% Caucasian, 11% Asian, 3% African American, and 1% Hispanic.

Materials and procedure. Participants were randomly assigned to one of four conditions: a standard utility-value condition ($n = 103$), a future utility-value condition ($n = 96$), a present utility-value condition ($n = 104$), or a control condition ($n = 105$). The procedure for Study 2 was similar to that of Study 1, with three exceptions. First, participants in all conditions (including control) received the directly-communicated UV information tested in Study 1, embedded in the instructional session.

Second, we included a writing task in which we manipulated self-generated utility value after students completed the instructional session. Participants in UV conditions were asked to write about the usefulness of fungi in their own lives with temporal frame unspecified (standard UV), specifically in the distant future (future UV), or specifically in the present or near future (present UV). Participants in the control condition were asked to describe two pictures in detail (one depicting fungi, the other depicting plant life), and then compare and contrast them, to control for the experience of writing about fungi. The experimental writing prompts are presented in Appendix A and sample responses to each of the three UV prompts are presented in Appendix B.

Third, measurement in Study 2 differed compared to Study 1 in accordance with the timing of the self-generated UV manipulation, which occurred after the instructional session in which the directly-communicated UV information was embedded. Because all participants received the same directly-communicated UV information, we were able to test task interest and task confidence (which were outcomes in Study 1) as the most proximal moderators of the self-generated UV manipulation (and thereby control for initial interest and confidence in biology, the moderators in Study 1; see Figure 1). In addition, we used scores on a pretest of the material as a covariate to control for participants' initial levels of performance on the task.

We added measures of competence valuation and test confidence immediately after the writing manipulation to assess the influence of the different writing conditions on students' attitudes about the test. We measured interest, behavioral intentions, and utility value after the test. The interest items were similar to those measured after participants received directly-communicated UV information, but the items were changed to avoid duplicating the wording of the earlier measure, given the short time interval between assessments. The measure of behavioral intentions evaluated how motivated participants were to learn about similar topics or use what they had learned in the future. Similar measures have been used in previous research to capture deeper and more maintained levels of interest development (Durik, Shechter, et al., 2015; Hulleman et al., 2010). The measure of utility value was expanded from the measure used in Study 1 to capture how participants were thinking about the usefulness of the material in the future and in their daily lives.

Measures. Questionnaire items were measured on a 1 (*Not ____ at All*) to 7 (*Very ____*) Likert-type scale in which anchors were customized for each question, except for the behavioral intentions items, which were measured on a 4-point Likert-type scale (*No, Probably not, Probably yes, Yes*). Zero-order correlations, descriptive statistics, and scale reliabilities are displayed in Table 4.

Covariates. We included three variables as covariates: initial interest, confidence in biology, and pretest score. As in Study 1, initial interest and confidence in biology were measured prior to the instructional session. The items in these measures were identical to those in Study 1. Pretest score was computed by summing the number of items each participant answered correctly on an eight-item multiple-choice pretest that was administered between

Table 4
Zero-Order Correlations and Descriptive Statistics for Major Variables in Study 2

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Confidence in biology											
2. Initial interest	.55***										
3. Pretest score	.13*	.12*									
4. Task interest	.41***	.69***	.19***								
5. Task confidence	.42***	.39***	.36***	.62***							
6. Competence valuation	.27***	.39***	.17***	.55***	.48***						
7. Test confidence	.47***	.49***	.27***	.53***	.74***	.54***					
8. Test score	.36***	.31***	.31***	.38***	.46***	.34***	.43***				
9. Posttest interest	.46***	.76***	.14**	.85***	.46***	.55***	.51***	.39***			
10. Posttest utility value	.56***	.65***	.13**	.68***	.41***	.53***	.45***	.38***	.80***		
11. Behavioral intentions	.49***	.62***	.21***	.64***	.46***	.50***	.50***	.40***	.73***	.75***	
M	3.48	2.98	5.80	3.25	4.46	3.82	3.7	21.67	2.99	3.18	2.29
SD	1.59	1.36	1.38	1.41	1.12	1.45	1.32	4.87	1.46	1.38	0.72
Cronbach's α	.93	.93		.94	.77	.94	.91		.97	.92	.74

* $p < .05$. ** $p < .01$. *** $p < .001$.

the first and second video lectures and tested recall of material covered in the first video lecture.

Moderators. Moderator variables were task interest and task confidence. These variables were outcomes in Study 1, but they were tested as moderators in Study 2 because there were no experimental manipulations yet in place, given that all participants received the directly-communicated UV information. As in Study 1, both of these measures were taken immediately after the instructional session. Items were identical to those used in Study 1.

Pretest variables. We measured two outcomes after participants completed the writing exercise but before they took the test on the material: competence valuation and test confidence. Competence valuation was measured with a three-item scale ("How much do you care about doing well on today's test?", "How important is it to you to do well on the upcoming test?", "How motivated are you to do well on the test?"; α = .94) and test confidence was measured with a two-item scale ("How confident are you that you will be able to do well on the test?", "How prepared do you feel for the test?"; α = .91).

Test score and posttest outcomes. Test score was computed by summing the number of items each participant answered correctly on a 30-item multiple-choice test on the material covered in the two video lectures. We measured three outcomes after participants completed the test: posttest interest, behavioral intentions, and posttest utility value. Posttest interest was measured with a four-item scale ("How fascinating do you find fungi?"; "How interesting do you find fungi?",; "How much fun is learning about fungi?"; "How much did you enjoy learning about fungi?"; α = .97). Behavioral intentions were measured with a three-item scale ("Do you think you will use the information about fungi you learned today in the future?"; "Did your experience today make you want to learn about other types of organisms?"; "Would you be interested in attending a follow-up study later in the semester on a different type of organism?"; α = .74). Posttest utility value was measured with a four-item scale ("To what degree can you imagine using what you've learned about fungi in your own life?"; "How useful do you think knowing about fungi could be to you in your future career?"; "How useful do you think understanding fungi could be to you in your daily life?"; "How valuable do you think learning about fungi is for everyone?"; α = .92).

