

WHAT'S GOOD FOR YOU IS GOOD FOR ME: TESTING THE EFFECTS OF OTHER-  
ORIENTED UTILITY-VALUE WRITING FOR INTERDEPENDENT STUDENTS

by

Cameron A. Hecht

A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

(Psychology)

At the

UNIVERSITY OF WISCONSIN-MADISON

2020

Date of final oral examination: 6/8/2020

This dissertation is approved by the following members of the Final Oral Committee:

Judith M. Harackiewicz, Professor, Psychology

Janet S. Hyde, Professor, Psychology

Yuri Miyamoto, Professor, Psychology

Markus Brauer, Professor, Psychology

Eric Grodsky, Professor, Sociology and Educational Policy Studies

**TABLE OF CONTENTS**

TABLE OF CONTENTS.....i

ACKNOWLEDGEMENTS.....ii

ABSTRACT.....iii

INTRODUCTION.....1

STUDY 1.....13

STUDY 2.....26

STUDY 3.....50

GENERAL DISCUSSION.....73

REFERENCES.....82

TABLES.....95

FIGURES.....117

APPENDICES.....122

## Acknowledgements

I would like to express my sincere and heartfelt appreciation for the support I have received in conducting this research and throughout my graduate training. I am grateful to my dissertation committee, Judith Harackiewicz, Janet Hyde, Yuri Miyamoto, Markus Brauer, and Eric Grodsky, for their thoughtful feedback. In particular, I thank my advisor, Judith Harackiewicz, who trained me to conduct social-psychological research in both the laboratory and the field, and who provided me the support I needed throughout my graduate career. I thank my lab mates, Elizabeth Canning, Yoi Tibbetts, Stacy Priniski, Michael Asher, Emily Rosenzweig, and Megan Bruun. I have learned a tremendous amount from their mentorship and continue to be inspired by their brilliance and work ethic. Their friendship has been indispensable, and when I think back on my time in graduate school, the amazing times we had together will always be first to mind. I am grateful to the impressive team of research assistants with whom I had the pleasure to work over the past six years. In particular, I thank Issac Kim, with whom I worked closely on Study 1. I am deeply grateful to my parents and my brother. Throughout my life, they led by example in demonstrating the tremendous accomplishments that are possible as a result of hard work, and they persistently encouraged me to follow that example (even when I didn't want to). Lastly, I thank my spouse for her many selfless acts of support, love, patience, and encouragement. My accomplishments over the last six years would truly not have been possible without her. This research was supported by the National Institutes of Health (Grant R01GM102703-05), as well as the Institute of Education Sciences, U.S. Department of Education, through Award #R305B150003 to the University of Wisconsin Madison. The opinions expressed are those of the author and do not represent the views of the National Institutes of Health or the United States Department of Education.

## Abstract

Utility-value interventions, which prompt students to reflect on the utility value (i.e., usefulness) of academic topics, have been found to increase perceptions of value and interest in the material. I tested the hypothesis that different ways of emphasizing utility value may work differently for individuals whose identities and goals are more “interdependent” (i.e., defined in relation to other people). “Other-oriented” utility-value writing (i.e., writing about value for others or in a letter to others) may be especially powerful for more interdependent individuals. I examined this possibility across three studies, attending to the roles of subject (i.e., other vs. self) and format (i.e., letter vs essay) in such effects, and examining interdependence both culturally (in terms of race/ethnicity and social class) and as an individual difference, regardless of culture. In Study 1, I analyzed data from a prior study in which introductory biology students ( $n = 579$ ) were randomly assigned to write different numbers of self-focused utility-value essays and other-focused letters. In Study 2, I conducted an experiment with online panelists ( $n = 587$ ), using a design that tested the separate effects of subject and format. In Study 3, I randomly assigned students in a diverse two-year college ( $n = 541$ ) to write different numbers of self-focused utility-value essays and other-focused letters, or to write only control essays. Across the three studies, I found evidence that other-oriented utility-value writing was associated with increased perceptions of value and interest for individuals who reported greater levels of interdependence, regardless of culture. Results of Study 2 suggest that these effects may have been driven by the letter format, rather than reflection on utility value for another person. Linguistic analyses of writing style and content suggest that the letter format may be powerful because it evokes more socially-oriented writing. I discuss the implications of these findings for theory and practice.

What's Good for You is Good for Me: Testing the Effects of Other-Oriented Utility-Value  
Writing for Interdependent Students

Picture yourself as an aspiring doctor reading a chapter about fungi in your biology textbook. You reach a passage about penicillin and it occurs to you that this topic could be useful in your pursuit of a medical career. Now picture a different scenario: you encounter the same passage about fungi. This time, the passage is not relevant to your career goals (you're planning to become an engineer), but you realize that it could be useful to your close friend's pursuit of a medical career. In which scenario will fungi seem more important to you? Many will answer, "Of course, the first one in which fungi were relevant to myself." This answer aligns with the everyday experience of many: we often care more about topics that relate to our own lives than those that relate to other peoples' lives. Indeed, many theories of motivation highlight the importance of personal relevance (Dewey, 1913; Diekmann et al., 2010; Eccles et al., 1983; Oyserman, 2009; Priniski et al., 2018; Renninger & Hidi, 2016) and its influence on academic attitudes and achievement is well documented (Harackiewicz et al., 2008; Hulleman et al., 2008; Wang, 2012). However, which scenario is more motivating may actually depend on the characteristics of the textbook reader. Individuals differ in how they think about themselves: for some, personal goals and successes are central, but for others, relationships and group memberships play a more important role (Markus & Kitayama, 1991). When people think about themselves more strongly in terms of their relationships (or have a more "interdependent self-construal"), they may be especially responsive to learning about the relevance of a topic for friends or family members.

Students constantly evaluate the importance of new academic topics, and what makes a topic resonate with a given student may depend on how they think about their identity. These

differences may be particularly important when designing interventions to help students become more involved in their studies. Social-psychological interventions, which attempt to alter the meanings of situations to change attitudes and behaviors, are successful when they are “wise” to the psychological processes underlying social problems such as lack of engagement in school or prejudice and stereotyping (Walton, 2014; Walton & Wilson, 2018). One effective intervention approach in academic settings is to emphasize the usefulness of academic topics in order to make the material more meaningful or relevant (Hulleman & Harackiewicz, 2009). What makes a topic meaningful to a person depends on that person’s sense of identity: for example, an individual whose identity is strongly based on relationships may be especially responsive to information about how the topic applies to important others in their life. An intervention that targets usefulness may therefore reach a broader population of students to the degree that it is wise to individual differences in self-construal.

### **Utility Value**

Students’ perceptions of usefulness are considered to be critical determinants of their motivation. The concept of usefulness plays a central role in Eccles’ expectancy-value theory of achievement motivation (Eccles et al., 1983; Wigfield & Eccles, 2000). Expectancy-value theory posits that achievement-related beliefs and behaviors are jointly determined by expectancies for success and subjective task value. One way to motivate students, therefore, is to increase their confidence or belief that they can succeed; indeed, a broad literature is devoted to understanding the role of competence-related perceptions and beliefs in promoting positive academic outcomes (Bandura, 1982; Pajares, 1996; Schunk, 1991). The other route by which to influence students’ motivation is to change the value they perceive in academic tasks. Eccles identified four types of subjective task value that affect academic motivation: intrinsic (enjoyment of a task), utility

(usefulness of a task for other goals), attainment (importance of a task to one's identity), and cost (negative aspects of a task, such as resource expenditure). Of these four types of subjective task value, utility value has been found to play an important role in promoting interest (Hulleman et al., 2010; Husman et al., 2004; Wigfield & Cambria, 2010), engagement (Durik et al., 2006; Husman & Lens, 1999), and academic performance (Bong, 2001b; Rosenzweig et al., 2019).

In addition to the vast body of correlational research highlighting the role of utility value, experimental evidence shows the power of interventions designed to enhance utility-value perceptions. An effective approach to emphasizing utility value in educational settings is prompting students to generate their own examples of the usefulness of an academic topic in writing exercises. Such writing has been found to increase perceived value, interest, performance, and positive behavioral intentions in laboratory experiments in which students learn about topics in mathematics (e.g., Canning & Harackiewicz, 2015; Hulleman et al., 2010) and biology (e.g., Hecht et al., 2020), particularly among students who lack confidence in the domain. This laboratory research provides evidence for the causal role of utility value in facilitating positive academic outcomes and indicates that utility-value writing exercises can be an effective intervention strategy.

Utility-value interventions have also produced positive effects in high-school and college science courses. A growing number of randomized controlled trials have found positive intervention effects on course grades, and these effects have been most pronounced for students with lower performance expectations or prior performance (Canning et al., 2018; Harackiewicz et al., 2016; Hulleman et al., 2017; Hulleman & Harackiewicz, 2009; Priniski et al., 2019) and for students from underrepresented populations (Harackiewicz et al., 2016). In addition to improving performance, utility-value interventions have been found to promote interest

(Hulleman et al., 2010, 2017; Hulleman & Harackiewicz, 2009), value perceptions (Gaspard et al., 2015; Hecht et al., 2020; Rosenzweig et al., 2019), and course taking and majoring in the sciences (Canning et al., 2018; Hecht et al., 2019).

The ability to test utility-value interventions in both laboratory and field experiments affords flexibility in understanding intervention effects. Laboratory experiments allow researchers to test nuanced questions about intervention design, mechanisms, and moderators of intervention effects by employing complex designs that are difficult or impossible to test in the field. On the other hand, field experiments allow researchers to test interventions in real-world settings to examine factors with important implications for theory and application, such as boundary conditions. By utilizing both laboratory and field experiments, researchers can engage in “full-cycle” social-psychological research in which results from the field and the lab are mutually informative (Harackiewicz & Barron, 2004; Hulleman & Barron, 2016; Mortensen & Cialdini, 2010). Utilizing both of these experimental settings paints a richer and more complex picture of how utility-value interventions operate.

### **Independent and Interdependent Self-Construal**

Utility-value interventions require students to connect new material to themselves, and a student’s conception of their “self” may therefore influence this experience. Over a century of theory and research has considered how individuals think about themselves (Baumeister, 1986; James, 1890; Markus & Wurf, 1987) and conceptions of the self may develop differently in different cultures (Triandis, 1989). Markus & Kitayama (1991) use the term “self-construal” to refer broadly to how individuals define the self. They identified two of many possible self-construals – “independent” and “interdependent” – that characterized differences between American and Japanese individuals. Individuals with an *independent* self-construal define the



self in terms of traits that are stable across situations and that make them different from others (e.g., funny, clever). For these individuals, self-esteem is largely contingent upon feelings of uniqueness. Individuals with an *interdependent* self-construal define the self in terms of important relationships or group memberships (e.g., son, Catholic). For those with an interdependent self-construal, self-esteem is contingent on being able to fit in with groups and maintain social harmony (Markus & Kitayama, 2010).

Though all individuals are theorized to have both an independent and interdependent self-construal, one's culture is believed to encourage stronger development of one self-construal (Markus & Kitayama, 1991; Singelis, 1994; Triandis, 1989). Strong development of an independent self-construal tends to be associated with individualist (often Western) cultures, whereas interdependent self-construal tends to be associated with collectivist (often non-Western) cultures. Researchers who study the cultural bases of self-construal often compare individuals from East Asian countries (e.g., Japan, South Korea) and Western countries (e.g., United States, Canada, United Kingdom; see Cross et al., 2011, for a review). Interdependent self-construal may also extend to other collectivist cultures (e.g., parts of Africa, Central/South America), but there is little research on self-construal in these regions. Because of the strong association between culture and self-construal, some researchers have used cultural background as a proxy for self-construal (e.g., Singelis & Sharkey, 1995; Yuki et al., 2005) whereas others have directly measured it (Hardin et al., 2004; Lee et al., 2000; Singelis, 1994) or manipulated it (e.g., Brewer & Gardner, 1996; Gardner et al., 1999).

Differences in self-construal are associated with differences in motivational processes. Positive self-regard is more connected to a sense of uniqueness for independent individuals and social relationships for interdependent individuals. For example, compared to individuals with a

more independent self-construal, interdependent individuals are more likely to amplify ratings of themselves when reporting on their collectivistic attributes (such as willingness to defend their group; Sedikides et al., 2003). Interdependent individuals are also more willing to acknowledge the skills and accomplishments of close others in identity-relevant domains than independent individuals (Gardner et al., 2002). Consequently, people with a more interdependent self-construal place higher levels of importance on social goals (e.g., supporting and maintaining contact with friends and family; van Horen et al., 2008) and are more likely to pursue goals for relational reasons (e.g., because the goal is important to a family member; Gore et al., 2009; Gore & Cross, 2006). To optimize the effects of motivation interventions for more interdependent individuals, it may be necessary to attend directly to these social goals and motives.

### **Interdependence among Subgroups within a Broader Cultural Context**

Although self-construal has largely been studied by comparing individuals from different parts of the world (e.g., Eastern vs. Western individuals), group differences can surface within a broader cultural context as well. Stephens, Markus, and colleagues (2014) suggest that within the United States, individuals from working-class backgrounds (e.g., with lower educational attainment or income) tend to be more interdependent than those from middle- or upper-class backgrounds. Because working-class conditions afford less access to financial resources, power, and status, adaptation to social context and hierarchy as well as mutual reliance for financial and material support are especially important for working-class individuals. The authors argue that in the broader context of a Western culture that prizes self-reliance and autonomy, this dependence on others and necessity of adjusting to contextual demands results in a type of interdependence in which both social responsiveness and personal resilience are valued. Stephens, Markus, and

colleagues (2014) refer to this as “hard interdependence” because of its relative emphasis on strength and toughness.

In particular, research has focused on how interdependence manifests among working-class individuals in higher education. In college settings, social class is often operationalized in terms of generational status: social class differences are examined by comparing first-generation (FG) college students (for whom neither parent has completed a four-year college degree) to continuing-generation (CG) students (for whom at least one parent has completed a four-year degree; e.g., Harackiewicz et al., 2016; Stephens, Fryberg, et al., 2012). Stephens, Fryberg, and colleagues (2012) surveyed students at a four-year university about their motives for completing their degree. They found that, on average, FG students reported more interdependent motives (e.g., helping out their family after college) than CG students. The mismatch between FG students’ relatively interdependent motives and the more independent values touted by American universities has been identified as one potential contributor to the social class achievement gap in these institutions (Stephens, Fryberg, et al., 2012; Stephens, Hamedani, et al., 2014; Stephens, Markus, et al., 2014; Stephens, Townsend, et al., 2012).

These findings add complexity to research on cultural differences in self-construal. First, this research reveals the presence of group-level differences in interdependence *within* a broad cultural context. The different material and social circumstances experienced by working- and middle-/upper-class individuals in the United States may result in subcultural differences, such as a “hard interdependence” among the socioeconomically disadvantaged (Stephens, Markus, et al., 2014). Second, by measuring interdependence in terms of students’ motives to complete a college degree, this research indicates that interdependence can manifest in the goals and values of individuals in particular contexts. Though it is common to measure self-construal as a cross-

situational individual difference (Gudykunst et al., 1996; Singelis, 1994), context-specific measures like Stephens, Fryberg, and colleagues' (2012) measure of college motives may provide additional insight into individuals' goals and experiences in particular settings. In exploring approaches to promote motivation among interdependent students, research should attend to working-class individuals as a key subgroup within the United States, and should evaluate whether intervention effects depend on individuals' cross-situational self-construals in addition to their interdependent motives within educational settings.

### **Other-Oriented Utility-Value Writing**

There may be at least two ways to evoke reflection on utility value that attends directly to the social goals, motives, and identities of individuals who are more interdependent. First, writing exercises can prompt individuals to generate examples of utility value for a specific other person (i.e., to have another person as the *subject* of the utility-value writing). Second, writing exercises can prompt individuals to write about utility-value in a letter to another person (i.e., in the *format* of a letter). Henceforth, I refer to utility-value writing that (a) has another person as the subject of the utility-value writing, and/or (b) is written in the format of a letter as “other-oriented utility-value writing,” because both types of writing involve reflecting on the value of a topic in relation to another person.

Interdependent individuals may benefit from other-oriented utility-value writing for at least two reasons. First, as discussed above, interdependent individuals are more likely to possess social goals and motives (Gore et al., 2009; Gore & Cross, 2006; van Horen et al., 2008). Many theoretical perspectives including expectancy-value theory (Eccles, 2009), identity-based motivation (Oyserman, 2009), and role congruity theory (Diekmann et al., 2011) share the assumption that tasks are more motivating when they connect with one's goals. Reflecting on the

usefulness of academic material for close others, or describing the usefulness of the material in a letter to another person, may connect with interdependent individuals' social goals, such as maintaining and strengthening relationships. Such writing may therefore be more motivating for these individuals than reflecting on personal usefulness.

Second, close others constitute an important part of the interdependent individual's identity (Markus & Kitayama, 1991). Utility-value connections can become especially meaningful and motivating as they become more relevant to an individual's sense of identity (e.g., "learning about covalent bonds is relevant to me because understanding this topic is important to my identity as a future chemist"; Eccles, 2009; Priniski et al., 2018; Ryan & Deci, 2002). For an interdependent student, connecting an academic topic to close others may help them see how the material connects to the relational aspect of their identity and thereby increase the personal meaningfulness of the material.

There is an existing variation of the utility-value intervention that directly prompts other-oriented utility-value writing: *other-letters* in which students write letters to friends or family members about the usefulness of a topic for the recipient. The other commonly-tested type of utility-value intervention is the *self-essay* in which students write an essay about the personal usefulness of a topic. Researchers have not yet tested whether other-letters may be a more effective intervention approach than self-essays for more interdependent individuals. Comparing these existing variations of the utility-value intervention is an important first step to address the question of whether other-oriented reflection on the usefulness of a topic can be motivating for interdependent students. Comparing these existing variations, however, is limited in that the variations confound subject (i.e., other vs. self) and format (i.e., letter vs. essay). Additional research is necessary to determine the relative impacts of subject and format in evoking strong

other-oriented utility-value writing. Assessing the effects of other-oriented utility-value writing and disentangling the roles of subject and format would provide insight into the psychological processes that motivate interdependent individuals in learning situations and inform the development of more targeted intervention strategies to promote positive academic outcomes.

### **The Current Studies**

The literature reviewed so far suggests that writing about the utility value of an academic topic in a way that connects to close others may promote positive outcomes for more interdependent students, but this possibility requires empirical examination. It is possible that other-oriented utility-value writing prompts confer no additional benefit beyond self-oriented prompts. For example, students who are asked to write self-essays are not prohibited from writing about utility value for others and may do so spontaneously. Whether explicitly prompting other-oriented utility-value writing has additional benefit for interdependent students is therefore an important empirical question.

Under the umbrella of this overarching question, more specific questions about implementation and moderation require investigation as well. Regarding implementation, researchers have not examined how utility-value subject (i.e., other vs. self) and format (i.e., letter vs. essay) contribute to the quality and effectiveness of other-oriented utility-value writing. Regarding moderation, research is needed to identify which groups may be most responsive to other-oriented utility-value writing. Theory suggests that culturally-interdependent groups, such as East and Southeast Asians (Markus & Kitayama, 2010), South or Central Americans (Cross et al., 2011), and/or individuals from working-class backgrounds (Stephens, Markus, et al., 2014) may especially benefit. In addition, research is needed to inform which individual-level measures of interdependence may best capture this responsiveness: cross-situational measures of self-

construal (e.g., Singelis, 1994), or situation-specific indicators of interdependent motives in the relevant educational setting (e.g., Stephens, Fryberg, et al., 2012). Addressing these questions will improve our understanding of how differences in interdependence affect motivation and engagement with academic material. In addition, such research can help researchers and practitioners to promote motivation for interdependent students more effectively by helping them to find greater meaning in course material.

In the present research, I conducted three studies to investigate the following overarching research question (RQ):

(RQ1) Does other-oriented utility-value writing increase perceptions of value and interest for individuals who are more (vs. less) interdependent?

In my investigation of this question, I also attended to the implementation and moderation questions identified above:

(RQ2) How do utility-value subject (i.e., other vs. self) and writing format (i.e., letter vs. essay) contribute to the effects of other-oriented utility-value writing for more interdependent individuals?

(RQ3) Which interdependent individuals benefit most from other-oriented utility-value writing?

(RQ3a) Which cultural background characteristics predict responsiveness to such an intervention (e.g., race/ethnicity, social class)?

(RQ3b) Which individual differences predict responsiveness to such writing, regardless of culture (e.g., self-construal, interdependent college motives)?

In Study 1, I conducted pilot analyses using existing data as a first step to address RQ1 and RQ3. I tested the effects of other-letters in an intervention study conducted in an

introductory biology course at a four-year university (Harackiewicz et al., 2016). Specifically, I tested whether letter-writing effects in this context varied depending on interdependence, operationalized at both the cultural (demographic) and individual (self-report) level. However, there were important limitations in this pilot study. First, and most importantly, students in this study had different numbers of opportunities to write letters, and the number of opportunities was confounded with the semester in which they took the course. As such, this study only afforded a correlational investigation of the effects of letter writing for more interdependent students (RQ1). Second, writing about utility value for others was confounded with format in this field study (i.e., students wrote either self-essays or other-letters). Therefore, this study could not be used to compare the roles of subject and format in other-oriented utility-value writing (RQ2). Third, only interdependent college motives (Stephens, Fryberg, et al., 2012) were collected as an individual-level measure of interdependence in this study, so it was not possible to compare the moderating effects of college motives and self-construal (RQ3b). In sum, Study 1 provided a preliminary test of some (but not all) of the research questions, and it could not provide a rigorous test of the questions that it did address.