Results

Analysis plan.

Two-moderator regression models. We tested the effects of condition on each outcome using multiple regression. As in Study 1, we included two moderators (task interest and task confidence) together in a single model; again, these variables were standardized to compute two-way interactions. We tested three orthogonal contrasts to compare the four conditions. The UV contrast compared the three treatment conditions to control (control, −3, standard UV, +1, present UV, +1, future UV, +1), the Specific Versus Standard UV contrast compared the two temporally specific exercises to standard UV (control, 0, standard UV, −2, present UV, +1, future UV, +1), and the Future Versus Present UV contrast compared future UV to present UV (control, 0, standard UV, 0, present UV, −1, future UV, +1). Our final model included 14 terms: three orthogonal contrasts, task interest, task confidence, three two-way interactions between each of the contrasts and task interest, three two-way interactions between each of the contrasts and task confidence, and three covariates: initial interest, confidence in biology, and pretest score. Effects of this model on the pretest variables, test performance, and posttest outcomes are reported in Table 5.

Residualized models. As in Study 1, the task interest and task confidence moderator variables were highly correlated (r = .62), so we tested each moderator in its own model using residualized scores. Each model contained nine terms: three orthogonal contrasts, a moderator (task interest or task confidence, residualized), three two-way Contrast × Moderator interactions, and two covariates: the baseline measure of the moderator (initial interest for task interest, confidence in biology for task confidence, residualized), and pretest score. As in Study 1, the findings from these residualized models were similar to those found in the two-moderator regression models but they are superior in accounting for the shared variance between the two moderators. Consistent with Study 1, there were no significant treatment interactions with the residualized task confidence measure, so we present the effects of the residualized interest model, but we also note results from the residualized confidence model when relevant. Effects from these models are reported in Table 6.

Table 5
Two-Moderator Regression Models for All Outcomes in Study 2

Predictor	Competence valuation			Test confidence			Test score		
	β	*t*(393)	*p*	β	*t*(393)	*p*	β	*t*(393)	*p*
UV contrast	.02	.57	.569	.06	1.81	.071	.11	2.58	.010
Specific vs. standard UV contrast	.05	1.20	.232	.02	0.76	.450	.05	1.14	.257
Future vs. present UV contrast	.07	1.59	.112	.03	0.83	.410	−.04	−1.02	.310
Task interest	.40	5.98	<.001	−.06	−1.05	.293	.15	2.13	.034
UV × Task Interest	.07	1.43	.153	.00	−0.04	.966	.07	1.28	.202
Specific vs. Standard UV × Task Interest	.11	2.17	.031	.09	2.24	.026	.04	0.86	.393
Future vs. Present UV × Task Interest	.12	2.21	.028	.04	1.00	.317	.05	0.82	.415
Task confidence	.22	3.78	<.001	.64	14.28	<.001	.22	3.70	<.001
UV × Task Confidence	−.07	−1.31	.192	.00	−0.04	.970	−.08	−1.55	.122
Specific vs. Standard UV × Task Confidence	−.08	−1.62	.105	−.10	−2.46	.015	−.11	−2.03	.043
Future vs. Present UV × Task Confidence	−.06	−1.12	.263	.00	0.01	.991	−.05	−0.97	.332
Initial interest	.04	0.56	.576	.22	4.60	<.001	.00	−0.08	.940
Confidence in biology	−.01	−0.15	.880	.10	2.51	.012	.19	3.70	<.001
Pretest score	.01	0.23	.816	.01	0.26	.794	.18	3.91	<.001
	Posttest interest			Behavioral intentions			Posttest utility value		
UV contrast	.04	1.64	.103	.04	1.19	.236	.07	2.26	.024
Specific vs. standard UV contrast	.02	0.87	.384	.09	2.46	.014	.14	4.60	<.001
Future vs. present UV contrast	.01	0.41	.680	.06	1.83	.067	.05	1.69	.092
Task interest	.70	18.22	<.001	.38	6.52	<.001	.52	9.97	<.001
UV × Task Interest	.01	0.31	.756	−.05	−1.22	.223	.04	0.88	.378
Specific vs. Standard UV × Task Interest	.04	1.29	.199	.06	1.37	.172	.03	0.82	.410
Future vs. Present UV × Task Interest	.05	1.52	.130	.10	2.19	.029	.09	2.25	.025
Task confidence	−.11	−3.28	.001	.04	0.77	.440	−.09	−2.03	.043
UV× Task Confidence	.01	0.37	.712	.06	1.31	.192	.00	0.12	.907
Specific vs. Standard UV × Task Confidence	−.06	−1.98	.049	−.05	−1.13	.259	−.02	−0.49	.622
Future vs. Present UV × Task Confidence	−.06	−1.84	.066	−.05	−1.16	.248	−.01	−0.25	.801
Initial interest	.30	8.47	<.001	.25	4.65	<.001	.17	3.51	<.001
Confidence in biology	.05	1.78	.076	.17	3.79	<.001	.28	7.16	<.001
Pretest score	.01	0.28	.781	.08	2.12	.035	.01	0.34	.736

Note. Standardized coefficients (betas), *t* statistics, and *p* values are reported. UV = utility-value.

Effects on outcomes in residualized task interest model.

Competence valuation. Consistent with our hypotheses, there was a significant Future Versus Present UV × Task Interest interaction (β = .11, p = .014) indicating that the future UV exercise increased competence valuation among participants with higher levels of task interest but not among participants with lower levels of task interest (Figure 3A). Similarly, there was a significant Specific Versus Standard UV × Task Interest interaction (β = .10, p = .031) indicating that compared to receiving the standard UV exercise, receiving a future or present UV exercise had a more positive effect on competence valuation for participants with higher levels of task interest. Participants with higher initial interest (β = .13, p = .019), task interest (β = .27, $p <$ .001), and pretest scores (β = .17, $p < .001$) also reported higher levels of competence valuation than participants with lower initial interest, task interest, and pretest scores. In addition, we found a significant effect of task confidence (β = .14, p = .012): participants with higher task confidence reported higher levels of competence valuation than participants with lower task confidence.

Test confidence. There was a significant Specific Versus Standard UV × Task Interest interaction (β = .10, p = .037) indicating that compared to receiving the standard UV exercise, receiving a future or present UV exercise had a more positive effect on test confidence for participants with higher levels of task interest. Participants with higher initial interest (β = .28, $p < .001$) and pretest scores (β = .25, $p < .001$) also reported higher levels of test confidence than participants with lower levels of initial interest and test confidence. In addition, we found a significant effect of task confidence on test confidence, indicating that participants with higher task confidence reported higher levels of test confidence (β = .45, $p < .001$).

Test score. There was a significant main effect of the UV contrast on test score (β = .12, p = .012), indicating that, on average, participants in a UV condition (M = 21.94, SD = 4.74) answered more problems correctly than participants in the control condition (M = 20.90, SD = 5.16). In addition, we found a significant effect of task confidence (β = .14, p = .006) and confidence in biology (β = .18, $p < .001$), indicating that participants with higher levels of task confidence and confidence in biology answered more test questions correctly than participants with lower levels of task confidence and confidence in biology. Consistent with previous research, the positive effect of receiving a utility-value manipulation was stronger for participants with lower task confidence, but this effect was not statistically significant (β = .07, p = .111; Figure 4). To further probe this interaction, we tested for simple effects of the UV contrast and found that whereas the utility-value manipulation had no effect for participants with higher task confidence (+1 SD; β = .03, p = .658), there was a significant positive effect for participants with lower task confidence (−1 SD; β = .17, p = .007). Participants with

Table 6
Residualized Models for All Outcomes in Study 2

Predictor	Competence valuation β	t(398)	p	Test confidence β	t(398)	p	Test score β	t(398)	p
Moderator: Task interest (residualized)									
UV contrast	.02	0.52	.601	.07	1.41	.161	.12	2.52	.012
Specific vs. standard UV contrast	.03	0.67	.506	.00	0.01	.989	.04	0.80	.423
Future vs. present UV contrast	.05	1.13	.261	.01	0.30	.766	−.04	−0.93	.353
Task interest	.27	4.80	<.001	−.04	−0.70	.485	.14	2.49	.013
Utility Value × Task Interest	.05	1.18	.237	−.01	−0.19	.851	.05	1.03	.303
Specific vs. Standard UV × Task Interest	.10	2.16	.031	.10	2.10	.037	.05	1.13	.259
Future vs. Present UV × Task Interest	.11	2.47	.014	.07	1.55	.122	.06	1.18	.240
Initial interest	.13	2.35	.019	.28	5.01	<.001	.02	0.42	.677
Pretest score	.17	3.74	<.001	.25	5.46	<.001	.32	6.92	<.001
	Posttest interest β	t(398)	p	Behavioral intentions β	t(398)	p	Posttest utility value β	t(398)	p
UV contrast	.05	1.48	.141	.05	1.22	.223	.08	2.03	.044
Specific vs. standard UV contrast	.01	0.31	.759	.08	1.85	.065	.14	3.43	.001
Future vs. present UV contrast	.01	0.21	.833	.06	1.51	.132	.05	1.32	.186
Task interest	.58	14.95	<.001	.36	7.04	<.001	.50	10.20	<.001
Utility Value × Task Interest	.00	0.03	.980	−.05	−1.16	.248	.02	0.58	.564
Specific vs. Standard UV × Task Interest	.05	1.52	.131	.07	1.69	.093	.05	1.31	.192
Future vs. Present UV × Task Interest	.06	1.89	.059	.11	2.52	.012	.10	2.57	.011
Initial interest	.29	7.48	<.001	.22	4.32	<.001	.13	2.68	.008
Pretest score	.15	4.90	<.001	.22	5.27	<.001	.15	3.65	<.001
	Competence valuation			Test confidence			Test score		
Moderator: Task confidence (residualized)									
UV contrast	.00	−0.07	.948	.04	0.98	.329	.10	2.17	.030
Specific vs. standard UV contrast	.01	0.23	.817	−.01	−0.14	.891	.03	0.57	.569
Future vs. present UV contrast	.03	0.60	.547	−.01	−0.28	.783	−.06	−1.40	.163
Task confidence	.14	2.53	.012	.45	9.76	<.001	.14	2.77	.006
Utility Value × Task Confidence	−.06	−1.23	.220	−.01	−0.14	.891	−.07	−1.60	.111
Specific vs. Standard UV × Task Confidence	−.01	−0.21	.836	−.03	−0.63	.532	−.05	−1.05	.297
Future vs. Present UV × Task Confidence	−.02	−0.45	.655	.02	0.45	.654	−.03	−0.67	.502
Confidence in biology	.02	0.47	.636	.11	2.52	.012	.18	3.87	<.001
Pretest score	.12	2.35	.019	.12	2.73	.007	.26	5.39	<.001
	Posttest interest			Behavioral intentions			Posttest utility value		
UV contrast	.01	0.24	.812	.02	0.43	.664	.05	1.08	.281
Specific vs. standard UV contrast	−.03	−0.59	.553	.05	1.04	.297	.10	2.18	.030
Future vs. present UV contrast	−.04	−0.85	.395	.02	0.37	.716	.00	0.05	.957
Task confidence	−.17	−3.09	.002	−.03	−.56	.578	−.13	−2.57	.011
Utility Value × Task Confidence	.00	−0.09	.926	.04	0.83	.406	.00	−0.04	.965
Specific vs. Standard UV × Task Confidence	.04	0.84	.402	.02	0.46	.647	.06	1.17	.244
Future vs. Present UV × Task Confidence	−.02	−0.35	.727	−.02	−0.36	.716	.02	0.39	.698
Confidence in biology	.09	1.71	.087	.17	3.43	.001	.27	5.47	<.001
Pretest score	.19	3.75	<.001	.21	4.18	<.001	.16	3.11	.002

Note. Standardized coefficients (betas), t statistics, and p values are reported. Each moderator (task interest and task confidence) is residualized, with shared variance with the other moderator statistically removed. UV = utility-value.

higher task interest (β = .14, p = .013) and pretest scores (β = .32, p < .001) also received higher test scores than participants with lower task interest and pretest scores.