In Study 2, I conducted an online experiment to replicate the results of Study 1, using a design that allowed me to draw causal inferences about the effects of utility-value writing (RQ1). In addition, in this study, I manipulated the subject of utility-value writing (other vs. self) and format (letter vs. essay) in a factorial design. Therefore, I was able to parse the relative effects of subject and format (RQ2). However, this study had an important limitation: the study was conducted among a broad sample of adults (rather than college students). Therefore, I could only measure participants' self-construals, but not their motives for completing a college degree. As such, like Study 1, it was impossible to compare college motives and self-construal as



moderators of treatment effects (RQ3b).

In Study 3, I conducted a field experiment in an introductory biology course at a two-year college, comparing the effects of other-letters and self-essays against a control group. Like Study 1 (and unlike Study 2), letter writing was the only means of other-oriented writing in this study because this format of writing about utility value for others had already been established in field settings. Moreover, it is a natural way to promote writing about value for close others, which is an important consideration outside of the laboratory. Like Study 2 (and unlike Study 1), this study was an experiment and therefore afforded causal inference, providing a more rigorous test of other-oriented utility-value writing in the field (RQ1). In addition, this two-year college had a high proportion of Asian, Latinx, and FG students, enabling me to compare intervention effects for students from several distinct interdependent cultures (RQ3a). Finally, in this study I was able to measure both self-construal and motives for completing a college degree and compare these measures as moderators of treatment effects (RQ3b).

### **Study 1**

This pilot study was an initial examination of the hypothesis that writing letters about utility value for others can increase perceptions of value and interest for more interdependent students (RQ1). Prior research indicates that writing about utility value can increase these outcomes (Canning & Harackiewicz, 2015; Hecht et al., 2020; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009), but researchers have not yet investigated whether other-oriented variations of utility-value writing are particularly effective for more interdependent students. I also tested for effects on course grades to evaluate whether effects on value and interest were also reflected in students' performance.

I indexed students' relative quantity of other-letter writing from a prior study in which the

number of opportunities to write a letter varied across semesters and evaluated whether letter-writing effects varied as a function of interdependence. Specifically, I tested whether effects of letter-writing were moderated by students' demographic characteristics (i.e., race/ethnicity, generational status, and gender) and/or their interdependent motives for completing a college degree (RQ3). Self-construal was not measured in this study and therefore could not be tested as a moderator.

## **Method**

### **Participants**

A utility-value intervention was implemented in a randomized-controlled trial in the first course of a two-course introductory biology sequence for biomedical majors at a flagship state university (Harackiewicz et al., 2016). The intervention was implemented in eight lecture sections over four semesters, and a total of 2,378 students were enrolled in the course over this period of time (8% underrepresented minority [URM; i.e., Black, Hispanic/Latinx, or Native American] and 21% first-generation [FG] college students). All consenting URM and FG students were included in the sample, along with a randomly selected subset of continuing-generation (CG) majority students (82% White, 18% Asian). Among 1,060 eligible students, 15 students dropped the course and six students did not consent, resulting in a final sample of 1,039 students. Of these 1,039 students, 579 were assigned to the utility-value intervention condition and 460 were assigned to the control condition.

The present study is comprised of the 579 students who were assigned to the utility-value condition. By restricting the sample to this subset, it is possible to test the effects of writing other-letters compared to self-essays. The sample consisted of 337 women (58%) and 242 men (42%). Of the 579 students, 379 were European American (65%), 70 were Asian American

(12%), 57 were Hispanic/Latinx (10%), 43 were Black (7%), 21 were Asian International students (4%), and 9 were Native American (1.6%). There were 274 FG students (47%) and 305 CG students (53%). The average age of the sample was 19.43 ( $SD = 1.94$ ).

## **Procedure**

Students completed a baseline questionnaire in the second week of the semester. On the questionnaire, students were asked to report their demographic information and motives for attending college. This questionnaire was voluntary and not a graded component of the course.

Next, students were blocked on gender, race, and generational status and then randomly assigned to a utility-value condition or a control condition within lecture sections. Students completed three writing assignments (500-600 words) for credit over the course of the semester, and the content of these assignments was determined by experimental condition.

Students completed a final questionnaire in the last two weeks of the semester. On the questionnaire, students reported their perceived value and interest in biology. At the end of the semester, grades in the course were obtained from instructors.

## **Writing Assignments**

For each of the three writing assignments, students were asked to select a concept that was covered in class and write a 1-2 page essay. In the control condition, students were simply asked to summarize the chosen concept, whereas in the utility-value condition, students were also asked to write about the usefulness or relevance of the concept.

Variations of utility-value writing assignments were tested in different experimental designs across the four semesters. The *utility-value essay* prompted students to connect course material to their own lives:

Write an essay addressing this question and discuss the relevance of the concept or issue to your own life. Be sure to include some concrete information that was covered in this unit, explaining *why* this

specific information is relevant to your life or useful for you. Be sure to explain *how* the information applies to you personally and give examples.

The *utility-value letter* prompted students to connect course material to a letter recipient:

Write a letter to a family member or close friend, addressing this question, and discuss the relevance of this specific concept or issue to this other person. Be sure to include some concrete information that was covered in this unit, explaining *why* the information is relevant to this person's life or useful for this person. Be sure to explain *how* the information applies to this person and give examples.

Students in the utility-value condition were assigned to complete different combinations of assignments, and some students were given choices between utility-value letters and essays for some of their assignments. These different assignment-type structures varied by semester (see Table 1 for all experimental designs). Consequently, the number of opportunities participants had to write a letter (i.e., were assigned to write a letter or given a choice of assignments) varied by semester.

## Measures

**Demographics.** Students reported their race/ethnicity, gender, and parental education on the baseline questionnaire. Students were classified as Asian if they were East or Southeast Asian, and were further grouped into Asian American (i.e., not an international student) or Asian International (i.e., international student). First-generation status was computed based on parental education: students for whom neither parent completed a four-year college degree were categorized as FG, and all other students were categorized as CG.

**Motives for completing a college degree.** Students were asked to indicate which of 12 items accurately described their reasons for completing a college degree. Five of these reasons were coded as interdependent (“Help my family out after I’m done with college;” “Give back to my community;” “Provide a better life for my own children;” “Show that people with my

background can do well;” and “Be a role model for people in my community”), and five were coded as independent (“Explore new interests,” “Expand my understanding of the world,” “Expand my knowledge of the world,” “Become an independent thinker,” “Learn more about my interests”). The interdependent and independent motives measures were operationalized as the number of interdependent and independent reasons selected, respectively.

**Final questionnaire measures.** Perceived value and interest in biology were both measured on the final questionnaire. The perceived value scale contained four items (“This course is important to my future,” “I think what we are learning in Introductory Biology is important,” “The study of biology is personally important to me,” “The field of biology is a good fit for me”;  $\alpha = .84$ ) and the interest scale contained five items (“I’m really looking forward to learning more about biology,” “To be honest, I just don’t find biology interesting” (reversed), “Biology fascinates me,” “I think the field of biology is very interesting,” “I’m excited about biology;  $\alpha = .94$ ). All items were measured on a 7-point *Strongly Disagree – Strongly Agree* Likert scale.

**Course grade.** Course instructors provided final course grades at the end of each semester (A = 4.0, AB = 3.5, B = 3.0, BC = 2.5, C = 2.0, D = 1.0, F = 0).

## Results

Zero-order correlations, descriptive statistics, and scale reliabilities are presented in Table 2. I obtained intraclass correlations (ICCs) for each of the three outcomes (perceived value, interest, and course grade) to evaluate whether multilevel modeling was necessary (Raudenbush & Bryk, 2002). The ICCs indicated that lecture section accounted for less than 1.2% of the variance in each measure. Therefore, I conducted all analyses using OLS multiple regression. Missing data (<1% for each measure) were handled with multiple imputation (Rubin, 1987).

Unstandardized regression coefficients (*bs*), standard errors, and *p*-values are reported from all regression models.

### **Analysis Plan**

I began by testing for baseline differences in interdependent and independent college motives by race/ethnicity, generational status, and gender. I was principally concerned with testing differences between European Americans and the two Asian groups as well as Hispanic/Latinx students, and between FG and CG students, as existing theory and research suggest that differences on any of these demographic factors might influence endorsement of interdependent motives (Cross et al., 2000; Markus & Kitayama, 2010; Stephens, Fryberg, et al., 2012). Next, before testing the influence of letter writing, I assessed intervention fidelity by examining completion rates across the three assignments. After checking fidelity, I examined whether letter writing was differentially effective depending on these demographic factors. I then examined whether letter writing was differentially effective depending on students' interdependent college motives, controlling for demographic differences.<sup>1</sup> Finally, I explored whether interdependent college motives explained increased sensitivity to letter writing among any given demographic group.

### **Demographic Effects on College Motives**

I regressed interdependent and independent college motives on three demographic factors (race/ethnicity, generational status, and gender). I tested the effects of race/ethnicity by comparing each group (i.e., Asian American, Hispanic/Latinx, Black, Asian International, Native American) to European American students (the largest group in the sample) using four dummy-coded contrasts. Generational status and gender were contrast coded (FG, +.5, CG, -.5; women,

---

<sup>1</sup> I also tested all letter writing x college motives interactions in a model that did not control for demographic differences. All letter-writing effects are consistent between these two models.

+ .5, men, -.5). The model thus included seven terms. Results are presented in Table 3.

Compared to European American students ( $M = 2.95$ ,  $SD = 1.47$ ), interdependent motives were significantly higher among Asian American students ( $M = 3.54$ ,  $SD = 1.48$ ;  $b = 0.56$ ,  $p = .003$ ), Hispanic/Latinx students ( $M = 3.60$ ,  $SD = 1.57$ ;  $b = 0.75$ ,  $p < .001$ ), and Black students ( $M = 4.07$ ,  $SD = 1.28$ ;  $b = 1.23$ ,  $p < .001$ ). Interestingly, interdependent motives were not higher among Asian International students ( $M = 2.43$ ,  $SD = 1.60$ ;  $b = -0.42$ ,  $p = .198$ ) compared to European American students. Finally, interdependent motives were higher among FG students ( $M = 3.41$ ,  $SD = 1.51$ ) than CG students ( $M = 2.89$ ,  $SD = 1.49$ ;  $b = 0.57$ ,  $p < .001$ ). There were no statistically significant demographic differences in independent college motives.

### **Intervention Fidelity**

I assessed intervention fidelity by examining completion of the three writing assignments. Completion was very high in this sample: of the 579 students, 554 (96%) completed all three of the assignments, 19 (3%) completed two assignments, 5 (1%) completed one assignment, and 1 (< 1%) did not complete any of the assignments. Given that fidelity was high, it was not necessary to conduct any secondary analyses of letter-writing effects to account for deviation from intended treatment.

### **Effects of Letter Writing and Demographic Factors on Outcomes**

Participants had different numbers of opportunities to write a letter in each of the different semesters (i.e., choices or assigned letters). Thus, a simple count of letters would be an inappropriate index of letter writing because its range would be confounded with semester, given that assignment structures differed across semesters (see Table 1). Therefore, to test the effects of letter writing, I created a proportion measure by dividing the number of letters a given student wrote by the number of opportunities he or she had to write a letter. I subjected the raw

proportion measure to an arcsine transformation in accordance with recommended practice for proportion scores (Studebaker, 1985; Winer, 1962).

Because there were only 9 Native American students in the sample, I did not have adequate power to test letter-writing effects for these students and therefore excluded them from the sample.<sup>2</sup> To test whether demographic differences moderated the effects of letter writing, I regressed perceived value, interest, and course grade on the remaining six demographic terms, the letter-writing index (standardized), and the six two-way letter writing x demographic interactions. Results are presented in Table 4.<sup>3</sup>

**Perceived value.** There was a significant letter writing x Asian American interaction ( $b = 0.34, p = .020$ ) indicating that writing a higher proportion of letters had a more positive effect on perceived value for Asian American students than for European American students (Figure 1a). There were no other significant effects in this model.

**Interest.** Similar to perceived value, there was a significant letter writing x Asian American interaction ( $b = 0.32, p = .045$ ). This interaction indicated that writing a higher proportion of letters had a more positive effect on interest for Asian American students than for European American students (see Figure 1b). There was also a significant main effect of gender ( $\beta = -0.22, p = .040$ ), indicating that, on average, men reported higher levels of interest ( $M = 5.56, SD = 1.17$ ) than women ( $M = 5.35, SD = 1.29$ ). There were no other significant effects in this model.

---

<sup>2</sup> All reported effects are consistent regardless of whether Native American students are included in the sample.

<sup>3</sup> In semester 4, students only had one opportunity to write a letter, and this opportunity was an assigned letter (rather than a choice). As such, all students in this semester had a score of 1.0 on the letters proportion measure (except for one student who did not complete the letter assignment). To account for this confounding, I also conducted the letter-writing analyses excluding semester 4, leaving three semesters in which all participants were exposed to both letters and essays and had at least one choice ( $n = 466$ ). All reported patterns of effects remain the same in these three semesters, but they are weaker and not statistically significant ( $.072 > p > .204$  for each letter-writing interaction effect). It is possible that reduced power in this subsample is responsible for the weaker effects.



**Course grade.** Contrary to hypotheses, there was no significant effect of letter writing on course grade ( $b = .01, p = .756$ ), nor any significant letter writing x demographic interactions ( $ps > .342$ ). However, there were two racial achievement gaps: Black students ( $M = 2.44, SD = 0.89$ ) received lower course grades than European American students ( $M = 2.89, SD = 0.74; b = -0.47, p < .001$ ), as did Hispanic/Latinx students ( $M = 2.58, SD = 0.84; b = -0.35, p = .002$ ). There was also a generational-status achievement gap: FG students ( $M = 2.70, SD = 0.79$ ) received lower grades than CG students ( $M = 2.90, SD = 0.80; b = -0.24, p < .001$ ). There were no other significant effects in this model.

### **Effects of Letter Writing, Demographics, and College Motives on Outcomes**

To test whether interdependent motives moderated the effects of letter writing (controlling for demographic differences and interactions with letter writing) I added interdependent motives (standardized) and the two-way letter writing x interdependent motives interaction to the model. In addition, to control for the possibility that the interdependent motives measure captured general motivation to complete a college degree (rather than *interdependent* motives, specifically), I also added independent motives (standardized) and the two-way letter writing x independent motives interaction to the model. Results are presented in Table 5.

**Perceived value.** There was an interaction between the letter-writing index and interdependent motives ( $b = 0.10, p = .050$ ) indicating that letter writing had a more positive effect on perceptions of value for students who reported more interdependent motives (see Figure 2a). In addition, the letter writing x Asian American interaction became non-significant in this model ( $b = 0.27, p = .057$ ), suggesting that interdependent motives may partially explain the positive effect of letter writing for Asian American students. Finally, on average, students with higher levels of interdependent motives reported higher levels of perceived value ( $b = 0.21, p <$

.001).

**Interest.** Consistent with perceived value, there was an interaction between the letter-writing index and interdependent motives on interest, though this effect was not statistically significant ( $b = 0.11, p = .054$ ). This pattern suggests that letter writing may have had a more positive effect on interest for students who reported more interdependent motives (see Figure 2b). As with perceived value, the letter writing x Asian American interaction became non-significant in this model ( $b = 0.25, p = .110$ ). Finally, on average, students with higher levels of interdependent college motives reported higher levels of interest ( $b = 0.20, p < .001$ ).

**Course grade.** As with the previous course-grade model, there was no significant effect of letter writing ( $b = 0.02, p = .636$ ) nor were there any letter writing x demographic or letter writing x college motives interactions ( $ps > .144$ ), but there were three achievement gaps: Black students ( $b = -0.44, p = .001$ ) and Hispanic/Latinx students ( $b = -0.32, p = .005$ ) received lower course grades than European American students, and FG students received lower grades than CG students ( $b = -0.23, p = .001$ ).

### **Moderated Mediation of Letter-Writing Effects for Asian American Students**

Compared to European American students, Asian American students reported higher levels of perceived value and interest when they wrote a higher proportion of letters. Moreover, Asian American students reported more interdependent motives for completing their college degree than European American students, and students with more interdependent motives reported more perceived value and marginally more interest when they wrote a higher proportion of letters. Therefore, I tested interdependent motives as a mediator of the positive letter-writing effects for Asian American students (see Figure 3 for a conceptual diagram).

I specified path models regressing interdependent motives on each of the demographic

terms (four race/ethnicity dummy codes, generational status, and gender), and regressing each outcome (perceived value, interest) on letter writing, each of the demographic terms, each letter writing x demographic interaction, each of the two college motives measures, and each of the two letter writing x college motives interactions. I tested mediation by computing indices of moderated mediation, as well as conditional indirect effects at high (+.98 SD, a proportion of 1.0) and low (-1 SD, a proportion of .24) levels of letter writing (Hayes, 2012). I used bootstrapping to compute 95% confidence intervals for each of these indirect effects.

There was a significant index of moderated mediation for the perceived value model, 95% CI [.003, .101]. In addition, there was a significant conditional indirect effect among students who wrote a high proportion of letters, 95% CI [.035, .235], but not among students who wrote a low proportion of letters, 95% CI [-.003, .113]. The same pattern of effects emerged for interest: there was a significant index of moderated mediation, 95% CI [.004, .108], and a significant conditional indirect effect among students who wrote a high proportion of letters, 95% CI [.035, .239] but not among those who wrote a low proportion of letters 95% CI [-.015, .114]. These findings are consistent with the possibility that Asian American students' higher levels of interdependent motives were partially responsible for their increased sensitivity to utility-value letter writing.

## **Discussion**

The results of this pilot study provide preliminary evidence that other-oriented utility-value writing may particularly facilitate perceptions of value and interest among students who are more interdependent (RQ1). Compared to European American students, Asian Americans reported higher levels of value and interest as a function of letter writing. Similarly, students with more interdependent motives for completing a college degree reported higher levels of

value and interest as a function of letter writing, and mediation analyses suggest that effects for Asian Americans may have been partially driven by their higher levels of interdependent motives. These findings suggest that the effects of other-oriented utility-value writing may be moderated by both cultural and individual-level indicators of interdependence (RQ3).

Interestingly, there were no effects of letter writing on course grade. It is possible that reflecting on utility value for others helps interdependent students to see value and become more interested in the material, but these positive attitudinal changes do not translate into improved performance.

It is notable that whereas letter writing was more associated with interest and value perceptions for Asian American students, this was not the case for Asian International students. Whereas Asian Americans reported higher levels of interdependent motives than European Americans, Asian International students did not: in fact, descriptively, Asian International students reported the lowest levels of interdependent motives in the sample, on average. One possibility is that Asian International college students represent a biased subpopulation: having left their home country to pursue an education in another country, these students may be less interdependently motivated. Of course, low interdependence among these students must be interpreted with caution: there were only 21 Asian International students in the sample, and as such, estimates for this group lack precision.

Similarly, Hispanic/Latinx students did not report greater value or interest as a function of letter writing compared to European American students, nor did FG students in comparison to CG students. Consistent with theory and research (Cross et al., 2011; Stephens, Fryberg, et al., 2012; Stephens, Markus, et al., 2014), these students *did* report higher levels of interdependent motives for completing a college degree. However, unlike Asian American students, this increased interdependence did not seem to translate into greater sensitivity to utility-value letter

writing. It is possible that, although each of these three groups reported greater levels of interdependent motives, their specific interdependent goals and values differed in important ways that made utility-value letter writing effective for Asian American students, but not for either of these other groups (RQ3a). Additional research is needed to evaluate whether these demographic differences are consistent in other settings and samples.

Although these preliminary findings are promising, this study has several limitations that necessitate further research. First, and most importantly, students in this study were not randomly assigned to write utility-value letters versus essays in a way that allows for causal inference. The number of opportunities to write a letter varied by semester, and letter writing was therefore operationalized as a proportional measure instead of as an experimental manipulation. Studies that manipulate other-oriented utility-value writing are necessary. In addition, some opportunities to write a letter were choices between a letter and an essay. Follow-up analyses that test for cultural differences in choices would be informative. Notably, there was almost no variance in the proportion measure in one of the semesters (due to the experimental design in that semester), and effects were weaker – though in the same direction – when that semester was excluded from analyses. These results should therefore be interpreted with caution and they require corroborating evidence from additional research.

Second, this study operationalized interdependence in terms of students' motives for obtaining a college degree. However, other-oriented utility-value writing may be effective for students who construe themselves more interdependently across situations in addition to those who are more interdependent within an educational context (RQ3b). Studies that measure interdependent self-construal (and ideally, *both* self-construal and college motives) are necessary to explore this possibility. Third, students in this study completed self- essays or other-letters.

Therefore, the subject of utility-value writing (self vs. other) was confounded with format (essay vs. letter). However, either subject or format may influence the effectiveness of utility-value writing for more interdependent students, and a combination of the two factors (i.e., other-letters) may be more effective than either element alone (RQ2). An experiment that manipulates each of these two factors is necessary to test the independent and combined effects of these characteristics.

## **Study 2**

I conducted an online study to extend the pilot research in Study 1. First, as noted above, a major limitation of Study 1 is that it was non-experimental, prohibiting causal inference about utility-value writing effects. In the present study, participants were randomly assigned to complete different types of utility-value writing, providing a causal examination of RQ1 (regarding the effects of other-oriented writing for more interdependent individuals). Second, this study was designed to empirically distinguish the effects of utility-value subject (i.e., other vs. self) from writing format (i.e., letter vs. essay) and therefore provided a test of RQ2. Third, this study included a measure of self-construal, allowing me to examine interdependent self-construal as a possible moderator of effects. By including this measure, I was able to further investigate RQ3 regarding potential moderators of treatment effects.

## **Method**

This study was preregistered at [aspredicted.org](https://aspredicted.org/#34811) (#34811). The preregistration is presented in Appendix A, as well as a description of any deviations from the preregistered procedure and analysis plan.

### **Participants**

Paid survey panelists were recruited for this study via Cloud Research ( $n = 587$ ).