Posttest interest. Consistent with our hypotheses, there was a Future Versus Present UV × Task Interest interaction indicating that compared to the present UV exercise, the future UV exercise had a more positive effect on posttest interest for participants with higher levels of task interest, although this effect was not statistically significant (β = .06, p = .059; see Figure 3B). Participants with higher initial interest (β = .29, p < .001), task interest (β = .58, p < .001), and pretest scores (β = .15, p < .001) also reported higher levels of posttest interest than participants with lower initial interest, task interest, and pretest scores.

Behavioral intentions. Consistent with our hypotheses, there was a significant Future Versus Present UV × Task Interest interaction (β = .11, p = .012) indicating that compared to the present UV exercise, the future UV exercise increased positive behavioral intentions for participants with high task interest but not for participants with low task interest (see Figure 3C). Participants with higher levels of initial interest (β = .22, p < .001), task interest (β = .36, p < .001), pretest scores (β = .22, p < .001), and confidence in biology (β = .17, p = .001) also reported more positive behavioral intentions than participants with lower initial interest, task interest, pretest scores, and confidence in biology.

Posttest utility value. There was a significant main effect of the UV contrast (β = .08, p = .044) indicating that participants

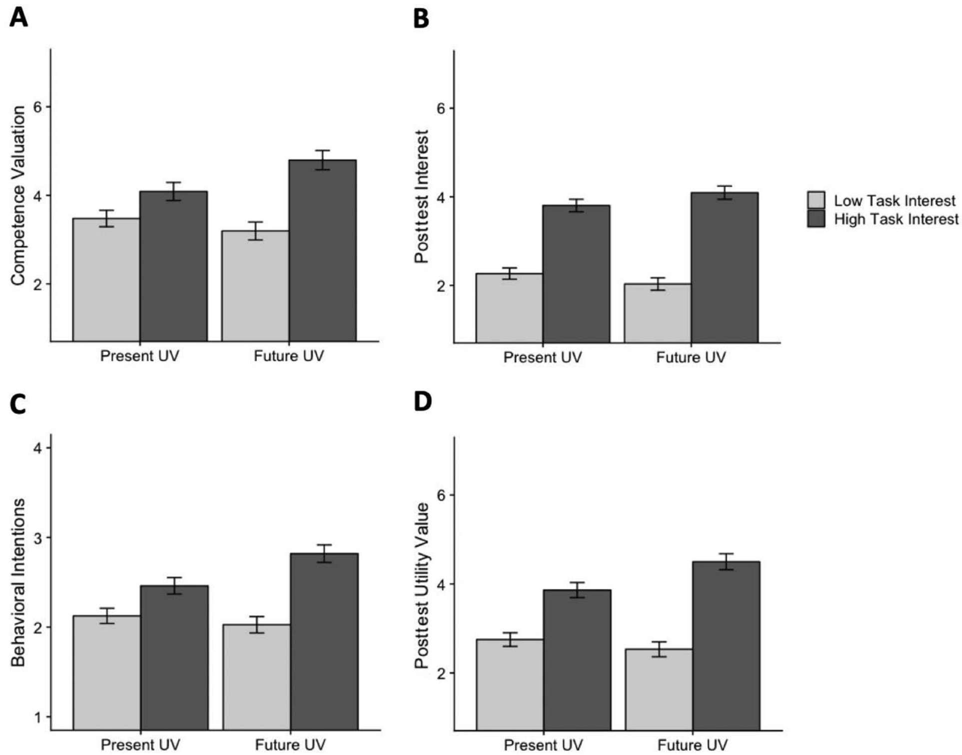

Figure 3. Effects of the Future Versus Present Utility-Value (UV) contrast on competence valuation (A), posttest interest (B), behavioral intentions (C), and posttest utility value (D) as a function of task interest (residualized on task confidence). Predicted values from the regression equations are graphed at ±1 standard deviation of task interest, and error bars represent ±1 standard error of the estimate.

who received a utility-value exercise reported higher levels of posttest utility value than participants in the control condition. There was also a significant main effect of the Specific Versus Standard UV contrast ($\beta = .14$, $p = .001$) indicating that participants who received a future or present UV exercise reported higher levels of utility value than participants who received the standard UV exercise. Consistent with our hypotheses, there was also a significant Future Versus Present UV × Task Interest interaction ($\beta = .10$, $p = .011$) indicating that, compared to the present UV exercise, the future UV exercise increased posttest utility value for participants with higher levels of task interest but not for participants with lower levels of task interest (see Figure 3D). Participants with higher initial interest ($\beta = .13$, $p = .008$), task interest ($\beta = .50$, $p < .001$), pretest scores ($\beta = .15$, $p < .001$), and confidence in biology ($\beta = .27$, $p < .001$) also reported higher levels of posttest utility value than participants with lower initial interest, task interest, pretest scores, and confidence in biology.