Panelists were recruited if they were 18-35 years of age, and only Asian American and European American participants were recruited for this study to maximize statistical power to compare these two groups. The sample consisted of 364 women (62%), 213 men (36%), and 10 participants who did not identify as women or men (2%). There were 355 European American participants (60%) and 323 Asian American participants (40%). Of the 587 participants, 264 (45%) did not have at least one parent who completed a four-year college degree. The average age of the sample was 26.91 ( $SD = 5.20$ ). Participants completed the study online individually from a computer and were compensated by the survey panel company.

### **Procedure**

Participants were randomly assigned to one of five conditions in a 2 (subject: other vs. self) x 2 (format: letter vs. essay) design with an appended control cell. After providing consent, participants were told that they would be learning about the biology of fungi. Next, they filled out a baseline questionnaire in which they completed the self-construal scale (Singelis, 1994), and reported their interest in biology. Participants were then asked to read a page of scientific text about the biology of fungi (see Appendix B). This text contained basic information about fungi, such as how they absorb nutrients and the difference between parasitism, saprophytism, and symbiosis. In addition, the text contained some information about uses of fungi in everyday life, such as in medicine, gardening and food. Participants were required to remain on the page of text for at least 3 minutes but were allowed to continue reading for as long as they wanted ( $Mdn = 3.57$  minutes).

After reading, participants engaged in a writing task, the content of which varied by experimental condition. After the writing task, participants completed a questionnaire that assessed their perceived value and interest in the material, as well as their behavioral intentions

(i.e., motivation to learn about similar topics or use what they had learned in the future). Similar measures of behavioral intentions have been used in previous research to assess deeper and more maintained levels of interest (Durik et al., 2015; Hecht et al., 2020; Hulleman et al., 2010).

Finally, participants took a 10-item multiple-choice test on the material.

### **Writing Prompts**

During the writing task, participants wrote about what they had learned about the biology of fungi. In the control condition, participants were prompted to write an essay summarizing the material. In each of the four utility-value conditions, participants were also prompted to summarize the material, but also to write about how fungi (or knowledge of fungi) could be useful. In the self-essay condition, participants were asked to write an essay explaining how fungi might be useful for themselves. In the self-letter condition, participants were asked to select a friend or family member to whom they could write a letter about the material, and to write that person a letter about how the material might be useful in the participant's own life. In the other-essay condition, participants were asked to select a friend or family member for whom fungi might be useful and write an essay about how fungi might be useful to that person. In the other-letter condition, participants were prompted to write a letter to a selected friend or family member about how fungi might be useful to that person. See Appendix C for all Study 2 writing prompts. These four utility-value conditions were necessary to test the separate and combined effects of writing format and utility-value subject, but this factorial design resulted in two conditions in which format and subject were inconsistent and may have been unusual to write about. In particular, it may feel unnatural for individuals to write an essay about value for a specific other person (other-essay), or a letter to another person about value for the self (self-letter). In testing treatment effects, I attend to the possibility that these "inconsistent" utility-



value conditions may differ from the “consistent” conditions, and test for such differences.

## Measures

**Demographics.** Participants reported their race/ethnicity, gender, and parental education on the baseline questionnaire. Participants were classified as Asian if they reported being East Asian ( $n = 136$ ) or Southeast Asian ( $n = 71$ ). As with generational status, parental education was computed based on completion of a four-year college degree. Participants for whom neither parent had completed a four-year college degree (“no college”) were compared to participants for whom at least one parent had completed a four-year college degree (“college”).

**Baseline psychological measures.** Self-construal was measured with the 30-item Self-Construal Scale (Singelis, 1994). Participants responded to 15 items measuring interdependent self-construal (e.g., “I often have the feeling that my relationships with others are more important than my own accomplishments”;  $\alpha = .85$ ) and 15 items measuring independent self-construal (e.g., “I enjoy being unique and different from others in many respects”;  $\alpha = .84$ ). These items were measured on a 7-point Likert-type *Strongly Disagree – Strongly Agree* scale. Interest in biology was measured with two items (“How interesting is biology to you?,” “How much do you enjoy learning about biology?”;  $\alpha = .93$ ) on a 7-point Likert-type scale (ranging from *Not \_\_\_\_\_ at All* to *Very \_\_\_\_\_*, with anchors customized to each item; e.g., *Not Interesting at All – Very Interesting*).

**Outcome questionnaire measures.** Perceived value was measured with a six-item scale (“How useful do you think knowledge about fungi could be to you in your future?,” “How valuable do you think knowledge about fungi is for everyone?,” “How likely is it that you could use knowledge about fungi to help someone you know?,” “To what degree can you imagine using what you have learned about fungi in your own life?,” “How useful do you think

understanding fungi could be to you in your daily life?,” “How important is knowing about fungi to you?”;  $\alpha = .94$ ). Task interest was measured with a four-item scale (“How fascinating are fungi?,” “How interesting do you find fungi?,” “How much fun is learning about fungi?,” “How much did you enjoy learning about fungi?”;  $\alpha = .94$ ). Both perceived value and interest were measured on a 7-point Likert-type scale with customized anchors. Behavioral intentions were measured on a three-item seven-point *Definitely Not – Definitely Yes* Likert-type 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 completing another study in which you would learn about a different type of organism?”;  $\alpha = .84$ ).

**Performance.** Performance was measured by summing the number of questions participants answered correctly on the 10-item multiple choice test.

**Coding of writing assignments.** In order to evaluate intervention fidelity (i.e., whether participants adhered to the writing assignment instructions; Hulleman & Cordray, 2009), trained research assistants coded the format (i.e., letter vs. essay) of participants’ writing. In addition, to evaluate whether and how participants wrote about utility value, research assistants coded for whether participants connected the material to (a) the self, (b) a specific other person, and/or (c) people in general (each of these three dimensions was coded separately). The “people in general” category was included because such connections – which were neither to the self nor another person – were common (e.g., “fungi are good for gardening because they make the soil healthier”). Each of these four categories was coded by two research assistants (agreement ranged from 83-97% across dimensions), and disagreements were resolved by a third research assistant.

**Linguistic variables.** To examine whether the different experimental writing prompts evoked different types of writing, I assessed several linguistic variables using Linguistic Inquiry and Word Count (LIWC) software (Pennebaker et al., 2015). I examined variables that would reflect the content of participants' writing (e.g., the degree to which they wrote about social themes), as well as their writing style (e.g., the emotional tone of their writing).

## Results

Zero-order correlations, descriptive statistics, and scale reliabilities for all major variables are presented in Table 6. All analyses were conducted using OLS multiple regression. In these analyses, gender was treated as a binary variable, and for the 10 participants who did not identify as women or men, gender was coded as missing and these missing values were handled using multiple imputation (Rubin, 1987). There were no other missing data in this study.

Unstandardized regression coefficients (*bs*), standard errors, and *p*-values are reported from all regression models.

### Analysis Plan

Consistent with the analytic approach in Study 1, I first tested for baseline differences in interdependence and independence by race/ethnicity, gender, and parental education. Then, prior to testing treatment effects, I evaluated intervention fidelity by assessing the degree to which participants completed their writing assignment in the assigned format (i.e., letter vs. essay).

Next, I tested the effects of experimental condition. As in Study 1, I first assessed whether treatment effects differed as a function of participants' demographic characteristics. I then evaluated whether treatment effects differed as a function of participants' interdependent (and independent) self-construals, controlling for demographic differences.<sup>4</sup>

---

<sup>4</sup> All treatment x self-construal interactions were also tested in a model that did not control for demographic differences. All treatment effects are consistent between these two models.

Finally, to explore differences in writing style and content, I tested for treatment effects on variables derived from participants' writing. Specifically, I tested for treatment effects on the types of utility-value connections participants made (coded by research assistants), as well as the linguistic content and style of their writing (using LIWC variables). I then explored these variables as potential mediators of any treatment effects.

### **Demographic Effects on Self-Construal**

I regressed each self-construal scale (interdependent and independent) on three demographic factors: Asian American (Asian American, +.5, European American, -.5), gender (woman, +.5, man, -.5), and parental education (no college, +.5, college, -.5). Results for each of the two outcomes are presented in Table 7.

There was no effect of Asian American status, gender, or parental education on interdependent self-construal. However, compared to European American participants ( $M = 5.01$ ,  $SD = 0.84$ ), independent self-construal was significantly lower among Asian American participants ( $M = 4.81$ ,  $SD = 0.80$ ;  $b = -.20$ ,  $p = .004$ ). In addition, compared to men ( $M = 5.07$ ,  $SD = 0.83$ ), independent self-construal was significantly lower among women ( $M = 4.87$ ,  $SD = 0.82$ ;  $b = -.20$ ,  $p = .005$ ).

### **Intervention Fidelity**

I assessed intervention fidelity by examining the degree to which participants adhered to their assigned writing format. I used logistic regression to regress the coded format variable (letter, 1, essay, 0) on whether participants were assigned to write a letter or an essay (assigned letter, +.5, assigned essay, -.5). Indeed, participants who were assigned to write a letter did so significantly more often than those assigned to write an essay ( $b = 4.49$ ,  $p < .001$ ). However, among the 242 participants assigned to write a letter, only 157 (65%) did so, and the other 85

participants (35%) wrote an essay instead, suggesting that it may have felt unnatural to write such a letter in this context. On the other hand, among the 345 participants assigned to write an essay (i.e., those in a utility-value essay condition or control), 338 (98%) did so, and only 7 (2%) wrote a letter instead (all of whom were in the other-essay condition).

To further probe adherence to the letter assignment, I restricted the sample to only those participants in a letter condition ( $n = 242$ ) and regressed the coded format variable on utility-value subject (other, +.5, self, -.5) and each of the demographic factors. Participants wrote a letter more often when they were assigned to write about value for the recipient (72%) than for themselves (58%;  $b = 0.66, p = .018$ ). The “inconsistent” self-letter assignment may have seemed challenging or unnatural, and this may have led many participants to write an essay instead. In addition, adherence to instructions to write a letter was higher among women (70%) than men (55%;  $b = 0.72, p = .012$ ).

In sum, although the experimental conditions led to the intended differences in format, on average, adherence to instructions to write a letter was below expectations, particularly in the self-letter condition and among men. Therefore, I supplemented the primary analyses, which used an intent-to-treat (ITT) approach, by testing the effects of participants’ actual writing format (regardless of experimental condition). The results of these analyses are noted below.

### **Intent-to-Treat Analyses**

I tested four orthogonal contrasts to compare the five experimental conditions. The *UV* contrast compared the four treatment conditions to control (control = -.8, self-essay = +.2, self-letter = +.2, other-essay = +.2, other-letter = +.2). The *Format* contrast compared the two letter conditions to the two essay conditions (control = 0, self-essay = -.5, self-letter = +.5, other-essay = -.5, other-letter = +.5). The *Subject* contrast compared the two “other” conditions to the two

“self” conditions (control = 0, self-essay = -.5, self-letter = -.5, other-essay = +.5, other-letter = +.5). Finally, the *Consistency* contrast compared the two “consistent” utility-value conditions to the two “inconsistent” utility-value conditions (control = 0, self-essay = +.5, self-letter = -.5, other-essay = -.5, other-letter = +.5). This contrast can also be understood as the interaction in the 2 x 2 (format x subject) factorial design. Consistent with the analytic approach in Study 1, I first regressed each of the four outcomes on these four contrasts, the three demographic factors, and the two-way interactions between each contrast and each demographic factor. I then tested an identical set of models, except also including interdependent and independent self-construal (standardized) as predictors, as well as the two-way interactions between each contrast and each of the two self-construal measures. I controlled for interest in biology in each of these models.<sup>5</sup>

**Effects of condition as a function of demographic characteristics.** Results from the model testing the effects of condition as a function of demographic characteristics on each of the four outcomes are reported in Table 8. In addition, raw means and standard deviations of each outcome as a function of condition are presented in Table 9.

**Perceived value.** There was a significant *Format* x parental education interaction ( $b = 0.57, p = .011$ ) indicating that there was a more positive effect of writing a letter (vs. an essay) on perceived value for participants without college-educated parents than for those with at least one college-educated parent (Figure 4a). In addition, participants with higher levels of interest in biology reported greater perceived value than participants with lower levels of interest ( $b = 0.65, p < .001$ ).

**Task interest.** Consistent with perceived value, there was a significant *Format* x parental

---

<sup>5</sup> Because level of education is linked to parental education, I also tested supplemental models that were identical except that they controlled for participants’ own level of education. All reported treatment effects are consistent in these supplemental models.

education interaction ( $b = 0.45, p = .043$ ), indicating a more positive effect of letter writing on task interest for participants without college-educated parents than for those with at least one college-educated parent (Figure 4b). There were also significant main effects of gender ( $b = -0.35, p = .001$ ) and interest in biology ( $b = 0.80, p < .001$ ): men and participants who were more interested in biology reported greater task interest than women and participants who were less interested in biology.

**Behavioral intentions.** As with perceived value and task interest, there was a significant *Format* x parental education interaction ( $b = 0.63, p = .004$ ), reflecting a more positive letter-writing effect on behavioral intentions for participants without college-educated parents than for at least one college-educated parent (Figure 4c). In addition, there was a significant UV x Asian American interaction ( $b = -0.57, p = .027$ ), indicating that the effect of being prompted to write about utility value (regardless of utility-value prompt type) was more positive for European American participants than for Asian American participants. Finally, there were main effects of gender ( $b = -0.20, p = .050$ ) and interest in biology ( $b = 0.77, p < .001$ ), indicating that men and participants with more interest in biology reported more positive behavioral intentions than women and participants with less interest in biology.

**Performance.** There was a significant *Consistency* x Asian American interaction ( $b = -0.82, p = .031$ ). This interaction indicated that Asian American participants performed better in the “inconsistent” conditions (i.e., self-letter and other-essay) than the “consistent” conditions, whereas this was not the case for European American participants. One possibility is that Asian American participants had to work harder to respond to the inconsistent writing prompts, and this may have resulted in more learning. In addition, Asian American participants received higher test scores than European American participants ( $b = 0.72, p < .001$ ) and participants with at

least one college-educated parent received higher test scores than those without college-educated parents ( $b = -0.50, p = .003$ ), on average.

**Effects of condition as a function of demographic characteristics and self-construal.**

Results from the model testing the effects of condition as a function of demographic characteristics and self-construal on each of the four outcomes are reported in Table 10.

**Perceived Value.** There was a significant *Format* x interdependent self-construal interaction ( $b = 0.27, p = .018$ ) indicating that letter writing had a more positive effect on perceived value for individuals with a more interdependent self-construal (Figure 5a). In addition, there was again a significant *Format* x parental education interaction ( $b = 0.49, p = .023$ ). Finally, there were main effects of interdependent self-construal ( $b = 0.22, p < .001$ ), independent self-construal ( $b = 0.27, p < .001$ ), and interest in biology ( $b = 0.52, p < .001$ ): participants who reported greater interdependence, independence, and interest in biology reported greater perceived value than those who reported less interdependence, independence, and interest.

**Task Interest.** Consistent with perceived value, there was a significant *Format* x interdependent self-construal interaction ( $b = 0.30, p = .017$ ), indicating a more positive effect of letter writing on task interest for more interdependent participants (Figure 5b). In addition, as with perceived value, there were significant positive main effects of interdependent self-construal ( $b = 0.18, p = .001$ ), independent self-construal ( $b = 0.16, p = .006$ ), and interest in biology ( $b = 0.72, p < .001$ ) on task interest.

**Behavioral intentions.** As with perceived value and task interest, there was a significant *Format* x interdependent self-construal interaction ( $b = 0.24, p = .043$ ), reflecting a more positive letter-writing effect on behavioral intentions for more interdependent participants (Figure 5c). In



addition, as with the model that did not include the self-construal predictors, there was a significant *Format* x parental education interaction ( $b = 0.54, p = .012$ ). Finally, consistent with perceived value and interest, there were significant positive main effects of interdependent self-construal ( $b = 0.20, p < .001$ ), independent self-construal ( $b = 0.19, p = .001$ ), and interest in biology ( $b = 0.66, p < .001$ ) on behavioral intentions.

**Performance.** There were no effects of experimental condition (nor interactions with condition) on performance. However, this model again revealed that Asian American participants received higher test scores than European American participants ( $b = 0.68, p < .001$ ) and participants with at least one college-educated parent received higher test scores than those without college-educated parents ( $b = -0.49, p = .004$ ). In addition, participants with a more interdependent self-construal received lower test scores than those with a less interdependent self-construal ( $b = -0.19, p = .044$ ). Finally, participants with more interest in biology received higher test scores than those with less interest in biology ( $b = 0.18, p = .044$ ).

**Summary of intent-to-treat analyses.** In sum, results of the ITT analyses revealed more positive effects of writing a utility-value letter (vs. an essay) on perceived value, task interest, and behavioral intentions for two groups of participants: individuals without college-educated parents and individuals with more interdependent self-construals. There was no effect of writing format or utility-value subject on test score for either of these groups. In addition, there were consistent group differences on each of the outcomes. Individuals with higher interdependent self-construals, independent self-construals, and participants with more interest in biology reported higher levels of perceived value, task interest, and behavioral intentions. In addition, Asian American participants, individuals with at least one college-educated parent, and participants who were more interested in biology received higher test scores, and participants

with more interdependent self-construals received lower test scores.

### **Effects of Actual Writing Format**

The ITT analyses showed positive effects of the letter format for individuals without college-educated parents, as well as participants with more interdependent self-construals. However, as noted above, 35% of participants assigned to write a letter wrote an essay instead. As such, I tested a separate set of models to evaluate the effects of the *actual* format of participants' writing, regardless of their assigned condition. Specifically, I tested models that were identical to the ITT models, except that I replaced the four condition contrasts with an *Actual Format* contrast (letter, +.5, essay, -.5). These analyses provided a test of whether the effects of participants' assigned writing format were consistent with the effects of their actual writing format. Raw means and standard deviations of each outcome as a function of actual format are presented in Table 11.

Indeed, the positive letter-writing effects for individuals without college-educated parents and more interdependent participants from the ITT analyses emerged in this new set of analyses. There was a significant *Actual Format* x parental education interaction on perceived value, task interest, and behavioral intentions ( $ps < .027$ ). In addition, there was a significant *Actual Format* x interdependent self-construal interaction on each of these three outcomes ( $ps < .045$ ). These supplemental analyses confirmed that the effects of participants' assigned and actual writing format were consistent. One possible explanation for this consistency is that participants who were assigned to write a letter but instead wrote an essay may have thought about writing a letter and engaged in similar thought processes as those who actually wrote a letter.

### **Linguistic Analyses**

To assess how the different writing prompts affected participants' writing, I tested the

effects of condition on the three coded writing content variables, four LIWC content variables, and four LIWC style variables (described below). Zero-order correlations and descriptive statistics for these measures are presented in Table 12.

**Coded utility-value content.** I used logistic regression to regress each of the three coded writing content variables – utility for the self, a specific other, and people in general (coded 1, 0) – on each of the four condition contrasts (Table 13). There was no effect of the *Letter vs. Essay* contrast on any of the utility-value content variables ( $ps > .095$ ). However, the subject manipulation (i.e., other vs. self) was successful in evoking differences in the content of participants’ writing. Participants assigned to an “other” condition wrote about utility value for a specific other person significantly more often than those assigned to a “self” condition ( $b = 3.02, p < .001$ ). Conversely, participants assigned to a “self” condition wrote about utility for the self significantly more often than those assigned to an “other” condition ( $b = -1.16, p = .001$ ). In addition, participants assigned to a “self” condition also wrote about utility value for people in general more often than those assigned to an “other” condition ( $b = -0.72, p = .002$ ). Interestingly, there was also a significant *Consistency* effect indicating that writing about value for another person was more common in the “inconsistent” utility-value conditions than the “consistent” conditions ( $b = -0.96, p = .020$ ). Specifically, in the “self” conditions, writing about value for another person was more common in letters (8%) than essays (2%), whereas in the “other” conditions, such writing was more common in essays (47%) than letters (41%).

**LIWC variables – content.** To measure the degree to which participants engaged in personal writing, I computed the percentage of first-person singular pronouns used in participants’ writing (e.g., I, me, my). Consistent with Harackiewicz and colleagues (2016), I assessed the other-oriented content of participants’ writing using the “social processes” LIWC

dictionary (e.g., discuss, encourage) and its two subcategories – family words (e.g., mother, grandpa) and friend words (e.g., friend, pal). Each of these variables ranges from 0 to 100.

I regressed each of these four variables on each of the four condition contrasts (Table 14). There was a significant effect of the *UV* contrast on first-person singular pronouns ( $b = 0.98, p < .001$ ), social words ( $b = 1.30, p = .001$ ), family words ( $b = 0.31, p < .001$ ), and friend words ( $b = 0.18, p < .001$ ). On average, participants in a utility-value condition were higher on each of these outcomes than participants in the control condition. In addition, there was a significant effect of the *Format* contrast on first-person singular pronouns ( $b = 0.86, p < .001$ ), social words ( $b = 1.20, p = .001$ ), and friend words ( $b = 0.25, p < .001$ ), indicating that participants who were assigned to write a letter wrote with significantly more first-person singular pronouns, social words, and friend words than those assigned to write an essay.

There was a significant effect of the *Subject* contrast on family words ( $b = 0.30, p < .001$ ): participants assigned to write about utility value for others used a higher proportion of family words than those assigned to write about utility value for themselves. There were no significant effects of the *Subject* contrast on any of the other linguistic content measures ( $ps > .055$ ). Finally, there was a significant *Consistency* effect indicating that family words were more common in the “inconsistent” utility-value conditions than the “consistent” conditions ( $b = -0.18, p = .001$ ). Specifically, in the “self” conditions, family words were more prevalent in letters (0.26%) than essays (0.07%), whereas in the “other” conditions, such words were more prevalent in essays (0.54%) than letters (0.38%).

**LIWC variables – style.** I used four writing summary variables calculated by LIWC to assess the style of participants’ writing (Pennebaker et al., 2015). These variables are calculated using proprietary algorithms to combine existing LIWC variables and detect broad linguistic

patterns. The “analytical thinking” variable is designed to detect language that suggests logical and formal patterns of thought. The “clout” variable is designed to detect language conveying confidence and leadership. The “authenticity” variable is designed to detect language conveying honesty, humility, and vulnerability. Finally, the “emotional tone” variable is designed to detect language that conveys more positive (and less negative) emotional tone. Each of these variables ranges from 0 to 100.

I regressed each of these four variables on each of the four condition contrasts (Table 15). There was a significant effect of the *UV* contrast on analytical thinking ( $b = -10.72, p < .001$ ) and emotional tone ( $b = 12.09, p < .001$ ). Participants assigned to write about utility value had writing that was less analytical and more emotionally positive than control participants. In addition, there was a significant effect of the *Format* contrast on analytical thinking ( $b = -11.63, p < .001$ ), clout ( $b = 4.91, p = .005$ ), authenticity ( $b = 7.87, p < .001$ ), and emotional tone ( $b = 7.1, p = .006$ ). Participants assigned to write a utility-value letter wrote in a less analytical way, but with more clout, greater authenticity, and more positive emotional tone.

There was also a significant effect of the *Subject* contrast on clout ( $b = 4.40, p = .013$ ) and authenticity ( $b = -7.30, p < .001$ ). Participants who were assigned to write about utility value for another person had writing that conveyed more clout and less authenticity than participants assigned to write about utility value for the self. There were no significant effects of the *Consistency* contrast on any of the style variables.

### **Exploratory Moderated Mediation Analyses**

I explored whether LIWC variables assessing style and content may play a role in mediating treatment effects from the ITT analyses (i.e., *Format* x parental education and *Format* x Interdependent self-construal interactions on perceived value, task interest, and behavioral

intentions). I tested for a pattern of moderated mediation in which letter writing led participants to write in a particular way (as captured by the linguistic variables), and that type of writing had a stronger effect on value, interest, and/or behavioral intentions for individuals without college-educated parents and/or more interdependent individuals (see Figure 6 for a conceptual diagram).

I narrowed potential mediators to only those that showed significant differences as a function of letter writing (i.e., first-person singular pronouns, social words, friend words, and each of the four style variables). I then tested separate path models for each of these linguistic variables on perceived value, task interest, and behavioral intentions. In these path models, I tested the set of predictors from the ITT models including self-construal moderators on the potential linguistic mediator (standardized) and the outcome, and I also included the effect of the potential linguistic mediator and two-way interactions between this variable and each demographic and self-construal moderator (i.e., gender, Asian American, parental education, interdependent self-construal, and independent self-construal) on the outcome. For each model, I examined whether there was a significant a-path (i.e., a main effect of letter writing on the linguistic variable) and a significant b-path (i.e., a linguistic variable x parental education and/or interdependent self-construal interaction on the outcome). I then used bootstrapping to test the pattern of moderated mediation by computing 95% confidence intervals of the indirect effects (i.e., indices of moderated mediation and conditional indirect effects for each level of the moderator).

It is important to emphasize that these analyses are exploratory: I examined seven potential linguistic mediators, two potential moderators (i.e., parental education and interdependent self-construal), and three outcomes (i.e., perceived value, task interest, and behavioral intentions). The risk of Type-I error is therefore inflated in these analyses. These

analyses are intended to probe linguistic mechanisms by which letter writing *may* have influenced each of the outcomes, but results should be viewed as tentative and requiring replication.

Consistent with the models only testing main effects of condition on the linguistic variables (Tables 12 and 13), each potential a-path (i.e., main effect of the *Format* contrast on the seven potential linguistic mediators) was positive and significant ( $ps < .014$ ).

**Mediation of format x interdependent self-construal effects.** Only one of the potential linguistic mediators showed evidence of significant b-paths that would support the proposed pattern of moderated mediation by interdependent self-construal: friend words. There were significant friend words x interdependent self-construal interactions on task interest ( $b = 0.16, p = .011$ ) and behavioral intentions ( $b = 0.13, p = .031$ ). These effects indicated that friend words were more positively associated with task interest and behavioral intentions for more interdependent individuals (Figure 7). The friend words x interdependent self-construal interaction on perceived value was not statistically significant ( $b = 0.09, p = .141$ ).

There was a significant index of moderated mediation on task interest, 95% CI [0.010, 0.213], consistent with the possibility that letter writing led to increased use of friend words which, in turn, had a more positive effect on task interest for more interdependent participants. Indeed, the conditional indirect effect of letter writing on task interest via friend words was significant for more interdependent individuals (+1 SD; 95% CI [0.052, 0.314]) but not for less interdependent individuals (-1 SD; 95% CI [-0.151, 0.083]). The index of moderated mediation was not significant on behavioral intentions, 95% CI [-0.010, 0.192]. However, the conditional indirect effect of letter writing on behavioral intentions via friend words was significant for more interdependent individuals (+1 SD, 95% CI [0.024, 0.277]) and not for less interdependent

individuals (-1 SD; 95% CI [-0.142, 0.082]).

**Mediation of format x parental education effects.** Only one potential mediator showed evidence of a significant b-path that would support the proposed pattern of moderated mediation by parental education: clout. There was a significant clout x parental education effect on task interest ( $b = 0.23, p = .031$ ) indicating that writing with more clout was more positively associated with task interest for participants without college-educated parents than for participants with at least one college-educated parent (Figure 8). The clout x parental education interactions on perceived value and behavioral intentions were not statistically significant ( $ps > .374$ ).

There was a significant index of moderated mediation, 95% CI [0.002, 0.141], consistent with the possibility that letter writing led to increased clout language which, in turn, had a more positive effect on task interest for participants without college-educated parents than those with at least one college-educated parent. However, the conditional indirect effect of letter writing on task interest via clout was not statistically significant for individuals without college-educated parents, 95% CI [-0.012, 0.093], nor for individuals with at least one college-educated parent, 95% CI [-0.068, 0.004].

**Summary of moderated mediation analyses.** These results suggest that friend words may have played a role in explaining the stronger effect of letter writing on task interest for more interdependent participants, and may partially explain the positive letter writing effects on behavioral intentions for relatively interdependent individuals (i.e., +1 SD). In addition, writing with more clout may have played a role in explaining the more positive effect of the letter format on task interest for individuals without college-educated parents as compared to those with at least one college-educated parent. However, again, due to the exploratory nature of these



analyses, these results should be interpreted tentatively.

### **Discussion**

In this study, I found additional evidence that other-oriented utility-value writing may be effective for individuals who are more interdependent (RQ1). The effects of being assigned to write a utility-value letter (versus an essay) varied as a function of participants' demographic and individual-level characteristics (RQ3). Specifically, letter writing was more positively associated with perceived value, task interest, and behavioral intentions for individuals without college-educated parents. Individuals from working-class backgrounds, such as those whose parents did not complete a four-year college degree, are theorized to be more interdependent than middle- and upper-class individuals, and research indicates that in higher education settings, they express more interdependent motives for pursuing a degree (Stephens, Fryberg, et al., 2012; Stephens, Markus, et al., 2014; Tibbetts et al., 2018). Although I did not find that individuals without college-educated parents were more interdependent in this sample (as indexed by interdependent self-construal), the results do lend support to the hypothesis that other-oriented forms of utility-value writing are more effective for individuals from more interdependent cultures. In addition, utility-value letter writing was more positively associated with value, interest, and behavioral intentions for participants with more interdependent self-construals. This finding is consistent with the hypothesis that other-oriented utility value writing can also be effective for more interdependent individuals, regardless of their cultural background. Critically, these effects were not only found in the ITT analyses, but they were also revealed in the supplemental models that tested the effects of the actual writing format used by participants. The consistency of effects between assigned and actual characteristics of participants' writing lends additional credence to these results.

Though these findings are broadly consistent with my hypotheses, there are three aspects of the results that complicate the picture. First, participants without college-educated parents did not report higher levels of interdependent self-construal than those with at least one college-educated parent. Consequently, the letter-writing effects for individuals without college-educated parents and participants with more interdependent self-construals must be understood as different effects. One possibility is that the interdependent self-construal measure (Singelis, 1994) captures aspects of interdependence that are distinct from those that characterize the interdependence of many working-class individuals. Indeed, Stephens and colleagues (2014) characterize working-class individuals by their “hard interdependence,” which is marked by mutual reliance – due to economic and social constraints – but also a sense of strength and “toughness,” informed by broader Western ideals. The Singelis (1994) measure may not capture this. The results of this study are consistent with the possibility that utility-value letter writing may be effective for individuals with many “types” of interdependence: those with an interdependent self-construal (Markus & Kitayama, 1991, 2010), and working-class individuals with a hard interdependence (Stephens, Fryberg, et al., 2012; Stephens, Markus, et al., 2014).

Second, the interactions with letter writing were not simply driven by positive effects for individuals without college-educated parents or for participants with highly-interdependent self-construals (Figures 4 and 7). The effects of letter writing were also negative for individuals with at least one college-educated parent and less-interdependent individuals. These patterns suggest that the letter format may not simply boost the efficacy of utility-value writing for some individuals, but it may also reduce the effects of utility-value writing for others. Communicating the value of the material to others may be less effective for these groups than simply writing about utility value in an essay. Nevertheless, the interactions between format, parental education,

and interdependent self-construal indicate that the effects of utility-value letter writing are more positive for individuals without college-educated parents and interdependent individuals than individuals with at least one college-educated parent and less interdependent individuals.

Third, in regard to RQ2, it is interesting that the hypothesized patterns of moderation emerged as a function of format (i.e., letter vs. essay) but not subject (i.e., other vs. self). I expected that having another person as the subject of utility-value writing and/or writing utility-value letters might be more beneficial for more interdependent individuals than less interdependent individuals. However, in this study, the utility-value letter format produced more positive effects for more interdependent individuals, and these effects did not depend on the utility-value subject. Reflecting on utility value in a letter, whether for the self or another person, appears to be the powerful element of utility-value writing for more interdependent individuals. Because letter writing involves interpersonal communication, it may be a particularly social way of engaging with academic material and reflecting on its value, and may therefore be especially beneficial for interdependent individuals. Indeed, being assigned to write in the format of a letter (vs. essay) was significantly associated with the use of social words (and specifically, friend words), and there was some evidence that the use of friend words played a role in mediating letter-writing effects on task interest and behavioral intentions for more interdependent participants.

It is also notable that the letter format increased the degree to which participants' writing reflected clout (i.e., confidence and leadership). Explaining the value of the material to another person may have led participants to take on the role of the "expert" and write more authoritatively. This manner of writing may therefore afford individuals a sense of interpersonal connection with a friend or family member, while also affirming their own understanding and

competence with the material. Notably, clout partially mediated the stronger effect of letter writing on task interest for participants without college-educated parents (compared to those with at least one college-educated parent). Indeed, the combination of connecting with others and affirming one's individual competence with the material may have aligned with what Stephens, Markus, and colleagues (2014) term "hard interdependence," and thereby increased interest in the task for participants without college-educated parents. Additional research is necessary to more carefully evaluate this possibility.

This study fills important gaps that could not be addressed in Study 1. First, in this study, participants were randomly assigned to engage in different types of writing. This study therefore provided a causal test of the effects of different types of other-oriented utility-value writing, and indicated that letter writing led to more positive effects for individuals without college-educated parents as well as those with more interdependent self-construals (RQ1, RQ3). Second, this study was designed to distinguish the independent and joint effects of writing format (i.e., letter vs. essay) and utility-value subject (i.e., other vs. self). As discussed above, results suggest that format played a central role in affecting value, interest, and behavioral intentions, whereas utility-value subject did not (RQ2). This question was impossible to address in Study 1 because format and subject were confounded in that study (and in most previous research). Third, in this study, I was able to test self-construal as a moderator of treatment effects. I could not measure college motives in this study (because not all participants were in college), but by measuring self-construal, I was able to examine whether the effects of other-oriented utility-value writing were dependent upon participants' broader views of the self.

In general, findings in this study were similar to those in Study 1. As in Study 1, other-oriented utility-value writing had more positive effects on value and interest for participants who

were more interdependent. However, there was also an important inconsistency: in Study 2, the effects of utility-value format did not depend on whether participants were Asian American or European American. In fact, inconsistent with prior theory and research (e.g., Markus & Kitayama, 2010; Singelis & Sharkey, 1995), Asian American participants did not report higher levels of interdependent self-construal than their European American counterparts in this study. One possibility is that the Asian Americans (and/or European Americans) who participate as research panelists on the online research platform used in this research differ in important ways from those who do not. For example, perhaps Asian American panelists are less interdependent, on average, than other Asian Americans in the broader population. Regardless, it is notable that these findings diverge from those found in Study 1, and additional research in more naturalistic settings is necessary to test for replication of these initial results.

This study has important limitations that should be addressed with additional research. First, this study included a measure of self-construal, but because the sample was not comprised of college students, it was not possible to measure college motives. Additional research in a college sample that includes both of these measures is necessary to evaluate (a) the correlation between these measures, (b) to what degree they show consistent (or divergent) patterns of demographic differences, and (c) to compare them as moderators of other-oriented utility-value writing effects (RQ3b). Second, although this study was designed to maximize statistical power to compare Asian American and European American participants, a drawback of this approach is that it was impossible to test effects for other racial/ethnic groups, including Hispanic/Latinx individuals. An additional study with greater numbers of both Asian American and Hispanic/Latinx individuals is necessary to test the effects of other-oriented utility-value writing for each of these groups compared to other racial/ethnic groups, and compared to one another

(RQ3a). Finally, although this study provided a causal test of different types of utility-value writing, it did so in the context of a brief, online learning experience. Additional research must be conducted that tests these effects in an authentic educational context.

### **Study 3**

Study 3 was a field experiment conducted in a diverse two-year college. In this study, I compared the effects of writing self-essays and other-letters to control. As in Study 1, utility-value subject (i.e., other vs. self) and format (i.e., letter vs. essay) were confounded for this experiment. It was impossible to implement a complex design (like the five-cell design in Study 2) while retaining adequate statistical power, so subject and format were varied together, as they have been in previous research. I assigned students to write about others in the form of a letter because letters provide a natural medium for writing about utility value for another person. Utility-value interventions have been found to be more effective when they include a variety of writing assignment formats (Priniski et al., 2019). Therefore, to maximize the likelihood of a positive overall impact of the writing assignments, all students in utility-value conditions were assigned to complete a mixture of self-essays and other-letters. Some students were assigned to write more letters whereas others were assigned to write more essays. The focus of this study was thus to compare the effects of writing relatively more vs. fewer utility-value letters, as compared to essays.

This study was designed to address questions that remained from the first two studies. First, the study was conducted in a two-year college with a high proportion of Asian and Hispanic/Latinx students. As such this context afforded the ability to test the effects of writing more (vs. fewer) utility-value letters for these interdependent cultural groups (RQ3a). Second, because I conducted this study in a college context, I was able to measure students'

interdependent and independent motives for completing a college degree (Stephens, Fryberg, et al., 2012) in addition to their self-construals (Singelis, 1994). This allowed me to compare and contrast these distinct measures of interdependence, one of which is context-general and the other of which is directly tied to students' experiences in educational settings (RQ3b). Third, because this study was a field experiment, I was able to test the causal effects of different types of utility-value writing in an educational setting.

Finally, I measured additional outcomes in this study to better understand how other-oriented utility-value writing affects perceptions of value and interest. Students' perceptions of the particular topics that they reflect upon in their writing are more proximal to the writing intervention than their more general perceptions of the domain. Indeed, effects of utility-value letter writing were found on measures of value and interest that were specific to the topic being taught (i.e., fungi) in Study 2, whereas such topic-specific measures were not included in Study 1. Therefore, in this study I included topic-specific measures of perceived value and interest. In addition, it is possible that reflecting on the relevance of a topic in relation to others specifically affects perceptions that the material can be used to help other people. To examine this possibility, I included a measure of "prosocial utility value," which assessed the belief that biology can be used to help others. In addition to these more specific measures of value and interest, I also included more general measures that were consistent with those included in Study 1. In sum, this study included three types of measures to assess students' attitudes about the content: value and interest in particular topics from the biology course, prosocial utility value of biology, and general value and interest in biology.

### **Method**

I tested different versions of a utility-value intervention in an introductory biology course

at Pasadena City College (PCC). PCC is a two-year college that offers associates degrees and prepares students to transfer to baccalaureate programs. The campus is 51% Hispanic/Latinx and 24% Asian. The 15-week biology course covered three major units: ecology, human physiology, and bacteria and cells. The course was conducted in “hybrid” format, including 1.5 hours of online content, 1.5 hours of lecture, and 3 hours of lab per week. Students in this study were in one of 21 lecture sections of the course (each consisting of 19-30 students) taught by one of 15 instructors. Course grades were determined by a combination of large projects, quizzes, online discussions, online assignments, writing assignments, lab work, and in-class participation.

This study was preregistered at [aspredicted.org](https://aspredicted.org/#31746) (#31746). The preregistration is presented in Appendix D, as well as a description of any deviations from the preregistered procedure and analysis plan.

### **Participants**

The sample consisted of PCC students who completed one of the 21 sections of introductory biology ( $n = 541$ ). In the sample, there were 298 women (55%), 238 men (44%), and 5 students who did not identify as women or men (1%). There were 274 Hispanic/Latinx students (51%), 129 Asian American students (24%), 79 European American students (15%), 38 Asian International students (7%), and 21 Black students (4%). Of the 541 students, 360 (67%) were FG students and 181 (33%) were CG students. The average age of the sample was 23.14 ( $SD = 6.00$ ).

### **Procedure**

Students completed a baseline questionnaire in the first week of the semester through an online survey platform (Qualtrics). On the questionnaire, they were asked to report their demographic information, college GPA, college motives (Stephens, Fryberg, et al., 2012, as



measured in Study 1), self-construal (Singelis, 1994, as measured in Study 2), perceived value for biology, prosocial utility value for biology (i.e., perceived usefulness of biology for helping others), and interest in biology. This questionnaire was completed for course credit during lab time for 19 of the 21 lecture sections, and as online homework assignments for the other two lecture sections. Students received credit for completing the questionnaire whether or not they consented to release their responses for research purposes.

Students were blocked on gender, race, and generational status, and were then randomly assigned to one of three conditions within lecture sections: a control condition or one of two utility-value conditions. Students completed three writing assignments (500-600 words) for credit over the course of the semester, the content of which was determined by experimental condition. Students in the one-letter UV condition were assigned one other-letter and two self-essays, and students in the two-letter UV condition were assigned two letters and one essay.

In the last two weeks of the semester, students completed a final questionnaire. On the questionnaire, students again reported their perceived value, prosocial utility value, and interest in biology. They also reported their perceived value and interest in each of the three major units that were covered in the semester. This questionnaire was completed for course credit during lab time in each of the 21 lecture sections. As with the baseline questionnaire, students received credit for completion regardless of whether they consented to release their responses for research purposes. At the end of the semester, grades in the course were obtained from institutional records.

### **Writing Assignments**

All students were assigned to write a paper (500-600 words) for course credit three times during the semester. Writing assignments were provided to students online via a survey page

(accessed through Canvas, the course management website). On this page, survey logic was used to provide students in different conditions with their respective writing assignments without instructors being aware of their conditions. Completed papers were submitted through the survey platform and downloaded by research personnel, who deidentified the papers (i.e., replaced identifying information with an ID number) and sent them to instructors for blind grading. Once graded, the assignments were sent back to the research personnel and reidentified (i.e., the ID number was replaced with identifying student information). The research personnel then sent the reidentified grades back to instructors who then posted the grades on the course management website.

Across all conditions, students were asked to choose a topic that was covered in the course in the preceding unit (e.g., cardiovascular health). They were then asked to formulate a question about that topic and write about it. In the control writing assignment, students were asked to write an essay answering their question by summarizing course material. In the two utility-value writing assignments, in addition to answering their question by summarizing course material, students were asked to describe how the topic could be useful. In the utility-value essay assignment, students were asked to write an essay describing the usefulness of the topic in their own lives, and in the utility-value letter assignment, students were asked to write a letter to a friend or family member describing the usefulness of the material for the letter recipient. Examples of each of type of writing prompt are presented in Appendix E.

In the control condition, students received a control writing assignment three times over the course of the semester. In both utility-value conditions, students received an essay prompt for their first assignment and a letter prompt for their second assignment. For the third assignment, students received either an essay prompt (one-letter UV condition) or a letter prompt (two-letter

UV condition).

## Measures

**Demographics and college GPA.** Students reported their race/ethnicity, gender, and parental education. Students were classified as Asian if they reported being East or Southeast Asian, and were further grouped into Asian American (i.e., not an international student) or Asian International (i.e., international student). Students were classified as European American, Hispanic/Latinx, or Black based on their reported race/ethnicity. Generational status was computed based on parental education: students for whom neither parent had completed a four-year college degree were categorized as FG, and all other students were categorized as CG. Students also reported their GPA at PCC (cumulative across all prior semesters, 4.0 scale).

**Baseline psychological measures.** The measures of interdependent and independent self-construal were identical to Study 2. The measures of interdependent and independent college motives were identical to Study 1. All other baseline items were reported on a 7-point Likert-type *Not at all true – Very true* scale. Perceived value was measured on a 4-item scale (“I think what we are learning in this course is important,” “BIOL 011 is important to my future,” “The study of biology is personally meaningful to me,” “The study of biology is personally important to me”;  $\alpha = .82$ ). Prosocial utility value was measured on a 3-item scale (“Biology can be useful for helping others,” “Biology can be useful for promoting human health and wellbeing,” “Biology can be useful for finding solutions to problems people face in their everyday lives”;  $\alpha = .80$ ). Perceived value and prosocial utility value were significantly positively correlated but had only 32% shared variance ( $r = .57$ ), suggesting that these scales measured distinct constructs. Interest was measured on a 5-item scale (“I’m excited about biology,” “I’m really looking forward to learning more about biology,” “To be honest, I just don’t find biology interesting”

(reversed), “Biology fascinates me,” “I think the domain of biology is very interesting”;  $\alpha = .89$ ).