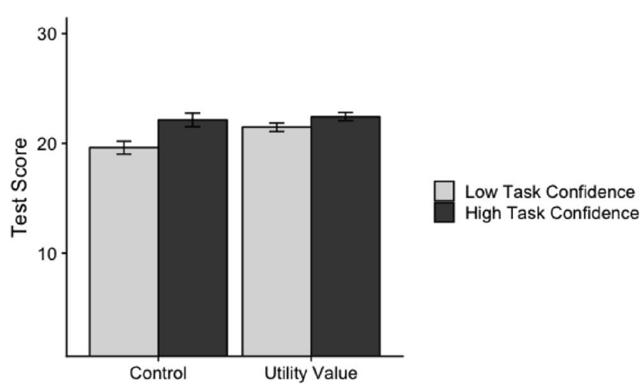

Figure 4. Test score as a function of the utility-value (UV) contrast and task confidence (residualized on task interest). Predicted values from the regression equation are graphed at ±1 standard deviation of task confidence, and error bars represent ±1 standard error of the estimate.

Differences between two-moderator model and residualized models. Effects on outcomes in the residualized models were mostly congruent with those in the two-moderator model, but one pattern of effects provided an important exception. In the two-moderator model, there was a significant Specific Versus Standard UV × Task Confidence interaction on test confidence, test score, and posttest interest, indicating that, compared to receiving the standard UV exercise, receiving a future or present UV exercise increased each of these outcomes for participants with low task confidence (−1 *SD*; $p < .039$ for each outcome) but not for participants with high task confidence (+1 *SD*; $p > .130$ for each outcome). Compared to the standard UV exercise, the future and present UV exercises included additional writing support (i.e., included examples of what students might write about; see Appendix A), and consistent with previous research, this additional support may have amplified treatment effects for less confident students (Canning & Harackiewicz, 2015, Study 2). However, given that these effects were not robust to residualization of task confidence, this pattern should be interpreted with caution. The apparent advantage of receiving a time-specific UV writing exercise for students with lower levels of task confidence may have depended upon overlapping variance between task confidence and task interest.

Moderated mediation. We tested whether competence valuation mediated the significant future versus present UV effects on behavioral intentions and posttest utility value for students with higher levels of task interest. We predicted that we would find evidence of moderated mediation, such that compared to the present UV exercise, the future UV exercise would increase competence valuation for participants with higher task interest, and competence valuation would in turn predict behavioral intentions and posttest utility value (Figure 5). To examine this possibility, we tested separate path models for each of the two outcomes, including the residualized task interest model on competence valuation and the outcome, and also including competence valuation as a predictor of the outcome. We tested the indices of moderated mediation and conditional indirect effects at high and low levels of task interest in each of these path models (Hayes, 2013).

Indeed, we found significant indices of moderated mediation on posttest utility value ($z = 2.41$, $p = .016$) and behavioral intentions ($z = 2.38$, $p = .017$), indicating that the indirect effect of the Future Versus Present UV contrast on each outcome via competence valuation varied significantly as a function of task interest. Consistent with our hypotheses, we found significant conditional indirect effects on behavioral intentions ($z = 2.39$, $p = .017$) and posttest utility value ($z = 2.41$, $p = .016$) for participants with high levels of task interest (+1 *SD*), but not for participants with low levels of task interest (−1 *SD*; *p*s > .286). The Future Versus Present UV × Task Interest effects on behavioral intentions and posttest utility value became nonsignificant in these models (UV: $\beta = .06$, $p = .085$; behavioral intentions: $\beta = .07$, $p < .081$), as would be expected in a significant moderated mediation model. These sfindings indicate that competence valuation mediated the effects of future (vs. present) UV on behavioral intentions and posttest utility value for participants with higher levels of task interest.

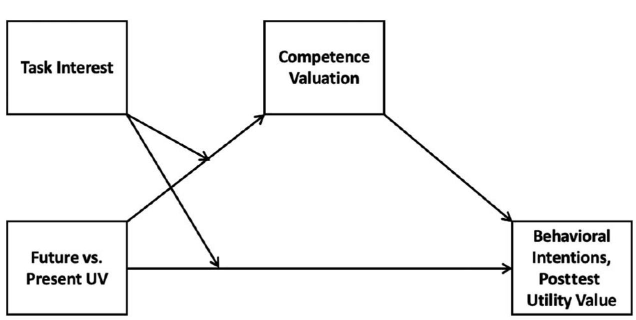

Figure 5. Conceptual diagram of the moderated mediation model testing the effects of future versus present utility value on posttest utility value and behavioral intentions via competence valuation for participants with higher task interest (residualized on task confidence).

Discussion

In this study, we found that receiving a future-oriented (vs. present-oriented) UV writing exercise significantly increased competence valuation, behavioral intentions, and posttest utility value among participants with higher levels of task interest. Prompting these participants to reflect on the instrumentality of a topic for long-term goals may help them to make the stronger relevance connections they need to support the further development of their interest (Husman & Shell, 2008; Renninger, 2009). It is interesting that the effect of the future-oriented utility-value exercise for more interested students was stronger for behavioral intentions than for posttest interest (the effect on posttest interest was in the expected direction, but only marginally significant). It is possible that because participants took a test between the writing manipulation and measurement of the interest outcomes, effects on participants' immediate state of interest had begun to fade, whereas effects on development along the interest continuum (as reflected in increased behavioral intentions) were strong. Regardless, the findings demonstrate that encouraging reflection on utility value for the distant future helped students with higher preexisting interest in the task to develop a deeper level of interest in the material.

Moderated mediation analyses suggest that participants with high levels of task interest came to care more about succeeding at the task (i.e., increased competence valuation) when they reflected on the long-term utility of the material, and this increased investment in the learning task helped to promote positive behavioral intentions and perceptions of utility value. This finding is consistent with previous research indicating that emphasizing utility value can work by increasing competence valuation (Durik, Shechter, et al., 2015), and provides insight into why this type of self-generated utility-value manipulation was effective for high-interest participants.