**Final questionnaire measures.** Perceived value ( $\alpha = .84$ ) and prosocial utility value ( $\alpha = .86$ ) were measured with the same items as the baseline measure. Interest was measured with the same five items used on the baseline questionnaire, plus an additional sixth item (“I enjoy learning about biology”;  $\alpha = .93$ ). Unit-specific value was measured with nine items (i.e., three items asked for ecology, human physiology, and bacteria and cells: “How useful is this topic?,” “How relevant is this topic to your life?,” “How important is this topic for society or people in general?”;  $\alpha = .93$ ). Unit-specific interest was also measured with nine items (i.e., three items per topic: “How interesting is this topic?,” “How much do you like this topic?,” “How excited are you about this topic?”;  $\alpha = .93$ ). Responses to unit-specific items were reported on a 7-point Likert-type *Not at all – Very much* scale. The unit-specific perceived value and interest measures were positively correlated with their topic-general counterparts and had 42% and 55% shared variance with these measures ( $r_s = .65$  and  $.74$ ), respectively. This suggests that although the unit-specific measures were highly correlated the general measures of perceived value and interest, these measures were distinct.

**Course grade.** The institution provided grades for students in the course (A = 4.0, B = 3.0, C = 2.0, D = 1.0, F = 0).

**Linguistic variables.** I computed the same four LIWC content variables and four LIWC style variables as in Study 2 in order to explore linguistic differences in participants’ responses to the experimental writing prompts.

## Results

Zero-order correlations, descriptive statistics, and scale reliabilities for all major variables are presented in Table 16. I computed ICCs for each outcome to evaluate whether it

was necessary to account for the nested structure of the data (students within lecture sections). Lecture section accounted for < 1% of the variance in each of the outcomes with the exception of course grade (12%)<sup>6</sup>. As such, I accounted for the effect of lecture section using fixed effects (i.e., dummy coded contrasts) for all analyses on course grade, and used OLS multiple regression for analyses on all other outcomes. As in Study 2, gender was treated as missing for students who did not identify as women or men. All missing data (1% for all baseline questionnaire variables, 22% for all final questionnaire variables, 28% for college GPA, and 27% for course grade)<sup>7</sup> were handled using multiple imputation (Rubin, 1987). Unstandardized regression coefficients (*bs*), standard errors, and *p*-values are reported from all regression models.

### **Analysis Plan**

As with the first two studies, I began by testing for baseline differences in interdependence and independence as a function of race/ethnicity, gender, and parental education. In this study, I was able to test for differences in both interdependent/independent self-construal and college motives. Next, I evaluated intervention fidelity by assessing (a) whether students completed each of the three assignments, and (b) whether students completed each assignment in the correct format (letter vs. essay).

After checking fidelity, I conducted ITT analyses, testing effects of condition regardless of assignment completion and actual format. As in Studies 1 and 2, I first assessed whether treatment effects differed as a function of students' demographic characteristics and then tested whether effects differed as a function of students' interdependence and independence.<sup>8</sup>

---

<sup>6</sup> I also computed ICCs nesting students within instructors, rather than lecture section. Similar to lecture section, instructor accounted for < 1.7% of the variance in each outcome with the exception of course grade (11%).

<sup>7</sup> Students with missing college GPAs either did not complete the baseline questionnaire or did not have prior GPAs (e.g., if they were first-semester students). Students with missing course grades did not consent to provide access to academic records.

<sup>8</sup> All treatment x interdependence/independence interactions were also tested in a model that did not control for demographic differences. All treatment effects are consistent between these two models.

Subsequently, I conducted an additional set of analyses to account for deviation from the treatment.

Finally, as in Study 2, I explored linguistic differences between the conditions. The goal of this analysis was to assess whether linguistic differences between letters and essays that emerged in the short essays completed in the lab replicated in longer writing assignments in the field.

### **Demographic Effects on Self-Construal and College Motives**

I regressed each of the two interdependent and independent scales (i.e., self-construal and college motives) on three demographic factors: race/ethnicity (dummy-coded contrasts treating European American as the reference group), generational status (FG, +.5, CG, -.5), and gender (woman, +.5, man, -.5). Results for each of the four outcomes are presented in Table 17.

Interdependent self-construal was higher among Asian Americans ( $b = 0.24, p = .035$ ) and Asian International students ( $b = 0.51, p = .001$ ) than European Americans. However, this was not the case for interdependent college motives. In fact, Asian International students reported significantly lower interdependent college motives than European American students ( $b = -0.94, p = .001$ ). In addition, interdependent college motives were significantly higher among Hispanic/Latinx students ( $b = 0.65, p < .001$ ) and Black students ( $b = 0.88, p = .010$ ) than among European American students, and independent college motives were higher among Hispanic/Latinx students as well ( $b = 0.40, p = .007$ ). There were no significant effects of gender or generational status on any of the four measures. The lack of a generational-status effect contrasts with extant research. Previous studies have documented higher interdependent motives among FG students than CG students in four-year universities (e.g., Harackiewicz et al., 2014; Stephens et al., 2012) as well as two-year colleges (Tibbetts et al., 2018), and such a difference

also emerged in Study 1 of the present research. FG students comprised 67% of the present sample, and it is possible that the relatively low variance in generational status in this study is partially responsible for this discrepancy with prior research.

### **Intervention Fidelity**

I assessed intervention fidelity by examining completion of the writing assignments and format of students' papers. Frequencies of completion and format (i.e., letter vs. essay vs. missing) by experimental condition and assignment number are displayed in Table 18. Non-completion of the writing assignments was high across conditions: 26% for assignment 1, 29% for assignment 2, and 34% for assignment 3. In fact, 99 students (18%) did not complete any of the three assignments, and only 310 (57%) completed all three of the assignments. These completion rates suggest that there was substantial deviation from the intended treatment.

I also examined whether assignment completion varied as a function of student characteristics. I regressed the number of assignments students completed on each of the demographic factors, as well as interdependent and independent self-construal and college motives. Women ( $M = 2.20$ ,  $SD = 1.15$ ) completed significantly more of the writing assignments than men ( $M = 1.98$ ,  $SD = 1.23$ ;  $b = 0.30$ ,  $p = .004$ ). There were no other significant effects in this model.

Next I examined whether students wrote in the assigned format (i.e., essay vs. letter) when they did complete a writing assignment. Compliance was perfect for assignment 1, given that all students were assigned an essay and the letter format had not yet been introduced. For assignment 2, all participants in the utility-value conditions were assigned to write a letter, but 54 (21% of the 255 students who completed an assignment in the utility-value conditions) wrote an essay instead. For assignment 3, all participants in the two-letter UV condition were assigned to

write a letter, but 26 (22% of the students who completed an assignment in this condition) wrote an essay instead. Conversely, all participants in the one-letter UV condition were assigned to write an essay for assignment 3, but only one of 123 students who completely an assignment in this condition wrote a letter instead. Thus when students failed to comply with instructions, it was almost always a failure to write a letter.

In sum, these results indicate relatively low intervention fidelity and suggest that ITT analyses may not provide an accurate representation of the effects of utility-value essay- and letter-writing in this context.

### **Intent-to-Treat Analyses**

I tested two orthogonal contrasts to compare the three experimental conditions. The *UV* contrast compared the two treatment conditions to control (control =  $-.67$ , one-letter UV =  $+.33$ , two-letter UV =  $+.33$ ). The *Two vs. One Letter UV* contrast compared the two treatment conditions (control =  $0$ , one-letter UV =  $-.5$ , two-letter UV =  $+.5$ ). There were relatively few Black and Asian International students in the sample (between 9 and 18 students of each racial/ethnic group per condition). Therefore, I combined these students with European American students to create a combined group of students who were neither Asian American nor Hispanic/Latinx. I compared the three resulting racial/ethnic groups using two orthogonal contrasts: *Asian American/Latinx vs. No* (Asian American =  $+.33$ , Hispanic/Latinx =  $+.33$ , Other =  $-.67$ ) and *Asian American vs. Hispanic/Latinx* (Asian American =  $+.5$ , Hispanic/Latinx =  $-.5$ , Other =  $0$ ).<sup>9</sup> These contrasts allowed me to compare students from the two culturally-interdependent ethnic groups (i.e., Asian and Latinx) to students not from these groups (i.e., European American, Black, and Asian International), and to compare each interdependent group

---

<sup>9</sup> Treatment effects are consistent regardless of whether the racial/ethnic groups are compared with these orthogonal contrasts or dummy codes comparing each of the four non-European American groups to European Americans.



to one another.

Consistent with the analytic approach in Studies 1 and 2, I first regressed each of the five outcomes on each of these two contrasts, each of the demographic factors (i.e., the race/ethnicity contrasts, generational status, and gender), and the two-way interactions between each contrast and each demographic factor. Then I tested a model that was identical, except that it also included interdependent and independent self-construal and college motives (all standardized) as predictors, as well as the two-way interactions between each treatment contrast and each of these four predictors. I controlled for the baseline measure of each outcome in these models (for grade, I controlled for college GPA, and for the unit-specific measures of perceived value and interest, I controlled for baseline perceived value and interest, respectively).<sup>10</sup>

**Effects of condition as a function of demographic characteristics.** Effects from the model testing only demographic moderators are presented in Table 19. In addition, raw means and standard deviations of each outcome as a function of condition are presented in Table 20. There was a significant positive effect of the baseline covariate on each of the outcomes ( $ps < .001$ ). No other effects were statistically significant in this model.

**Effects of condition as a function of demographic characteristics, self-construal, and college motives.** Effects from the model testing demographic, self-construal, and college motives moderators are presented in Table 21. In addition to the effects of the baseline covariates, there was an effect of the *Asian American vs. Hispanic/Latinx* contrast on course grade ( $b = 0.28, p = .048$ ) indicating that grades were higher among Asian American student ( $M = 3.06, SD = 1.11$ )

---

<sup>10</sup> Previous research indicates that utility-value interventions can increase performance and interest for students with lower expectations for success or prior performance (e.g., Harackiewicz et al., 2016; Hulleman et al., 2010; Hulleman & Harackiewicz, 2009). I tested for such effects in the present sample by testing identical models to those reported here, except also including baseline expectations for success and college GPA as moderators of treatment effects. There were no interactions between either of these moderators and any of the treatment contrasts, and including these terms did not affect the models presented here. These terms were therefore dropped from the models.

than Hispanic/Latinx students ( $M = 2.57, SD = 1.19$ ). There was also a significant *Two vs. One Letter UV* x independent college motives interaction on perceived value ( $b = 0.35, p = .019$ ), unit-specific perceived value ( $b = 0.35, p = .027$ ), and unit-specific interest ( $b = 0.42, p = .014$ ). These effects suggested that being in the two-letter utility-value condition (compared to the one-letter utility-value condition) had a more positive effect on each of these outcomes for students with more independent college motives.

**Summary of intent-to-treat analyses.** In sum, the ITT analyses did not reveal effects of being assigned to write two (vs. one) letters for any of the demographic groups or for more interdependent students. However, an unpredicted effect of being assigned to write two letters emerged: this condition was associated with higher levels of perceived value and interest for individuals with more *independent* college motives. In addition, Asian American students received significantly higher course grades than Hispanic/Latinx students. Given the low intervention fidelity in this study, the degree to which treatment effects in the ITT analyses are robust is unclear. I therefore conducted secondary analyses to further probe the effects of the different types of utility-value treatments.

### **Effects of Type and Number of Writing Assignments Completed**

I conducted an additional set of analyses among students who completed at least one of the three writing assignments ( $n = 442$ ), examining what they actually wrote (as opposed to what they were assigned to write). I created four groups by including control participants and summing the number of letters actually written by students in either of the utility-value conditions: control ( $n = 146$ ), UV0L (UV condition, zero letters written;  $n = 75$ ), UV1L (UV condition, one letter written;  $n = 147$ ), and UV2L (UV condition, two letters written;  $n = 74$ ). Raw means and standard deviations of each outcome for each of these groups are presented in

Table 22. I compared these four groups using three orthogonal contrasts: a *UV* contrast (control =  $-0.75$ ,  $UV0L = +0.25$ ,  $UV1L = +0.25$ ,  $UV2L = +0.25$ ), an *Any UV Letters vs. None* contrast (control =  $0$ ,  $UV0L = -1$ ,  $UV1L = +0.5$ ,  $UV2L = +0.5$ ), and a *Two UV Letters vs. One* contrast (control =  $0$ ,  $UV0L = 0$ ,  $UV1L = -0.5$ ,  $UV2L = +0.5$ ). These contrasts allowed me to test the effect of receiving any sort of utility-value treatment vs. control, the effects of writing any utility-value letters vs. none, and finally, to compare the effects of writing two vs. one utility-value letter (corresponding to the experimental treatment conditions).

I tested these contrasts instead of the experimental factors in models that were otherwise identical to the ITT models. In addition, to account for potential confounding of these contrasts with assignment completion (i.e., more letters corresponds to more assignments completed), I also included a completion variable, corresponding to the number of writing assignments students actually completed, regardless of type (ranging 1-3, standardized) and two-way interactions between this completion variable and each of the demographic, self-construal, and college motives moderators. This approach allowed me to test the effects of letter writing and assignment completion. Because I tested the effects of actual (rather than assigned) letter writing, participants were not strictly retained in their experimental conditions (i.e., two-letter and one-letter utility-value). As such, letter-writing effects from these models are non-experimental and cannot be interpreted as causal. For example, letter completion may be confounded with individual differences such as conscientiousness, and apparent effects of letter writing may thus be attributable to such individual differences.

**Effects of type and number of assignments completed as a function of demographic characteristics.** Effects from the model testing only demographic moderators are presented in Table 23. Students who completed more assignments performed better in the course ( $b = 0.25$ ,  $p$

< .001). In addition, there was a significant main effect of the *Any UV Letters vs. None* contrast on interest ( $b = -0.41, p = .029$ ) indicating that, on average, students in a utility-value condition who wrote at least one letter reported less interest in the material than those who only wrote UV essays. There was also an unpredicted *UV x Generational status* interaction on unit-specific perceived value ( $b = -0.58, p = .037$ ) indicating that the effect of being in a utility-value condition was more positive for CG students than FG students. Finally, there was a significant positive effect of the baseline covariate (i.e., baseline perceived value, prosocial utility value, interest, and college GPA) on each of the outcomes ( $ps < .001$ ).

**Effects of type and number of assignments completed as a function of demographic characteristics, self-construal, and college motives.** Effects from the model testing demographic, self-construal, and college motives moderators are presented in Table 24. There was a significant *Any UV Letters vs. None x Interdependent self-construal* interaction on prosocial utility value ( $b = 0.58, p = .007$ ), unit-specific perceived value ( $b = 0.41, p = .037$ ), and unit-specific interest ( $b = 0.44, p = .048$ ). These effects indicated that within the utility-value conditions, writing at least one letter was more positively associated with each of these outcomes for students with more interdependent self-construals (Figure 9). In addition, there was a significant *Two UV Letters vs. One x Interdependent self-construal* interaction on unit-specific perceived value ( $b = 0.48, p = .009$ ), indicating that writing two letters was more positively associated with unit-specific perceived value for students with more interdependent self-construals (Figure 9b). There was also a significant *UV x gender* effect ( $b = 0.59, p = .039$ ) indicating that utility-value treatment had a more positive effect on prosocial utility value for women than men (Figure 10). In addition, assignment completion was more positively associated with unit-specific interest ( $b = 0.17, p = .022$ ) for students with more independent self-

construals, and more positively associated with interest for women than for men ( $b = 0.25, p = .046$ ). Finally, the effects from the model with only demographic moderators were also significant in this model, with the exception of the *UV* x Generational status effect on unit-specific perceived value ( $b = -0.47, p = .095$ ).

**Summary of effects of type and number of assignments completed.** In sum, the analyses testing the type and number of assignments actually completed revealed a positive effect of writing at least one utility-value letter on prosocial utility value, unit-specific perceived value, and unit-specific interest for students with more interdependent self-construals. In addition, writing two letters (rather than only one) was more positively associated with unit-specific perceived value for more interdependent students. These effects are broadly consistent with hypotheses, but as noted above, they cannot be interpreted as causal. Interestingly, writing at least one utility-value letter was negatively associated with interest at the main effect level.

In addition, there were several effects of assignment completion, regardless of assignment type. Assignment completion, which might be thought of as engagement in the class or conscientiousness, was positively associated with course grade. Completing more assignments was also more positively associated with interest for women than for men, and more positively associated with the unit-specific interest for students with more independent self-construals. Though not directly relevant to the present research questions, these findings are interesting and may warrant further research.

Assignment to a utility-value condition was more positively associated with prosocial utility value for women than for men. This effect did not emerge in the ITT analyses, and may have only emerged here because students who did not complete any writing assignments were not included in these analyses. Previous research indicates that women tend to endorse

communal goals more than men (Diekmann et al., 2017; Horgan & Smith, 2006) and it is possible that women spontaneously considered the prosocial utility value of the material in their utility-value assignments. However, this interaction was not predicted, and the finding should be replicated in future research to determine whether it is robust.

Finally, there was an important inconsistency with the ITT analyses. In the ITT analyses, assignment to the two-letter (vs. one-letter) UV condition was associated with higher levels of value and interest for students with more independent college motives. However, in the analyses testing the type and number of assignments completed, writing a greater number of letters (whether comparing two letters to one, or any letters to none) was not associated with these outcomes for more independent students. Given that intervention fidelity was relatively low, it is possible that the ITT findings were driven by random variation between the two utility-value conditions rather than reflecting true differential effects of letter writing. Additional research would be necessary to examine whether these patterns replicate.

### **Linguistic Analyses**

To assess how the different writing prompts affected participants' writing in this study, I tested the effects of the different writing assignment types on the four LIWC content variables and four LIWC style variables examined in Study 2. The linguistic variables were computed only from students' third writing assignments, allowing for clear differentiation between the conditions. For this assignment, students in the two-letter utility-value condition were assigned to write a utility-value letter, those in the one-letter utility-value condition were assigned to write a utility-value essay, and those in the control condition were assigned to write a control essay. Zero-order correlations and descriptive statistics for these measures are presented in Table 25. In these analyses, I restricted the sample to only those students that completed the third assignment

( $n = 355$ ) and regressed each of the linguistic variables on two contrasts corresponding to the type of assignment each student actually completed: *UV* (control =  $-.67$ , utility-value essay =  $+.33$ , utility-value letter =  $+.33$ ) and *Letter vs. Essay* (control =  $0$ , utility-value essay =  $-.5$ , utility-value letter =  $+.5$ ).

**LIWC variables – content.** As in Study 2, I tested for effects on first-person singular pronouns, social words, and the two social subcategories (family words and friend words). Effects on each of the LIWC content variables are presented in Table 26. Effects of the three assignment types were mostly consistent with those in Study 2. There was a significant effect of the *UV* contrast on first-person singular pronouns ( $b = 1.03, p < .001$ ), social words ( $b = 1.73, p < .001$ ), and friend words ( $b = 0.14, p < .001$ ), indicating that each of these types of writing occurred more frequently in the utility-value conditions than the control condition. In addition, as in Study 2, there was a significant effect of the *Letter vs. Essay* contrast on social words ( $b = 2.08, p < .001$ ), and friend words ( $b = 0.21, p < .001$ ). Students who were assigned to write a utility-value letter on assignment 3 wrote papers with more social words and friend words than those assigned to write a utility-value essay. There was no effect of the *UV* contrast on family words ( $b = 0.12, p = .316$ ), nor an effect of the *Letter vs. Essay* contrast on first-person singular pronouns ( $b = -0.28, p = .133$ ), in contrast to Study 2.

**LIWC variables – style.** I tested for effects of assignment type on each of the four LIWC summary variables: analytical thinking, clout, authenticity, and emotional tone (Table 27). As in Study 2, students in a UV condition had writing that reflected less analytical thinking ( $b = -11.68, p < .001$ ) and more positive emotional tone ( $b = 9.91, p < .001$ ) than students in the control condition. In this study, students in the UV condition also had writing that reflected more clout than participants in the control condition ( $b = 6.15, p = .001$ ).

As in Study 2, writing a utility-value letter (as compared to an essay) resulted in writing that reflected less analytical thinking ( $b = -6.90, p = .003$ ), more clout ( $b = 13.39, p < .001$ ), and more positive emotional tone ( $b = 10.87, p < .001$ ), on average. However, in contrast to Study 2, letters did not reflect more authenticity than essays ( $b = -3.14, p = .125$ ).

### Discussion

This study provided additional support for the hypothesis that other-oriented utility-value writing can support interdependent students' value and interest in academic material (RQ1). Writing at least one utility-value letter (compared to none) was associated with higher perceived value and interest in the particular units taught in the biology course, as well as perceptions that biology could be used to help other people, for students with more interdependent self-construals (though not students with more interdependent college motives; RQ3b). These findings are consistent with Study 2, in which being assigned to write a utility-value letter (vs. an essay) had a more positive effect on value and interest in a biological topic for participants with more interdependent self-construals. In addition, the linguistic characteristics of letter writing were largely consistent between these two studies. In each study, writing a utility-value letter (vs. an essay) was associated with increased social words (and in particular, friend words), as well as a less analytic, more authoritative (i.e., clout), and more emotionally positive style. Together, these studies provide consistent evidence of how the format of utility-value assignments (letter vs. essay) can affect the content of students' writing, and suggest that writing in this format can promote positive perceptions of academic material for individuals whose conceptions of themselves are defined in terms of their relationships with others.

In the present study, the effects of utility-value letter writing were not moderated by students' race/ethnicity or generational status (RQ3a). Existing theory and research suggests that



some cultures have developed to emphasize interdependence more than others (e.g., Asian, Hispanic/Latinx, working-class cultures; Cross et al., 2011; Markus & Kitayama, 2010; Stephens, Fryberg, et al., 2012), and I hypothesized that individuals from these backgrounds might particularly benefit from engaging in other-oriented utility-value writing. Indeed, Studies 1 and 2 provided some evidence for this possibility, though these effects were not consistent across studies (i.e., letter-writing effects for Asian American students in Study 1 and for participants without college-educated parents in Study 2). But in the present study, there was no evidence of moderation by these cultural background characteristics. One possibility is that self-report measures, such as those assessing self-construal or college motives (Singelis, 1994; Stephens, Fryberg, et al., 2012) detect differences that are relatively stable across contexts, whereas demographic differences in these constructs are more variable.

Interestingly, the most consistent effects of letter writing for interdependent students emerged when comparing writing any letter to writing no letters. I assigned all students in the utility-value conditions to write a mixture of letters and essays, and expected that a mixture that included a greater number of letters would increase benefit interdependent students. However, compliance with treatment was quite low, and many students in the utility-value conditions did not complete any letters. It is thus notable that writing at least one letter increased perceptions of value and interest for students with more interdependent self-construal. This finding suggests that for these students, it may be beneficial to engage in some reflection on utility value in the format of a letter. In addition, there was a stronger effect of writing two letters (vs. one) for more interdependent students on unit-specific perceived value, suggesting that there may be some advantage to providing a higher dose of letters. However, additional research is needed to thoroughly test this possibility.

In this study, I collected measures of interdependent and independent self-construal (Singelis, 1994) and motives for completing a college degree (Stephens, Fryberg, et al., 2012). Though statistically significant, the correlations between these measures were surprisingly low ( $r_s < .23$ ), suggesting that – while related – these measures are distinct. Measures of self-construal may detect individuals' cross-situational views of the self, whereas students' college motives may reflect the degree to which interdependence and independence characterize their goals and values within a college context. The relatively small association between these indicators suggests that individuals who define themselves in terms of their relationships may nevertheless focus on independent goals in school, and those who define themselves more in terms of their individuality may nevertheless pursue a college degree with the goal of giving back to others. Future research should continue to examine the individual and situational characteristics that determine alignment between people's self-construal and their motives in a particular context.

In the case of students at Pasadena City College, I found that Asian students reported higher levels of interdependent self-construal than European American students, consistent with theory and prior research (Markus & Kitayama, 2010; Singelis & Sharkey, 1995). However, Hispanic/Latinx students – whose cultural backgrounds are also theorized to be characterized by interdependence (Cross et al., 2011) – did not report higher levels of interdependent self-construal. Instead, consistent with Study 1, these students reported higher levels of interdependent college motives. One possibility is that interdependence may take different forms in different cultures, and college motives may better capture the interdependent goals that characterize Hispanic/Latinx students. Another possibility is that interdependent college motives, which include goals such as “show that people with my background can do well” and “be a role

model for people in my community,” may particularly detect the goals of individuals from underrepresented ethnic/racial minority groups. Students from these groups face structural and psychological disadvantages in the education system (Carroll & Muller, 2018; Riegle-Crumb, 2006; Steele, 1997; Sutton et al., 2018), and as such, they may be particularly motivated to help others that face similar barriers to success. Indeed, prior research suggests that Hispanic/Latinx and black cultures place particular importance on helping members of their own communities (Harper, 2005; Torres, 2009). Consistent with this possibility, in the present study (and in Study 1), black students also reported higher levels of interdependent college motives than European American students, but neither black nor Hispanic/Latinx individuals reported higher levels of interdependent self-construal. Future research comparing Hispanic/Latinx individuals living in the United States to those living in Central and South American countries may help to inform which aspects of interdependence are linked to Central and South American culture, and which may be specifically linked to the experiences of underrepresented minorities.

Demographic differences in self-construal and college motives were not entirely consistent with those found in Studies 1 and 2, or with prior research. For example, whereas Asian Americans reported higher levels of interdependent self-construal than European Americans in the present study, this was not the case among the survey panelists in Study 2. Similarly, in contrast to Study 1, Asian Americans in this study did not report more interdependent college motives than European Americans. In addition, inconsistent with theory and prior research (Stephens, Fryberg, et al., 2012; Stephens, Markus, et al., 2014), FG students did not report higher levels of interdependent college motives in this study. These inconsistent results suggest that cultural differences in self-construal and college motives may be stronger or weaker in different contexts. Additional research is necessary to identify the factors that

determine when demographic differences in these measures are likely to emerge.

Although writing at least one letter (vs. none) was more positively associated with unit-specific value perceptions and interest for more interdependent students, this effect did not emerge on the general measures of perceived value and interest, which were broadly about the field of biology. It is possible that these effects are most likely to remain localized to the particular topics that students write about and do not readily translate to more general attitudes about a domain, at least in the short term. Indeed, the letter-writing effects in Study 2 were also on measures of value and interest that were topic-specific (i.e., about fungi). On the other hand, the letter-writing effects in Study 1 were on measures of value and interest for biology in general. Additional research is necessary to evaluate the conditions under which reflecting on the other-oriented relevance of material might affect individuals' conceptions of an entire academic domain. Such research is especially important if we wish to understand how these interventions might influence future decisions (e.g., course taking) and have long-lasting effects.

The most important limitation of this study is the poor intervention fidelity. Only 57% of participants completed all three of the writing assignments, and for assignments 2 and 3 (after both letter and essay formats had been introduced), many students who were assigned to write a letter wrote an essay instead. As a result, the ITT analyses were uninterpretable, and it was necessary to conduct a secondary set of analyses among students who completed at least one assignment, testing the effects of the type and quantity of assignments they actually completed. Therefore, causal inferences cannot be drawn from this study about the effects of letter writing. However, the results are consistent with the possibility that letter writing can be an effective means of promoting value and interest for students with more interdependent self-construals, particularly in light of the findings from Study 2 which provided causal evidence to support this

hypothesis. An important next step for this research is to conduct an additional field experiment similar to Study 3 in which a higher degree of intervention fidelity can be ensured. Such a study would provide stronger evidence that the positive effects of letter writing found in Study 2 can, indeed, translate into positive intervention effects in academic settings.

### **General Discussion**

In the present research, I investigated three questions: whether other-oriented utility-value writing would benefit more interdependent individuals (RQ1), the role of format (i.e., letter vs. essay) and subject (i.e., other vs. self) in producing these effects (RQ2), and which cultural and individual-level (i.e., self-report) indicators of interdependence moderate the effects of such writing (RQ3a and RQ3b, respectively).

#### **Research Question 1: Effects of Other-Oriented Writing for More Interdependent**

##### **Individuals**

In general, findings across the three studies are consistent with the hypothesis that other-oriented utility-value writing can promote perceptions of value and interest for students who are more interdependent. Such writing had a more positive effect on value and interest for more interdependent students at a flagship state university (Study 1), in an online survey panel (Study 2), and at a two-year college (Study 3).

These findings enhance our understanding of the psychological experience of interdependent students as they engage with academic content. Considering academic material in relation to friends or family seems to play an especially important role in the development of these students' value and interest in an academic topic. In addition, the present studies have promising implications for practice. Findings suggest that asking students to write letters about utility value may be a particularly effective intervention strategy for students who are more

interdependent, and potentially for Asian American and/or working-class students. As such, these results may help researchers and practitioners to use a more precise and targeted approach to promote value and interest among students. For example, utility-value interventions may have more widespread positive effects if researchers first evaluate the motivational and cultural characteristics of students and subsequently provide assignments that are individualized based on these characteristics.

Notably, there were no effects of other-oriented utility-value writing on academic performance for more interdependent individuals in these studies. Although a large body of research indicates that value and interest predict academic performance (e.g., Harackiewicz et al., 2008; Hulleman et al., 2008; Wang, 2012), these are just two of many factors that influence students' performance, and the effects on interest and value in the present studies may not have been strong enough to, in turn, affect performance. On the other hand, it is possible that effects on long-term choice outcomes (e.g., course taking, academic major) might emerge in follow-up studies. Such choices are more theoretically linked to students' motivational beliefs than performance, and value and interest have been found to strongly predict course-taking, academic major, and career aspirations (e.g., Harackiewicz et al., 2008; Nagengast et al., 2011; Wang, 2012). In addition, previous research has found effects of utility-value interventions on students' long-term course-taking trajectories (Canning et al., 2018; Hecht et al., 2019), and letter writing predicted more positive behavioral intentions for more interdependent participants in Study 2, indicating some potential for this approach to affect participants' future choices. Longitudinal research will be necessary to examine the potential of utility-value letter writing to promote pursuit of a particular domain among more interdependent students.

## **Research Question 2: The Relative Roles of Subject and Format**

In Study 2, I manipulated the format (i.e., letter vs. essay) and subject (i.e., other vs. self) of utility-value writing in a factorial design and found that format (but not subject) predicted perceived value, interest, and positive behavioral intentions for more interdependent participants. Writing a letter to a friend or family member about the value of the material had a more positive effect on interest and value perceptions for more interdependent individuals, regardless of the subject of the utility-value letter (i.e., whether participants were assigned to write about the value of the material for the letter recipient or for themselves). Writing to a friend or family member about the value of a topic is inherently more social than writing about value in an essay format. The individual must imagine communicating the information and thereby reflect on the value of the material in a more social context. This increased connection between the academic topic and interpersonal relationships may make the material feel especially important and relevant to interdependent individuals, for whom relationships are an important aspect of their identity.

Indeed, the letter format led individuals to write in a way that reflected more social processes, and in particular, writing about friends (as indexed by LIWC) partially mediated effects of letter writing on task interest and behavioral intentions for more interdependent participants in Study 2. The letter format also increased the degree to which individuals' writing reflected "clout" (i.e., authority and leadership), and this type of writing partially mediated the effects of letter writing on task interest for individuals without college-educated parents (compared to those with at least one college-educated parent). By explaining the material to a friend or family member, these individuals may have felt a greater sense of comfort with the material and grown more interested. These findings suggest that utility-value letters may spark socially-oriented psychological processes – including a focus on others and taking on the role of "teacher" – that may be especially powerful for particular interdependent groups. As such, the

format of utility-value writing may not simply be an incidental feature of the intervention, but rather a critical intervention component for particular groups of students.

On the other hand, a drawback of the letter assignment in the present research is that individuals were less likely to comply with instructions when they were assigned to write a utility-value letter as compared to an essay. In Study 2, 35% of participants assigned to write a letter wrote an essay instead, and in Study 3, more than 20% of students who completed an assignment when assigned a letter wrote an essay instead. Conversely, in Study 2, only 2% of participants assigned to write an essay wrote a letter instead, and only one student in Study 3 wrote a letter when assigned to write an essay. One possible explanation is that for the age group targeted here (i.e., college students and 18-35 year-old adults), assignments to write in this format may feel less scientific and possibly “childish” to some. Such perceptions may lead to reactance. It is also possible that the letter assignment was more cognitively demanding as it requires the individual to describe the value of a topic to another person, and participants may have simply opted for the “easier” essay assignment. Finally, in Study 3, because all students were assigned an essay before a letter and because the writing prompts look similar to one another (see Appendix E), students may have simply assumed the letter assignment was the same as the essay assignment they had already completed. Additional research is needed to understand the potential drawbacks of assigned letters, particularly among learners in this age group, and to develop strategies that increase compliance with assignment instructions while preserving the benefits of this format for more interdependent individuals.

### **Research Question 3: Moderation of Other-Oriented Utility-Value Writing**

Research question 3 concerned the cultural and individual-level (i.e., self-report) moderators of other-oriented utility-value writing. Across the three studies, self-reported



measures of interdependence moderated the effects of letter writing (RQ3b). Specifically, utility-value letter writing was more positively associated with measures of interest and value for students with more interdependent college motives in Study 1, survey panelists with more interdependent self-construals in Study 2, and students with more interdependent self-construals in Study 3. On the other hand, moderation by cultural background was inconsistent (RQ3a). I expected that such writing might benefit Asian, Hispanic/Latinx, and/or individuals without college-educated parents on the basis of prior theory and research (Cross et al., 2011; Markus & Kitayama, 2010; Stephens, Fryberg, et al., 2012; Stephens, Markus, et al., 2014). However, letter-writing effects were stronger for Asian Americans in Study 1, individuals without college-educated parents in Study 2, and were not stronger for any particular groups in Study 3. Although these findings provide some evidence that other-oriented utility-value writing may benefit individuals from some cultural backgrounds, results suggest that such writing more consistently promotes interest and value for more interdependent individuals, regardless of cultural background.

Further complicating this issue is the fact that demographic differences in self-construal and college motives were inconsistent across the three studies. For example, Asian American students were higher than European American students in interdependent self-construal in Study 3, but not in Study 2. They were also higher than European Americans in interdependent college motives in Study 1, but not in Study 3. There were similar inconsistencies in social-class differences. FG students were higher in interdependent college motives in Study 1 but not in Study 3. These findings suggest that theorized cultural differences in independence and interdependence may not be uniform across contexts. Instead, students' values and self-construals may partly on the characteristics of one's daily life and the local context in which they

are embedded. Each of the three studies were conducted among very different samples (i.e., students at a flagship state university, online survey panelists, and students at a diverse two-year college), and the experience of Asian Americans, Hispanic/Latinx individuals, and individuals without college-educated parents may vary greatly across these contexts.

Such variability raises an important challenge for future research: to identify sources of contextual heterogeneity in cultural differences in interdependence. In addition, these findings suggest that the present intervention strategy may be more effective for more interdependent students across contexts, rather than for individuals from particular backgrounds. Results from these studies suggest that utility-value letter writing can be effective when students endorse more interdependent values, and when particular groups are not especially high in interdependence, such writing is unlikely to benefit these groups as much.

### **Limitations**

This research has several important limitations. First, these studies do not allow for strong causal inference regarding the effects of other-oriented utility-value writing in the field. Of the two studies conducted in college settings, one was not designed to test the effects of utility-value letter writing (Study 1), and the other – which *was* designed to provide such a test – had poor intervention fidelity and required supplemental correlational analyses (Study 3). Study 2 provided causal evidence for the positive effects of letter writing, but these effects were obtained in a brief online learning session and lack ecological validity. A field experiment with a design similar to that tested in Study 3, but with improved intervention fidelity, is needed to provide a stronger test of other-oriented utility-value writing.

Second, the samples in each of the different studies were comprised of different demographic groups. The diversity of the samples was a strength with respect to generalizability,

but differences in the samples made specific comparisons difficult. In particular, Study 2 – which provided the best experimental assessment of other-oriented utility-value writing – was limited to Asian American and European American participants. As such, it was not possible to examine whether letter writing was effective for Hispanic/Latinx individuals in this study. In addition, because Study 2 was not conducted specifically among college students, generational status (i.e., FG vs. CG) was not a meaningful construct in this sample. Although letter-writing effects were more positive for individuals without college-educated parents, additional research is necessary to examine whether such effects may also emerge for FG students in particular academic contexts.

Third, the different studies included different measures of interdependence and independence. The Study 1 analyses were conducted with a secondary dataset that did not contain a measure of self-construal, and Study 2 was not conducted among college students, precluding measurement of college motives. Only Study 3 contained both of these measures, and the correlations between independent and interdependent self-construal and college motives were very small in that study. Thus, because self-construal was not measured in Study 1, it is impossible to know whether similar effects of letter writing in that study would have emerged for students with more interdependent self-construals. In future research, it will be valuable to identify the aspects of interdependence and independence that are detected by each of these measures, and to study both of these measures in more contexts. For example, because the college motives measure was designed to study the effects of parental education, this measure may detect “hard interdependence” to a greater degree than the self-construal scale. Research investigating these issues will be necessary to identify intervention strategies that are effective *both* for individuals with interdependent self-construals and college motives.

Finally, these studies were conducted in three very different contexts. Although utility-value interventions have been found to increase interest, performance, and value perceptions in previous research (Canning & Harackiewicz, 2015; Harackiewicz et al., 2016; Hecht et al., 2020; Hulleman & Harackiewicz, 2009), these effects have typically been found in the context of four-year universities and high schools. In the case of the present research, Study 2 was conducted in a brief online learning session and Study 3 was conducted in the context of a two-year college. The effects of utility-value interventions in brief online studies are not well understood to date, and research suggests that these interventions can be less effective in two-year college contexts (Canning et al., 2019). Increasingly, intervention research is identifying that the effects of social-psychological interventions are heterogeneous, depending on features of the particular context (Walton & Yeager, 2020; Yeager et al., under review, 2019). Given the diversity of the contexts in the present research, the stability of letter-writing effects for more interdependent individuals is somewhat surprising. Nevertheless, in future research, samples from a wide variety of settings should be included and theoretically relevant moderators should be tested to identify systematic sources of heterogeneity. Such work is necessary to inform (a) the conditions under which other-oriented utility-value reflection is most theoretically relevant for interdependent students' motivation, and (b) the contexts in which other-oriented utility-value writing may have the most practical implications for improving students' attitudes and outcomes.

## **Conclusion**

For social-psychological interventions to be effective, they must be implemented with an understanding of the pre-existing psychological experience of those who will receive the intervention (Harackiewicz & Priniski, 2018; Lewin, 1951; Miller & Prentice, 2013; Ross & Nisbett, 1991; Walton, 2014; Walton & Wilson, 2018). Perceptions of usefulness have been

identified as one worthwhile target of intervention (e.g., Hulleman & Harackiewicz, 2009), and the present research suggests that individuals who define themselves largely in terms of their relationships (i.e., those who are more interdependent) may benefit from reflecting on the usefulness of academic material in relation to valued others. In sum, this research provides insight into the processes by which individuals who are more interdependent come to develop interest and value perceptions in academic topics, and provides evidence for a promising intervention approach that may help to engage these students in their coursework.

## References

- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*, 122–147. <https://doi.org/10.1037/0003-066X.37.2.122>
- Baumeister, R. F. (Ed.). (1986). *Public self and private self*. Springer New York.  
<https://doi.org/10.1007/978-1-4613-9564-5>
- Bong, M. (2001a). Between- and within-domain relations of academic motivation among middle and high school students: Self-efficacy, task value, and achievement goals. *Journal of Educational Psychology*, *93*, 23–34. <https://doi.org/10.1037/0022-0663.93.1.23>
- Bong, M. (2001b). Role of self-efficacy and task-value in predicting college students' course performance and future enrollment intentions. *Contemporary Educational Psychology*, *26*, 553–570. <https://doi.org/10.1006/ceps.2000.1048>
- Brewer, M. B., & Gardner, W. (1996). Who is this “we”? Levels of collective identity and self representations. *Journal of Personality and Social Psychology*, *71*, 83–93.  
<https://doi.org/10.1037/0022-3514.71.1.83>
- Canning, E. A., & Harackiewicz, J. M. (2015). Teach it, don't preach it: The differential effects of directly-communicated and self-generated utility–value information. *Motivation Science*, *1*, 47–71. <https://doi.org/10.1037/mot0000015>
- Canning, E. A., Harackiewicz, J. M., Priniski, S. J., Hecht, C. A., Tibbetts, Y., & Hyde, J. S. (2018). Improving performance and retention in introductory biology with a utility-value intervention. *Journal of Educational Psychology*, *110*, 834–849.  
<https://doi.org/10.1037/edu0000244>

- Canning, E. A., Priniski, S. J., & Harackiewicz, J. M. (2019). Unintended consequences of framing a utility-value intervention in two-year colleges. *Learning and Instruction, 62*, 37–48. <https://doi.org/10.1016/j.learninstruc.2019.05.001>
- Carroll, J. M., & Muller, C. (2018). Curricular differentiation and its impact on different status groups including immigrants and students with disabilities. In B. Schneider (Ed.), *Handbook of the sociology of education in the 21st century* (pp. 251–273). Springer International Publishing. [https://doi.org/10.1007/978-3-319-76694-2\\_11](https://doi.org/10.1007/978-3-319-76694-2_11)
- Cross, S. E., Bacon, P. L., & Morris, M. L. (2000). The relational-interdependent self-construal and relationships. *Journal of Personality and Social Psychology, 78*, 791–808. <https://doi.org/10.1037/0022-3514.78.4.791>
- Cross, S. E., Hardin, E. E., & Gercek-Swing, B. (2011). The *what, how, why, and where* of self-construal. *Personality and Social Psychology Review, 15*, 142–179. <https://doi.org/10.1177/1088868310373752>
- Dewey, J. (1913). *Interest and effort in education*. Houghton Mifflin.
- Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science, 21*, 1051–1057. <https://doi.org/10.1177/0956797610377342>
- Diekman, A. B., Clark, E. K., Johnston, A. M., Brown, E. R., & Steinberg, M. (2011). Malleability in communal goals and beliefs influences attraction to stem careers: Evidence for a goal congruity perspective. *Journal of Personality and Social Psychology, 101*, 902–918. <https://doi.org/10.1037/a0025199>

- Diekmann, A. B., Steinberg, M., Brown, E. R., Belanger, A. L., & Clark, E. K. (2017). A goal congruity model of role entry, engagement, and exit: Understanding communal goal processes in STEM gender gaps. *Personality and Social Psychology Review, 21*, 142–175. <https://doi.org/10.1177/1088868316642141>
- Durik, A. M., Shechter, O. G., Noh, M., Rozek, C. S., & Harackiewicz, J. M. (2015). What if I can't? Success expectancies moderate the effects of utility value information on situational interest and performance. *Motivation and Emotion, 39*, 104–118. <https://doi.org/10.1007/s11031-014-9419-0>
- Durik, A. M., Vida, M., & Eccles, J. S. (2006). Task values and ability beliefs as predictors of high school literacy choices: A developmental analysis. *Journal of Educational Psychology, 98*, 382–393. <https://doi.org/10.1037/0022-0663.98.2.382>
- Eccles, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist, 44*, 78–89. <https://doi.org/10.1080/00461520902832368>
- Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., Midgley, C., & Spence, J. T. (1983). Expectations, values and academic behaviors. In *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75–146). Freeman.
- Gardner, W. L., Gabriel, S., & Hochschild, L. (2002). When you and I are “we,” you are not threatening: The role of self-expansion in social comparison. *Journal of Personality & Social Psychology, 82*, 239–251. <https://doi.org/10.1037//0022-3514.82.2.239>