Receiving any type of self-generated utility-value exercise significantly increased posttest utility-value perceptions across all participants, on average. Because participants in all conditions were provided with directly-communicated UV information, this finding indicates that reflecting on and writing about the utility value of a learning topic can lead participants to see more usefulness in the material, over and above having UV information provided in the instructional materials. In addition, receiving a time-specific UV exercise significantly increased posttest utility value across all participants, on average. There are at least two possible explanations for this effect: first, individuals may engage in more productive reflection on utility value when their attention is directed toward more specific types of applications, regardless of whether those applications are in the present or the distant future. Second, the time-specific UV writing prompts included more support for participants' reflection, providing examples of what they might write about. Future research is necessary to examine whether specificity, the provision of examples, or both were responsible for the positive effect of the time-specific utility-value exercises.

Finally, we found that a self-generated utility-value exercise improved performance for all participants, on average, over and above the effect of directly-communicated UV information, which was provided to all participants. This finding is consistent with previous research indicating that self-generated utility-value exercises can have positive overall effects on participants' performance in biology (Canning et al., 2018; Harackiewicz et al., 2016). Also, although this effect was not significantly moderated by task confidence, there was a significant simple effect of receiving a self-generated UV exercise on performance for participants with lower levels of task confidence, partially replicating previous research from a mental-math paradigm (Canning & Harackiewicz, 2015, Study 2).

Taken together, these findings are consistent with the notion that self-generated utility-value writing exercises can affect different outcomes for individuals with different motivational characteristics. Hecht and colleagues (2019) conducted a long-term follow up of a utility-value intervention conducted in a college biology course and found that different motivational processes were relevant for the effects of the UV intervention on short-term performance (task engagement) and long-term persistence in the field (personal relevance). Our findings are congruent with these effects: whereas receiving a self-generated UV exercise improved performance (overall, and specifically for individuals with lower levels of task confidence), reflecting on the relevance of the material for the distant future increased interest and perceived utility value for more interested students. UV interventions may thus support students who enter learning situations with different levels of interest and confidence, though in different ways, improving learning outcomes for lower-performing students, and promoting subsequent interest development for more initially interested students.

General Discussion

We conducted two laboratory experiments exploring the role of utility value in triggering and sustaining interest in a learning task. We tested the effects of directly-communicated and self-generated UV manipulations in a learning task focused on knowledge acquisition and examined whether these manipulations would promote interest for participants who began the task with some interest in the topic, or for more confident participants. Results indicated that embedding directly-communicated UV information in the instructional session was successful in triggering task interest for individuals who reported higher levels of initial interest. In addition, prompting reflection on the utility value of the material for the distant future after the instructional session helped to promote deeper levels of interest (i.e., posttest interest and behavioral intentions) for students who had initially reported higher levels of task interest.

We were able to evaluate replication of previous laboratory findings with directly-communicated and self-generated utility-value manipulations (Canning & Harackiewicz, 2015; Durik & Harackiewicz, 2007; Durik, Shechter, et al., 2015; Hulleman et al., 2010; Shechter et al., 2011) in a new domain. In general, results in the biology-learning paradigm were similar to previously reported findings in a mental-math paradigm. Previous research indicates that providing directly-communicated UV information can trigger interest for students with high initial interest and/or confidence (Canning & Harackiewicz, 2015; Durik & Harackiewicz, 2007; Durik, Shechter, et al., 2015; Shechter et al., 2011). Consistent with these results, we found that providing UV information increased interest for students with high levels of initial interest. In addition, consistent with prior research (Canning & Harackiewicz, 2015, Study 3), we found that directly-communicated UV did not undermine outcomes for individuals who were less confident in biology. We also found that a self-generated UV writing exercise in this context improved performance, overall and specifically for participants with low task confidence. This finding was consistent with prior laboratory research (Canning & Harackiewicz, 2015, Study 2), and field research (e.g., Harackiewicz et al., 2016; Hulleman & Harackiewicz, 2009).

There were two important differences from prior research in the results we obtained using this new learning task: (a) directly-communicated UV was particularly effective for more interested students (whereas previous research found stronger effects for more confident students), and (b) contrary to findings in the mental-math paradigm (Canning & Harackiewicz, 2015, Study 2), combining directly-communicated and self-generated UV intervention strategies did not increase perceived UV and interest for less confident participants. Although these results show impressive consistency across domains, some differences may be due to different motivational processes operating, as discussed above. Future research should extend the present findings by using more diverse measures of interest and confidence. For example, we measured confidence in biology, a general domain measure, prior to the instructional session but task-specific confidence following the instructional session in the present research, reasoning that participants would have trouble assessing their own ability to succeed with a specific biological topic until they became more familiar with the task. However, future research should establish that this pattern of findings is consistent using an earlier task-specific measure of confidence. In addition, in the present research, we measured interest at just two levels of development throughout the progression of the learning task (i.e., task interest and behavioral intentions), but it will be important to develop measures of interest along the entire interest continuum. For example, behavioral measures might capture even deeper levels of interest development by assessing whether students take opportunities to reengage with and gain additional knowledge about the topic (Renninger & Hidi, 2016; Renninger & Pozos-Brewer, 2015).

UV interventions have been tested in both laboratory and field settings, and this approach has allowed scholars to conduct "full-cycle" social-psychological research, in which findings from the field inform questions to be tested in the laboratory, aiding the development of future field experiments, and so forth (Harackiewicz & Barron, 2004; Hulleman & Barron, 2016; Mortensen & Cialdini, 2010). However, previous tests of utility-value manipulations in the laboratory have relied on a skill-focused mental-multiplication learning task, resulting in a disconnect from field research where UV interventions have primarily been tested in science courses that focus on knowledge acquisition. By testing UV interventions in a science-learning knowledge-acquisition task in the laboratory, these studies expand the degree to which the findings can be used to inform future field research. Our findings suggest that directly-communicated UV information and/or inclusion of a future-oriented self-generated UV exercise may particularly help students in contexts where initial interest is high, such as introductory science courses for majors. Such effects may in turn initiate longitudinal processes that buffer against attrition over time (Cohen & Sherman, 2014; Harackiewicz & Priniski, 2018; Hecht, Priniski, & Harackiewicz, 2019). Future research is needed to explore this possibility.