- Gardner, W. L., Gabriel, S., & Lee, A. Y. (1999). “I” value freedom, but “we” value relationships: Self-construal priming mirrors cultural differences in judgment. *Psychological Science, 10*, 321–326. <https://doi.org/10.1111/1467-9280.00162>
- Gaspard, H., Dicke, A.-L., Flunger, B., Brisson, B. M., Häfner, I., Nagengast, B., & Trautwein, U. (2015). Fostering adolescents’ value beliefs for mathematics with a relevance intervention in the classroom. *Developmental Psychology, 51*, 1226–1240. <https://doi.org/10.1037/dev0000028>
- Gore, J. S., & Cross, S. E. (2006). Pursuing goals for us: Relationally autonomous reasons in long-term goal pursuit. *Journal of Personality and Social Psychology, 90*, 848–861. <https://doi.org/10.1037/0022-3514.90.5.848>
- Gore, J. S., Cross, S. E., & Kanagawa, C. (2009). Acting in our interests: Relational self-construal and goal motivation across cultures. *Motivation and Emotion, 33*, 75–87. <https://doi.org/10.1007/s11031-008-9113-1>
- Gudykunst, W. B., Matsumoto, Y., Ting-Toomey, S., Nishida, T., Kim, K., & Heyman, S. (1996). The influence of cultural individualism-collectivism, self construals, and individual values on communication styles across cultures. *Human Communication Research, 22*, 510–543. <https://doi.org/10.1111/j.1468-2958.1996.tb00377.x>
- Harackiewicz, J. M., & Barron, K. E. (2004). Conducting social psychological research in educational settings: “Lessons we learned in school.” In C. Sansone, C. Morf, & A. T. Panter (Eds.), *Handbook of methods in social psychology* (pp. 471–484). Sage Publications.
- Harackiewicz, J. M., Canning, E. A., Tibbetts, Y., Giffen, C. J., Blair, S. S., Rouse, D. I., & Hyde, J. S. (2014). Closing the social class achievement gap for first-generation students

- in undergraduate biology. *Journal of Educational Psychology*, *106*, 375–389.  
<https://doi.org/10.1037/a0034679>
- Harackiewicz, J. M., Canning, E. A., Tibbetts, Y., Priniski, S. J., & Hyde, J. S. (2016). Closing achievement gaps with a utility-value intervention: Disentangling race and social class. *Journal of Personality and Social Psychology*, *111*, 745–765.  
<https://doi.org/10.1037/pspp0000075>
- Harackiewicz, J. M., Durik, A. M., Barron, K. E., Linnenbrink-Garcia, L., & Tauer, J. M. (2008). The role of achievement goals in the development of interest: Reciprocal relations between achievement goals, interest, and performance. *Journal of Educational Psychology*, *100*, 105–122. <https://doi.org/10.1037/0022-0663.100.1.105>
- Harackiewicz, J. M., & Priniski, S. J. (2018). Improving student outcomes in higher education: The science of targeted intervention. *Annual Review of Psychology*, *69*, 409–435.  
<https://doi.org/10.1146/annurev-psych-122216-011725>
- Hardin, E. E., Leong, F. T. L., & Bhagwat, A. A. (2004). Factor structure of the self-construal scale revisited: Implications for the multidimensionality of self-construal. *Journal of Cross-Cultural Psychology*, *35*, 327–345. <https://doi.org/10.1177/0022022104264125>
- Harper, S. R. (2005). Leading the way: Inside the experiences of high-achieving African American male students. *About Campus*, *10*, 8–15. <https://doi.org/10.1002/abc.118>
- Hecht, C. A., Grande, M. R., & Harackiewicz, J. M. (2020). The role of utility value in promoting interest development. *Motivation Science*. <https://doi.org/10.1037/mot0000182>
- Hecht, C. A., Harackiewicz, J. M., Priniski, S. J., Canning, E. A., Tibbetts, Y., & Hyde, J. S. (2019). Promoting persistence in the biological and medical sciences: An expectancy-

- value approach to intervention. *Journal of Educational Psychology*, *111*, 1462–1477.  
<https://doi.org/10.1037/edu0000356>
- Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist*, *41*, 111–127. [https://doi.org/10.1207/s15326985ep4102\\_4](https://doi.org/10.1207/s15326985ep4102_4)
- Horgan, T. G., & Smith, J. L. (2006). Interpersonal reasons for interpersonal perceptions: Gender-incongruent purpose goals and nonverbal judgment accuracy. *Journal of Nonverbal Behavior*, *30*, 127–140. <https://doi.org/10.1007/s10919-006-0012-4>
- Hulleman, C. S., & Barron, K. E. (2016). Motivation interventions in education: Bridging theory, research, and practice. In L. Corno & E. M. Anderman (Eds.), *Handbook of educational psychology* (pp. 160–171). Routledge/Taylor & Francis Group.
- Hulleman, C. S., & Cordray, D. S. (2009). Moving from the lab to the field: The role of fidelity and achieved relative intervention strength. *Journal of Research on Educational Effectiveness*, *2*, 88–110. <https://doi.org/10.1080/19345740802539325>
- Hulleman, C. S., Durik, A. M., Schweigert, S. B., & Harackiewicz, J. M. (2008). Task values, achievement goals, and interest: An integrative analysis. *Journal of Educational Psychology*, *100*, 398–416. <https://doi.org/10.1037/0022-0663.100.2.398>
- Hulleman, C. S., Godes, O., Hendricks, B. L., & Harackiewicz, J. M. (2010). Enhancing interest and performance with a utility value intervention. *Journal of Educational Psychology*, *102*, 880–895. <https://doi.org/10.1037/a0019506>
- Hulleman, C. S., & Harackiewicz, J. M. (2009). Promoting interest and performance in high school science classes. *Science*, *326*, 1410–1412.  
<https://doi.org/10.1126/science.1177067>

- Hulleman, C. S., Kosovich, J. J., Barron, K. E., & Daniel, D. B. (2017). Making connections: Replicating and extending the utility value intervention in the classroom. *Journal of Educational Psychology, 109*, 387–404. <https://doi.org/10.1037/edu0000146>
- Husman, J., Derryberry, W. P., Crowson, H. M., & Lomax, R. (2004). Instrumentality, task value, and intrinsic motivation: Making sense of their independent interdependence. *Contemporary Educational Psychology, 29*, 63–76. [https://doi.org/10.1016/S0361-476X\(03\)00019-5](https://doi.org/10.1016/S0361-476X(03)00019-5)
- Husman, J., & Lens, W. (1999). The role of the future in student motivation. *Educational Psychologist, 34*, 113–125. [https://doi.org/10.1207/s15326985ep3402\\_4](https://doi.org/10.1207/s15326985ep3402_4)
- James, W. (1890). *The principles of psychology*. Harvard University Press (reprinted 1983).
- Lee, A. Y., Aaker, J. L., & Gardner, W. L. (2000). The pleasures and pains of distinct self-construals: The role of interdependence in regulatory focus. *Journal of Personality and Social Psychology, 78*, 1122–1134. <https://doi.org/10.1037/0022-3514.78.6.1122>
- Lewin, K. (1951). *Field theory in social science* (D. Cartwright, Ed.). Harper.
- Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*, 224–253. <https://doi.org/10.1037/0033-295X.98.2.224>
- Markus, H. R., & Kitayama, S. (2010). Cultures and selves: A cycle of mutual constitution. *Perspectives on Psychological Science, 5*, 420–430. <https://doi.org/10.1177/1745691610375557>
- Markus, H. R., & Wurf, E. (1987). The dynamic self-concept: A social psychological perspective. *Annual Review of Psychology, 38*, 299–337. <https://doi.org/10.1146/annurev.ps.38.020187.001503>

- Marsh, H. W., Trautwein, U., Lüdtke, O., Köller, O., & Baumert, J. (2005). Academic self-concept, interest, grades, and standardized test scores: Reciprocal effects models of causal ordering. *Child Development, 76*, 397–416. <https://doi.org/10.1111/j.1467-8624.2005.00853.x>
- Miller, D. T., & Prentice, D. A. (2013). Psychological levers of behavior change. In E. Shafir (Ed.), *The behavioral foundations of public policy* (pp. 301–309). Princeton University Press.
- Mortensen, C. R., & Cialdini, R. B. (2010). Full-cycle social psychology for theory and application. *Social and Personality Psychology Compass, 4*, 53–63. <https://doi.org/10.1111/j.1751-9004.2009.00239.x>
- Nagengast, B., Marsh, H. W., Scalas, L. F., Xu, M. K., Hau, K.-T., & Trautwein, U. (2011). Who took the “×” out of expectancy-value theory?: A psychological mystery, a substantive-methodological synergy, and a cross-national generalization. *Psychological Science, 22*, 1058–1066. <https://doi.org/10.1177/0956797611415540>
- Oyserman, D. (2009). Identity-based motivation: Implications for action-readiness, procedural-readiness, and consumer behavior. *Journal of Consumer Psychology, 19*, 250–260. <https://doi.org/10.1016/j.jcps.2009.05.008>
- Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66*, 543–578. <https://doi.org/10.3102/00346543066004543>
- Pennebaker, J. W., Booth, R. J., Boyd, R. L., & Francis, M. E. (2015). *Linguistic Inquiry and Word Count: LIWC2015*. Pennebaker Conglomerates ([www.LIWC.net](http://www.LIWC.net)).

- Priniski, S. J., Hecht, C. A., & Harackiewicz, J. M. (2018). Making learning personally meaningful: A new framework for relevance research. *The Journal of Experimental Education*, *86*, 11–29. <https://doi.org/10.1080/00220973.2017.1380589>
- Priniski, S. J., Rosenzweig, E. Q., Canning, E. A., Hecht, C. A., Tibbetts, Y., Hyde, J. S., & Harackiewicz, J. M. (2019). The benefits of combining value for the self and others in utility-value interventions. *Journal of Educational Psychology*, *111*, 1478–1497. <https://doi.org/10.1037/edu0000343>
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed). Sage Publications.
- Renninger, K. A., & Hidi, S. (2016). *The power of interest for motivation and engagement*. Routledge.
- Riegle-Crumb, C. (2006). The path through math: Course sequences and academic performance at the intersection of race-ethnicity and gender. *American Journal of Education*, *113*, 101–122. <https://doi.org/10.1086/506495>
- Rosenzweig, E. Q., Harackiewicz, J. M., Priniski, S. J., Hecht, C. A., Canning, E. A., Tibbetts, Y., & Hyde, J. S. (2019). Choose your own intervention: Using choice to enhance the effectiveness of a utility-value intervention. *Motivation Science*, *5*, 269–276. <https://doi.org/10.1037/mot0000113>
- Ross, L., & Nisbett, R. E. (1991). *The person and the situation: Perspectives of social psychology*. Temple University Press.
- Rubin, D. B. (Ed.). (1987). *Multiple imputation for nonresponse in surveys*. John Wiley & Sons, Inc. <https://doi.org/10.1002/9780470316696>

- Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic-dialectical perspective. In E. L. Deci & R. M. Ryan (Eds.), *Handbook of self-determination research* (pp. 3–33). University of Rochester Press.
- Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist, 26*, 207–231. <https://doi.org/10.1080/00461520.1991.9653133>
- Sedikides, C., Gaertner, L., & Toguchi, Y. (2003). Pancultural self-enhancement. *Journal of Personality and Social Psychology, 84*, 60–79. <https://doi.org/10.1037/0022-3514.84.1.60>
- Singelis, T. M. (1994). The measurement of independent and interdependent self-construals. *Personality and Social Psychology Bulletin, 20*, 580–591. <https://doi.org/10.1177/0146167294205014>
- Singelis, T. M., & Sharkey, W. F. (1995). Culture, self-construal, and embarrassability. *Journal of Cross-Cultural Psychology, 26*, 622–644. <https://doi.org/10.1177/002202219502600607>
- Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52*, 613–629. <https://doi.org/10.1037/0003-066X.52.6.613>
- Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., & Covarrubias, R. (2012). Unseen disadvantage: How American universities' focus on independence undermines the academic performance of first-generation college students. *Journal of Personality and Social Psychology, 102*, 1178–1197. <https://doi.org/10.1037/a0027143>
- Stephens, N. M., Hamedani, M. G., & Destin, M. (2014). Closing the social-class achievement gap: A difference-education intervention improves first-generation students' academic

- performance and all students' college transition. *Psychological Science*, *25*, 943–953.  
<https://doi.org/10.1177/0956797613518349>
- Stephens, N. M., Markus, H. R., & Phillips, L. T. (2014). Social class culture cycles: How three gateway contexts shape selves and fuel inequality. *Annual Review of Psychology*, *65*, 611–634. <https://doi.org/10.1146/annurev-psych-010213-115143>
- Stephens, N. M., Townsend, S. S. M., Markus, H. R., & Phillips, L. T. (2012). A cultural mismatch: Independent cultural norms produce greater increases in cortisol and more negative emotions among first-generation college students. *Journal of Experimental Social Psychology*, *48*, 1389–1393. <https://doi.org/10.1016/j.jesp.2012.07.008>
- Studebaker, G. A. (1985). A “rationalized” arcsine transform. *Journal of Speech, Language, and Hearing Research*, *28*, 455–462. <https://doi.org/10.1044/jshr.2803.455>
- Sutton, A., Langenkamp, A. G., Muller, C., & Schiller, K. S. (2018). Who gets ahead and who falls behind during the transition to high school? Academic performance at the intersection of race/ethnicity and gender. *Social Problems*, *65*, 154–173.  
<https://doi.org/10.1093/socpro/spx044>
- Tibbetts, Y., Priniski, S. J., Hecht, C. A., Borman, G. D., & Harackiewicz, J. M. (2018). Different institutions and different values: Exploring first-generation student fit at 2-year colleges. *Frontiers in Psychology*, *9*. <https://doi.org/10.3389/fpsyg.2018.00502>
- Torres, L. (2009). Latino definitions of success: A cultural model of intercultural competence. *Hispanic Journal of Behavioral Sciences*, *31*, 576–593.  
<https://doi.org/10.1177/0739986309349186>
- Triandis, H. C. (1989). The self and social behavior in differing cultural contexts. *Psychological Review*, *96*, 506–520. <https://doi.org/10.1037/0033-295X.96.3.506>



- van Horen, F., Pöhlmann, C., Koeppen, K., & Hannover, B. (2008). Importance of personal goals in people with independent versus interdependent selves. *Social Psychology, 39*, 213–221. <https://doi.org/10.1027/1864-9335.39.4.213>
- Walton, G. M. (2014). The new science of wise psychological interventions. *Current Directions in Psychological Science, 23*, 73–82. <https://doi.org/10.1177/0963721413512856>
- Walton, G. M., & Wilson, T. D. (2018). Wise interventions: Psychological remedies for social and personal problems. *Psychological Review, 125*, 617–655. <https://doi.org/10.1037/rev0000115>
- Walton, G. M., & Yeager, D. S. (2020). Seed and soil: Psychological affordances in contexts help to explain where wise interventions succeed or fail. *Current Directions in Psychological Science. https://doi.org/10.1177/0963721420904453*
- Wang, M.-T. (2012). Educational and career interests in math: A longitudinal examination of the links between classroom environment, motivational beliefs, and interests. *Developmental Psychology, 48*, 1643–1657. <https://doi.org/10.1037/a0027247>
- Wigfield, A., & Cambria, J. (2010). Students' achievement values, goal orientations, and interest: Definitions, development, and relations to achievement outcomes. *Developmental Review, 30*, 1–35. <https://doi.org/10.1016/j.dr.2009.12.001>
- Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68–81. <https://doi.org/10.1006/ceps.1999.1015>
- Winer, B. J. (1962). *Statistical principles in experimental design*. McGraw-Hill Book Company. <https://doi.org/10.1037/11774-000>

- Yeager, D. S., Carroll, J. M., Buontempo, J., Cimpian, A., Woody, S., Crosnoe, R., Muller, C., Murray, J. S., Yang, S. M., Mhatre, P., Kersting, N., Hulleman, C. S., Kudym, M., Murphy, M. C., Walton, G. M., & Dweck, C. S. (under review). *Growth mindset intervention effects depend on teachers' mindsets.*
- Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., Tipton, E., Schneider, B., Hulleman, C. S., Hinojosa, C. P., Paunesku, D., Romero, C., Flint, K., Roberts, A., Trott, J., Iachan, R., Buontempo, J., Yang, S. M., Carvalho, C. M., ... Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature*, *573*, 364–369. <https://doi.org/10.1038/s41586-019-1466-y>
- Yuki, M., Maddux, W. W., Brewer, M. B., & Takemura, K. (2005). Cross-cultural differences in relationship- and group-based trust. *Personality and Social Psychology Bulletin*, *31*, 48–62. <https://doi.org/10.1177/0146167204271305>

## Tables

Table 1. *Experimental Designs across Semesters in Study 1.*

Assignment Distribution	Semester 1			Semester 2			Semester 3			Semester 4		
	A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3
Distribution 1	Choice	Choice	Choice	Choice	Choice	Choice	Letter	Essay	Choice	Essay	Letter	Essay
Distribution 2	NA	NA	NA	NA	NA	NA	Essay	Letter	Choice	Letter	Essay	Essay

*Note.* A1 = assignment 1, A2 = assignment 2, A3 = assignment 3.

Table 2. *Zero-Order Correlations and Descriptive Statistics for Major Variables in Study 1*

Variable	1	2	3	4	5
1. Interdependent college motives					
2. Independent college motives	.21***				
3. Perceived value	.16***	.00			
4. Interest	.14***	.06	.84***		
5. Course grade	-.13**	-.05	.32***	.25***	
<i>M</i>	3.14	3.65	5.51	5.43	2.80
<i>SD</i>	1.52	1.51	1.13	1.25	0.80
Cronbach's $\alpha$			.84	.94	

\*\*  $p < .01$ , \*\*\*  $p < .001$ .

Table 3. *Demographic Effects on Interdependent and Independent College Motives in Study 1*

Predictor	Interdependent college motives			Independent college motives		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
Asian American vs. European American	0.56	0.19	.003	0.33	0.20	.096
Hispanic/Latinx vs. European American	0.75	0.21	< .001	0.26	0.22	.219
Black vs. European American	1.23	0.23	< .001	-0.12	0.24	.630
Asian International vs. European American	-0.42	0.33	.198	-0.06	0.34	.868
Native American vs. European American	-0.33	0.49	.504	0.29	0.51	.576
Generational status	0.57	0.12	< .001	-0.25	0.13	.055
Gender	-0.21	0.12	.088	-0.23	0.13	.077

*Note.* Predictors are coded as follows: generational status (FG, +.5, CG, -.5), gender (woman, +.5, man, -.5). Race/ethnicity contrasts are dummy coded (1, 0) with European American as the reference group.

Table 4. *Effects of Letter Writing and Demographic Characteristics in Study 1*

Predictor	Perceived value			Interest			Course Grade		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
Asian American vs. European American	0.16	0.15	.288	0.12	0.16	.449	-0.13	0.10	.213
Hispanic/Latinx vs. European American	0.15	0.16	.359	0.05	0.18	.796	-0.35	0.11	.002
Black vs. European American	-0.02	0.18	.913	-0.14	0.20	.485	-0.47	0.13	< .001
Asian International vs. European American	-0.08	0.25	.747	-0.21	0.28	.458	-0.08	0.18	.652
Generational status	0.03	0.10	.775	0.07	0.11	.521	-0.24	0.07	< .001
Gender	-0.02	0.10	.842	-0.22	0.11	.040	-0.09	0.07	.195
Letter Writing	0.00	0.06	.934	0.03	0.06	.678	0.01	0.04	.756
Letter Writing x Asian American vs. European American	0.34	0.14	.020	0.32	0.16	.045	0.06	0.10	.547
Letter Writing x Hispanic/Latinx vs. European American	-0.07	0.16	.679	-0.06	0.18	.724	0.07	0.11	.553
Letter Writing x Black vs. European American	0.09	0.18	.605	-0.27	0.20	.169	0.09	0.13	.464
Letter Writing x Asian International vs. European American	-0.24	0.24	.323	-0.36	0.27	.182	-0.16	0.17	.343
Letter Writing x Generational status	0.07	0.10	.456	-0.02	0.11	.845	-0.03	0.07	.705
Letter Writing x Gender	0.08	0.10	.412	0.16	0.11	.140	-0.02	0.07	.763

*Note.* Predictors are coded as follows: generational status (FG, +.5, CG, -.5), gender (woman, +.5, man, -.5). Race/ethnicity contrasts are dummy coded (1, 0) with European American as the reference group. Letter writing is standardized.