Importantly, none of our intervention approaches produced harmful side effects for particular groups of students. The key to avoiding these side effects may have been to exercise caution in introducing a focus on the distant future in our materials. Emphasizing connections between a task and future goals may help to support some students' motivation (Husman & Shell, 2008; Renninger, 2009), but such connections may also be threatening for students who are less confident that they can succeed at the task (Canning & Harackiewicz, 2015; Lee et al., 2013). It may be important not to raise the issue of future connections until students have had some experience and success in learning the material. The writing exercise came after students had learned about the topic in the instructional session, and a focus on future connections may be less threatening at this point in the learning process. In developing interventions, researchers will benefit from considering the positive and negative processes their interventions may initiate in order to maximally benefit targeted groups without causing unintended harm to other groups (Harackiewicz & Priniski, 2018).

An important limitation of the present research is that our samples were racially homogenous: 2% underrepresented minority (i.e., African American, Hispanic, or Native American) in Study 1 and 4% underrepresented minority in Study 2. Therefore, we did not have the statistical power to test effects for underrepresented racial/ethnic groups. In light of research indicating that utility-value interventions can reduce racial achievement gaps (Harackiewicz et al., 2016), it will be essential for future research to explore the implications of the novel manipulations tested in this research (e.g., the future-oriented self-generated UV writing exercise) for underrepresented students. Similarly, a small proportion of our participants were East Asian in Study 2 ($n = 41$ across 4 conditions). This made it impossible to test for similar patterns of findings from a related study that highlighted the importance of Eastern versus Western culture as a moderator of temporal framing in UV manipulations (Shechter et al., 2011). In that study, the researchers found that emphasizing future-oriented applications in a directly-communicated UV manipulation increased interest for East Asian participants, whereas emphasizing proximal utility value was more effective for Western participants. Future research with more statistical power to test the moderating effects of culture will be necessary to examine whether this same pattern emerges when manipulating the temporal frame of self-generated UV manipulations.

Implications

This research provides insight into theory on how interest develops over time (Hidi & Renninger, 2006; Renninger & Hidi, 2016; Renninger & Hidi, 2019). Different instructional materials and activities may be necessary to trigger students' interest at different points in the learning process. Our findings suggest that activities emphasizing the usefulness of academic material can serve as powerful on-ramps at multiple points in a learning task (Alexander et al., 2019), facilitating deeper levels of interest development for individuals who have already begun to experience some interest in a topic.

More generally, this research contributes to a growing body of work on how social-psychological interventions can be used to improve motivational and academic outcomes, such as interest, value perceptions, and performance (Harackiewicz & Priniski, 2018; Lazowski & Hulleman, 2016; Walton & Wilson, 2018). Our findings highlight the potential of motivation interventions to improve achievement and facilitate interest development when they are carefully designed and tailored to the needs of particular groups of students (Harackiewicz & Priniski, 2018; Walton, 2014; Yeager & Walton, 2011). Interventions that communicate the usefulness of academic content and encourage reflection on application of the material to the distant future have the potential to deepen interest for students who enter a learning situation with higher levels of initial interest, and strategies that combine directly-communicated and self-generated UV approaches can help to improve performance for less confident students.

We tested different UV manipulations in the context of an hour-long laboratory session, but future research should examine the degree to which these findings extend to classrooms. For example, directly-communicated UV interventions have not yet been tested in college courses, but such studies will be possible if researchers collaborate with practitioners to develop lecture and homework materials. Our findings complement previous research suggesting that combining directly-communicated and self-generated UV interventions can improve performance for less confident students (Canning & Harackiewicz, 2015), and suggest that such a combined approach may be effective in science courses. Our findings also indicate that directly-communicated UV information and a future-focused variation of a UV writing exercise may both serve as effective tools to catalyze interest development where initial interest is high for most students, such as introductory college courses for majors. Educational practitioners and researchers should consider how different approaches to emphasizing the usefulness of educational content can affect interest and performance for students with different levels of initial interest and confidence to enhance the motivational support provided in their courses.

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(*Appendices follow*)

Appendix A

Experimental Writing Prompts

Control Writing Prompt

[picture of fungi]	**[picture of plant life]**

Type a short essay (2–3 paragraphs in length) describing the objects that you see in the two pictures above. Simply describe each object, focusing on details, and compare them in a final paragraph.

Please start typing your essay on the computer screen as soon as you are ready to begin. You will have 10 min to complete this exercise, after which the next page will automatically load.

Standard Utility-Value Writing Prompt

Write a short essay (2–3 paragraphs in length) briefly summarizing what you just learned and explaining **how fungi (or knowledge about fungi) might be useful to you in your own life**. Be sure to give examples.

Please start typing your essay on the computer screen as soon as you are ready to begin. You will have 10 min to complete this exercise, after which the next page will automatically load.

Present Utility-Value Writing Prompt

The things we learn can be useful in our everyday lives in a number of ways. For instance, people can use new information to improve their **healthy eating** (e.g., learning to cook tasty, healthy meals), **healthy living in their dorm/apartment** (e.g., keeping a safe and sanitary living space), or **current academic success** (e.g., gaining knowledge that promotes academic goals). These are a few ways, among many, that new information can be useful to us in the present.

Type a short essay (2–3 paragraphs in length) describing **how fungi (or knowledge about fungi) might be useful to you in your present life.** You might describe how the information could be used in the contexts of healthy eating, healthy living in your dorm/apartment, academic success, or any other relevant context. Of course, you've only been exposed to this information once, but for the purposes of this short essay, please focus on how learning about fungi could be useful to you in your daily life and give examples.

Please start typing your essay on the computer screen as soon as you are ready to begin. You will have 10 min to complete this exercise, after which the next page will automatically load.

Future Utility Value-Writing Prompt

The things we learn can be useful for our future in a number of ways. For instance, people can use new information to improve their **future health** (e.g., learning to cook tasty, healthy meals), **healthy living in their future home** (e.g., keeping a safe and sanitary living space), or **job/career success** (e.g., gaining knowledge that promotes career goals). These are a few ways, among many, that new information can be useful to us in the future.

Type a short essay (2–3 paragraphs in length) describing **how fungi (or knowledge about fungi) might be useful to you in your future life.** You might describe how the information could be used in the contexts of your future health, healthy living in your home, career success, or any other relevant context. Of course, you've only been exposed to this information once, but for the purposes of this short essay, please focus on how learning about fungi could be useful to you in your future life and give examples.

Please start typing your essay on the computer screen as soon as you are ready to begin. You will have 10 min to complete this exercise, after which the next page will automatically load.

(*Appendices continue*)

Appendix B

Sample Responses to Utility-Value Prompts

Sample Responses to Standard Utility-Value Writing Prompt

1. "The average American may have little to no knowledge about the basic understandings of fungi, however the seemingly annoying mushrooms growing on your front lawn are a part of a family that is responsible for many operations that keep our earth processing properly, such as decomposition, production of food and modern medicine. Gaining knowledge about fungi gave me appreciation to the thing I once thought was a pest that grows in random places. Instead, I now know to respect its uniqueness as it is in an entirely different kingdom than all other plants. The breakthrough of using fungi to create Penicillin, arguably the most important drug discovered in history, lead me to wonder what other novel ways in which we can use fungi to better human kind, such as further studying the methods fungi decomposes pollution. Overall, this lesson has taught me to think differently about the fungi kingdom that I once made a grimace when I thought about it"

2. "Although fungi isn't well known by many people, the characteristics of fungi can actually be pretty important to know for the future. Fungi has many different functions that affect everyone's lives. The biology of fungi makes it harmful by the biology of how it gains resources. The type that makes fungi act like a parasite can be harmful. This trait can be harmful because with the fungi taking nutrients off of resources that we need to survive, it can cause us to be sick if we eat it or touch it. Therefore, it can cause strange new illnesses that we may not know how to cure. In addition, the way fungi rapidly grow and constantly are spreading pores to reproduce, it can cause illness and allergies. Hence, the way fungi functions can produce harmful affects on our lives if we don't understand how fungi work. On the other hand, fungi can also be a good thing. For example, the most known drug, Penicillin, contains bacteria-eating fungi. This property of the drug has been able to help many people effectively, and has become one of the best medical breakthroughs in life. Therefore, if we incorporate more knowledge of positive effects of fungi into our daily lives, it can potentially better our health and our lifestyle. Overall, knowing how fungi affects our lives can benefit us by making us better."

Sample Responses to Present Utility-Value Writing Prompt

1. "Fungi can be important to our daily lives in many ways. First of all, it helps with the production of organic foods. It helps organic plants grow so that we do not need to use things like pesticides. Because of this, we can eat a healthier diet in our modern lives when it is very easy to eat unhealthy. Secondly, some fungi themselves are extremely healthy to eat in our daily lives. The main example would be mushrooms. They provide dietary fibers as well as proteins that we need to stay healthy. They are a good alternative to meat so we don't have to continue eating and killing animals. Lastly, fungi is very helpful with the production of medicine. For example, penicillin, which is an extremely common drug. It has saved many lives over the years! Fungi also help with medicines that help with strep throat and the common cold. Without fungi, we wouldn't have a lot of the medicines that help us with our daily lives. Overall, Fungi make it easier to eat healthy, staying clean, as well as with medicines that keep us alive everyday. All of these help us get through our day to day lives at college especially!"

2. "Edible fungi such as mushrooms turn out to be packed with nutrients, after watching this video and learning about the health benefits of eating mushrooms, I will be more inclined to use mushrooms more when I am cooking to create healthier dishes. Fungi can apparently take root in homes, causing a significant amount of property damage as well as producing possible allergens which bring about health problems in humans. Knowing about how those fungi grow and what conditions lead them to grow well will be vital in attempting to clean and remove those fungi from houses. I personally feel that a little bit of general knowledge on fungi, which are all around us in our everyday lives and hence at the very least slightly relevant to us is important to have, because knowledge is good to have, relevant knowledge, even more so."

(*Appendices continue*)

Sample Responses to Future Utility-Value Writing Prompt

1. "To me, Fungi and knowledge of Fungi will be very useful in my future everyday life. As a pre-pharmacy student, learning how fungi are made in to drugs and learning how to deal with Fungal infections will be extremely important. As a future Pharmacist, knowledge about Fungi is very important. For example, one area in pharmacy that Fungi are very crucial are antibiotics. Many different antibiotics come from Fungi. Knowledge of antibiotics and knowledge of the structure of Fungi will help me to understand how drugs affect people's bodies and help me to be a successful Pharmacist."

2. "Fungi and my knowledge about fungi is useful to me in my future life because it effects many different aspects of life. First off, fungi can make people sick and be harmful to your home. Certain types of fungi can hurt your body by entering it and making you sick, but there are also other kinds that can cure sickness and make you feel better, such as penicillin. Also, fungi can get into your house and make you sick and harm your house as well. Now that I know this, I will always keep my home clean to avoid having any issues with fungi and the harmful side of them. Second, I am planning on becoming a biomedical engineer, and that has a lot to do with biology and therefor fungi. I need to gain knowledge on fungi because I will be learning more about it in the future. So I will be learning even more about fungi and how they work in the future because I will possibly be dealing with fungi in my future life and job. Also, learning about fungi was helpful because I learned about how mushrooms and different types of fungi can be healthy and nutritious for a person. In the future when I start to cook meals for my family or even just myself I can incorporate my knowledge of the health benefits on fungi into my cooking and my recipes. It is important for everyone to learn about fungi and all the positive and negative facts about it."

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