Table 5. *Effects of Letter Writing, Demographic Characteristics, and College Motives in Study 1*

Predictor	Perceived value			Interest			Course grade		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
Asian American vs. European American	0.08	0.15	.592	0.03	0.16	.842	-0.11	0.10	.310
Hispanic/Latinx vs. European American	0.05	0.16	.745	-0.06	0.18	.746	-0.32	0.11	.005
Black vs. European American	-0.19	0.18	.303	-0.30	0.20	.144	-0.44	0.13	.001
Asian International vs. European American	-0.07	0.25	.787	-0.20	0.28	.477	-0.11	0.18	.544
Generational Status	-0.05	0.10	.576	0.00	0.11	.992	-0.23	0.07	.001
Gender	0.00	0.05	.938	0.10	0.05	.057	0.05	0.03	.134
Letter writing	0.01	0.06	.874	0.04	0.06	.539	0.02	0.04	.636
Letter writing x Asian American vs. European American	0.27	0.14	.057	0.25	0.16	.110	0.06	0.10	.576
Letter writing x Hispanic/Latinx vs. European American	-0.12	0.16	.450	-0.12	0.18	.504	0.05	0.11	.628
Letter writing x Black vs. European American	0.00	0.18	.984	-0.36	0.20	.070	0.06	0.13	.630
Letter writing x Asian International vs. European American	-0.29	0.24	.232	-0.41	0.27	.129	-0.13	0.17	.447
Letter writing x Generational status	0.03	0.10	.759	-0.06	0.11	.582	-0.03	0.07	.613
Letter writing x Gender	-0.04	0.05	.374	-0.08	0.05	.131	0.00	0.03	.900
Interdependent college motives	0.21	0.05	< .001	0.20	0.06	< .001	-0.05	0.04	.145
Letter writing x Interdependent college motives	0.10	0.05	.050	0.11	0.06	.054	0.03	0.04	.349
Independent college motives	-0.03	0.05	.524	0.04	0.05	.453	-0.04	0.03	.277
Letter writing x Independent college motives	0.02	0.05	.640	0.04	0.05	.438	-0.01	0.03	.699

*Note.* Predictors are coded as follows: generational status (FG, +.5, CG, -.5), gender (woman, +.5, man, -.5). Race/ethnicity contrasts are dummy coded (1, 0) with European American as the reference group. All other variables are standardized.

Table 6. Zero-Order Correlations and Descriptive Statistics for Major Variables in Study 2

Variable	1	2	3	4	5	6	7
1. Interdependent self-construal							
2. Independent self-construal	.42***						
3. Interest in biology	.23***	.32***					
4. Perceived value	.35***	.38***	.48***				
5. Task interest	.30***	.32***	.56***	.79***			
6. Behavioral intentions	.32***	.34***	.55***	.81***	.79***		
7. Performance	-.10*	-.14***	.05	-.08	.00	.04	
<i>M</i>	4.93	4.82	5.04	5.09	5.08	4.89	6.40
<i>SD</i>	0.83	0.84	1.54	1.45	1.40	1.38	2.04
Cronbach's $\alpha$	.84	.85	.93	.94	.94	.84	

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

Table 7. Demographic Effects on Interdependent and Independent Self-Construal in Study 2

Predictor	Interdependent self-construal			Independent self-construal		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
Asian American	-0.05	0.07	.510	-0.20	0.07	.004
Gender	-0.05	0.07	.487	-0.20	0.07	.005
Parental education	-0.02	0.07	.769	0.06	0.07	.362

*Note.* Predictors are coded as follows: Asian American (Asian American, +.5, European

American, -.5), gender (woman, +.5, man, -.5), parental education (no college, +.5, college, -.5).

Table 8. *Effects of Condition and Demographic Characteristics in Study 2*

Predictor	Perceived value			Task interest			Behavioral intentions			Performance		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	-0.11	0.14	.416	-0.17	0.14	.215	-0.05	0.13	.699	-0.04	0.23	.864
Format contrast	-0.08	0.12	.481	-0.07	0.12	.541	0.00	0.11	.997	0.06	0.20	.745
Subject contrast	0.05	0.12	.653	0.09	0.12	.457	0.11	0.11	.349	0.15	0.20	.431
Consistency contrast	0.19	0.12	.118	0.00	0.12	.968	0.05	0.11	.693	-0.33	0.20	.089
Asian American	-0.13	0.10	.203	0.02	0.10	.859	-0.05	0.10	.636	0.72	0.17	< .001
Gender	-0.21	0.11	.052	-0.35	0.10	.001	-0.20	0.10	.050	0.25	0.17	.153
Parental education	0.07	0.10	.468	0.12	0.10	.241	0.01	0.10	.893	-0.50	0.17	.003
UV x Asian American	-0.44	0.27	.096	-0.29	0.26	.271	-0.57	0.26	.027	-0.42	0.44	.339
UV x Gender	-0.09	0.27	.736	0.03	0.27	.914	0.02	0.26	.928	0.16	0.44	.713
UV x Parental education	0.08	0.26	.762	0.30	0.26	.256	0.22	0.25	.378	0.16	0.43	.709
Format x Asian American	-0.09	0.23	.687	0.07	0.23	.747	0.23	0.22	.304	-0.14	0.38	.718
Format x Gender	0.13	0.23	.585	0.08	0.23	.742	0.13	0.22	.555	0.04	0.38	.923
Format x Parental education	0.57	0.22	.011	0.45	0.22	.043	0.63	0.22	.004	0.24	0.37	.518
Subject x Asian American	0.02	0.23	.940	0.05	0.23	.818	-0.06	0.22	.788	0.16	0.38	.665
Subject x Gender	0.00	0.23	.995	-0.17	0.23	.451	0.07	0.22	.764	-0.18	0.39	.632
Subject x Parental education	0.22	0.22	.337	0.33	0.22	.135	0.18	0.22	.415	-0.05	0.37	.888
Consistency x Asian American	-0.07	0.23	.762	-0.27	0.23	.227	-0.11	0.22	.608	-0.82	0.38	.031
Consistency x Gender	0.01	0.23	.977	0.05	0.23	.823	0.02	0.22	.922	0.17	0.38	.667
Consistency x Parental education	0.06	0.23	.780	-0.05	0.22	.819	-0.12	0.22	.577	-0.55	0.37	.142
Interest in biology	0.65	0.05	< .001	0.80	0.05	< .001	0.77	0.05	< .001	0.09	0.08	.301

*Note.* Predictors are coded as follows: Asian American (Asian American, +.5, European

American, -.5), gender (woman, +.5, man, -.5), parental education (no college, +.5, college, -.5),

UV contrast (control = -.8, self-essay = +.2, self-letter = +.2, other-essay = +.2, other-letter =

+.2), Format contrast (control = 0, self-essay = -.5, self-letter = +.5, other-essay = -.5, other-letter

= +.5), Subject contrast (control = 0, self-essay = -.5, self-letter = -.5, other-essay = +.5, other-

letter = +.5), Consistency contrast (control = 0, self-essay = +.5, self-letter = -.5, other-essay = -

.5, other-letter = +.5). Interest in biology is standardized.



Table 9. Means and Standard Deviations by Condition for Outcomes in Study 2

Condition	Perceived value		Task interest		Behavioral intentions		Performance	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	5.03	1.27	5.33	1.33	5.19	1.45	6.41	2.12
Self-Essay	5.02	1.33	5.14	1.39	5.11	1.42	6.21	2.13
Other-Essay	4.78	1.35	5.04	1.36	5.06	1.30	6.53	2.04
Self-Letter	4.72	1.45	4.99	1.63	4.99	1.44	6.48	1.87
Other-Letter	4.89	1.45	5.00	1.49	5.09	1.38	6.39	2.04

Table 10. *Effects of Condition, Demographic Characteristics, and Self-Construal in Study 2*

Predictor	Perceived value			Task interest			Behavioral intentions			Performance		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	-0.08	0.13	.561	-0.16	0.13	.232	-0.02	0.13	.894	-0.14	0.23	.532
Format contrast	-0.09	0.11	.418	-0.07	0.12	.524	-0.01	0.11	.931	0.11	0.20	.580
Subject contrast	0.09	0.11	.442	0.11	0.12	.351	0.12	0.11	.287	0.13	0.20	.512
Consistency contrast	0.11	0.11	.353	-0.05	0.12	.676	0.00	0.11	.981	-0.30	0.20	.137
Asian American	-0.04	0.10	.689	0.10	0.10	.304	0.03	0.10	.746	0.68	0.17	< .001
Gender	-0.12	0.10	.224	-0.30	0.10	.004	-0.14	0.10	.141	0.20	0.17	.243
Parental education	0.03	0.10	.773	0.08	0.10	.406	-0.02	0.10	.818	-0.49	0.17	.004
UV x Asian American	-0.22	0.26	.399	-0.12	0.26	.645	-0.40	0.25	.112	-0.69	0.45	.123
UV x Gender	-0.01	0.26	.969	0.07	0.26	.779	0.08	0.26	.749	0.14	0.44	.757
UV x Parental education	0.09	0.25	.729	0.28	0.25	.280	0.24	0.25	.328	0.11	0.43	.794
Format x Asian American	-0.01	0.22	.967	0.17	0.22	.442	0.33	0.22	.131	-0.13	0.38	.737
Format x Gender	0.04	0.22	.875	0.01	0.23	.976	0.09	0.22	.689	0.10	0.39	.789
Format x Parental education	0.49	0.22	.023	0.39	0.22	.073	0.54	0.21	.012	0.38	0.38	.311
Subject x Asian American	-0.07	0.22	.745	-0.06	0.22	.800	-0.14	0.22	.527	0.16	0.38	.676
Subject x Gender	0.08	0.23	.709	-0.14	0.23	.549	0.14	0.22	.510	-0.24	0.39	.529
Subject x Parental education	0.36	0.22	.099	0.41	0.22	.062	0.24	0.21	.253	-0.08	0.38	.834
Consistency x Asian American	-0.21	0.22	.331	-0.41	0.22	.071	-0.23	0.22	.282	-0.73	0.38	.057
Consistency x Gender	0.08	0.22	.711	0.10	0.23	.651	0.07	0.22	.762	0.21	0.39	.586
Consistency x Parental education	-0.10	0.22	.660	-0.15	0.22	.500	-0.22	0.21	.303	-0.47	0.38	.211
Interdependent self-construal	0.22	0.05	< .001	0.18	0.05	.001	0.20	0.05	< .001	-0.19	0.09	.044
UV x Interdependent self-construal	0.03	0.13	.796	0.07	0.13	.591	0.10	0.13	.433	0.18	0.23	.420
Format x Interdependent self-construal	0.29	0.12	.018	0.30	0.12	.017	0.24	0.12	.043	0.00	0.21	.992
Subject x Interdependent self-construal	-0.06	0.12	.649	-0.14	0.12	.277	-0.06	0.12	.623	0.03	0.21	.896
Consistency x Interdependent self-construal	-0.19	0.12	.114	-0.09	0.12	.476	-0.08	0.12	.498	-0.31	0.21	.138
Independent self-construal	0.27	0.06	< .001	0.16	0.06	.006	0.19	0.06	.001	-0.19	0.10	.059
UV x Independent self-construal	0.20	0.14	.144	0.26	0.14	.065	0.08	0.13	.551	0.11	0.24	.653
Format x Independent self-construal	-0.13	0.12	.304	-0.08	0.13	.527	-0.01	0.12	.914	0.12	0.22	.581
Subject x Independent self-construal	0.02	0.12	.843	-0.06	0.13	.644	0.03	0.12	.810	-0.04	0.22	.870
Consistency x Independent self-construal	0.05	0.12	.683	-0.03	0.13	.794	-0.02	0.12	.838	0.31	0.22	.151
Interest in biology	0.52	0.05	< .001	0.72	0.05	< .001	0.66	0.05	< .001	0.18	0.09	.044

*Note.* Predictors are coded as follows: Asian American (Asian American, +.5, European

American, -.5), gender (woman, +.5, man, -.5), parental education (no college, +.5, college, -.5),

UV contrast (control = -.8, self-essay = +.2, self-letter = +.2, other-essay = +.2, other-letter =

+.2), Format contrast (control = 0, self-essay = -.5, self-letter = +.5, other-essay = -.5, other-letter

= +.5), *Subject* contrast (control = 0, self-essay = -.5, self-letter = -.5, other-essay = +.5, other-letter = +.5), *Consistency* contrast (control = 0, self-essay = +.5, self-letter = -.5, other-essay = -.5, other-letter = +.5). All other variables are standardized.

Table 11. *Means and Standard Deviations by Actual Format for Outcomes in Study 2*

Format	Perceived value		Task interest		Behavioral intentions		Performance	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Essay	4.95	1.34	5.13	1.41	5.10	1.38	6.33	2.08
Letter	4.71	1.46	4.99	1.54	5.05	1.45	6.60	1.92

Table 12. *Zero-Order Correlations and Descriptive Statistics for Linguistic Variables in Study 2*

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Self (coded)											
2. Specific other (coded)	.03										
3. People in general (coded)	-.09*	-.32***									
4. First-person singular pronouns (LIWC)	.42***	.30***	-.23***								
5. Social words (LIWC)	-.09*	.20***	-.04	.06							
6. Family words (LIWC)	-.01	.47***	-.17***	.32***	.29***						
7. Friend words (LIWC)	.05	.16***	-.09*	.21***	.19***	.11**					
8. Analytical thinking (LIWC)	-.18***	-.22***	.16***	-.49***	-.32***	-.18***	-.12**				
9. Clout (LIWC)	-.21***	.10*	.08	-.38***	.71***	.06	.13**	.02			
10. Authenticity (LIWC)	.22***	-.08*	-.11**	.56***	-.01	.02	.06	-.25***	-.36***		
11. Emotional tone (LIWC)	.08	.14***	-.01	.17***	.15***	.08	.15***	-.14***	.09*	-.01	
<i>M (proportion for variables 1-3)</i>	.09	.20	.80	1.70	8.45	0.26	0.16	60.86	67.99	23.98	71.22
<i>SD</i>	0.28	0.40	0.40	2.24	3.83	0.62	0.42	24.54	19.43	22.49	28.50

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

Table 13. *Coded Utility-Value Content as a Function of Condition in Study 2*

Predictor	Self			Specific other			People in general		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	1.20	0.61	.049	16.82	627.64	.979	-0.14	0.28	.618
Format contrast	-0.04	0.35	.902	0.69	0.41	.096	-0.22	0.23	.358
Subject contrast	-1.16	0.35	.001	3.02	0.41	<.001	-0.72	0.23	.002
Consistency contrast	0.38	0.35	.280	-0.96	0.41	.020	0.02	0.23	.943

*Note.* Predictors are coded as follows: *UV* contrast (control = -.8, self-essay = +.2, self-letter = +.2, other-essay = +.2, other-letter = +.2), *Format* contrast (control = 0, self-essay = -.5, self-letter = +.5, other-essay = -.5, other-letter = +.5), *Subject* contrast (control = 0, self-essay = -.5, self-letter = -.5, other-essay = +.5, other-letter = +.5), *Consistency* contrast (control = 0, self-essay = +.5, self-letter = -.5, other-essay = -.5, other-letter = +.5).

Table 14. *LIWC Content Variables as a Function of Condition in Study 2*

Predictor	First-person singular pronouns			Social words			Family words			Friend words		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	0.98	0.23	<.001	1.30	0.40	.001	0.31	0.06	<.001	0.18	0.04	<.001
Format contrast	0.86	0.20	<.001	1.20	0.34	.001	0.02	0.05	.772	0.25	0.04	<.001
Subject contrast	0.18	0.20	.380	0.66	0.34	.056	0.30	0.05	<.001	0.07	0.04	.057
Consistency contrast	-0.06	0.20	.762	0.01	0.34	.973	-0.18	0.05	.001	0.02	0.04	.566

*Note.* Predictors are coded as follows: *UV* contrast (control = -.8, self-essay = +.2, self-letter = +.2, other-essay = +.2, other-letter = +.2), *Format* contrast (control = 0, self-essay = -.5, self-letter = +.5, other-essay = -.5, other-letter = +.5), *Subject* contrast (control = 0, self-essay = -.5, self-letter = -.5, other-essay = +.5, other-letter = +.5), *Consistency* contrast (control = 0, self-essay = +.5, self-letter = -.5, other-essay = -.5, other-letter = +.5).

Table 15. *LIWC Style Variables as a Function of Condition in Study 2*

Predictor	Analytical thinking			Clout			Authenticity			Emotional tone		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	-10.72	2.52	< .001	3.09	2.05	.132	-2.25	2.34	.337	12.09	2.97	< .001
Format contrast	-11.63	2.16	< .001	4.91	1.76	.005	7.87	2.01	< .001	7.10	2.55	.006
Subject contrast	-3.20	2.16	.139	4.40	1.76	.013	-7.30	2.01	< .001	4.02	2.55	.116
Consistency contrast	-0.40	2.16	.855	1.35	1.76	.444	1.98	2.01	.326	3.51	2.55	.169

*Note.* Predictors are coded as follows: *UV* contrast (control = -.8, self-essay = +.2, self-letter = +.2, other-essay = +.2, other-letter = +.2), *Format* contrast (control = 0, self-essay = -.5, self-letter = +.5, other-essay = -.5, other-letter = +.5), *Subject* contrast (control = 0, self-essay = -.5, self-letter = -.5, other-essay = +.5, other-letter = +.5), *Consistency* contrast (control = 0, self-essay = +.5, self-letter = -.5, other-essay = -.5, other-letter = +.5).

Table 16. *Zero-Order Correlations and Descriptive Statistics for Major Variables in Study 3*

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. College GPA														
2. Interdependent self-construal	.05													
3. Independent self-construal	.02	.35***												
4. Interdependent college motives	-.06	.14***	.22***											
5. Independent college motives	-.15**	.10*	.13**	.53***										
6. Baseline perceived value	.21***	.28***	.29***	.09*	.05									
7. Baseline prosocial utility value	.15**	.28***	.32***	.09*	.06	.57***								
8. Baseline interest	.16**	.16***	.28***	.14**	.12**	.76***	.50***							
9. Perceived value	.18**	.15**	.24***	.05	.03	.68***	.47***	.58***						
10. Prosocial utility value	.15**	.10	.10*	.04	.06	.43***	.51***	.42***	.58***					
11. Interest	.17**	.13**	.20***	.03	.07	.61***	.43***	.67***	.80***	.58***				
12. Unit-specific value	.12*	.04	.15**	.04	.05	.48***	.44***	.46***	.65***	.66***	.66***			
13. Unit-specific interest	.10	.07	.16**	-.01	.01	.51***	.32***	.52***	.71***	.52***	.74***	.79***		
14. Course grade	.51***	-.02	-.09	-.05	-.08	.11*	.08	.09	.23***	.20***	.23***	.26***	.21***	
<i>M</i>	3.16	4.87	5.05	3.29	2.97	4.89	5.7	5.42	4.77	5.53	5.17	5.54	4.88	2.77
<i>SD</i>	0.64	0.79	0.84	1.46	1.11	1.37	1.16	1.23	1.43	1.35	1.37	1.25	1.39	1.19
Cronbach's $\alpha$		.81	.78			.82	.80	.89	.84	.86	.92	.93	.93	

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

Table 17. *Demographic Effects on Self-Construal and College Motives Measures in Study 3*

Predictor	Interdependent self-construal			Independent self-construal			Interdependent college motives			Independent college motives		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
Asian American vs. European American	0.24	0.11	.035	-0.14	0.12	.252	-0.01	0.20	.956	0.18	0.16	.261
Hispanic/Latinx vs. European American	0.09	0.11	.378	0.14	0.11	.224	0.65	0.19	<.001	0.40	0.15	.007
Asian International vs. European American	0.51	0.16	.001	0.01	0.17	.959	-0.94	0.28	.001	-0.09	0.22	.687
Black vs. European American	-0.04	0.19	.837	0.10	0.21	.616	0.88	0.34	.010	0.36	0.27	.184
Generational status	0.08	0.08	.306	0.02	0.08	.801	0.07	0.14	.628	0.18	0.11	.104
Gender	0.04	0.07	.608	-0.04	0.07	.575	0.17	0.12	.162	0.04	0.10	.645

*Note.* Predictors are coded as follows: generational status (FG, +.5, CG, -.5), gender (woman, +.5, man, -.5). Race/ethnicity contrasts are dummy coded (1, 0) with European American as the reference group.

Table 18. *Assignments Missing or Completed in Essay or Letter Format by Condition and Assignment Number in Study 3*

Condition	Assignment 1			Assignment 2			Assignment 3		
	Missing	Essay	Letter	Missing	Essay	Letter	Missing	Essay	Letter
Control	50	129	0	50	127	2	64	115	0
One-letter UV	44	137	0	51	27	103	58	122	1
Two-letter UV	46	135	0	56	27	98	64	26	91

*Note.* “Essay” refers to assigned format and therefore includes both control and utility-value essays. There were no control prompts that instructed students to write in a letter format.

Table 19. Effects of Condition and Demographic Characteristics in Study 3

Predictor	Perceived value			Prosocial utility value			Interest			Unit-specific perceived value			Unit-specific interest			Course grade		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	0.02	0.11	.884	0.09	0.12	.493	0.03	0.11	.795	0.06	0.13	.655	0.17	0.13	.195	0.07	0.12	.587
Two vs. One Letter UV contrast	-0.13	0.14	.372	-0.18	0.15	.223	-0.17	0.13	.205	-0.08	0.15	.609	-0.09	0.16	.588	-0.25	0.13	.059
Asian American/Latinx vs. No	-0.13	0.12	.286	-0.10	0.14	.490	0.03	0.14	.811	-0.03	0.13	.831	0.00	0.15	.984	0.06	0.12	.621
Asian American vs. Hispanic/Latinx	0.05	0.13	.702	0.11	0.16	.498	0.02	0.13	.881	-0.14	0.13	.311	-0.08	0.15	.580	0.25	0.13	.062
Generational status	-0.02	0.11	.886	-0.10	0.12	.435	-0.15	0.11	.166	-0.05	0.12	.668	-0.08	0.13	.535	0.01	0.11	.959
Gender	-0.18	0.11	.087	0.10	0.12	.439	-0.07	0.11	.535	0.03	0.11	.763	-0.03	0.12	.810	0.10	0.10	.355
UV x Asian American/Latinx vs. No	-0.16	0.27	.560	-0.31	0.28	.272	-0.36	0.25	.138	-0.46	0.27	.086	-0.35	0.29	.228	0.10	0.24	.680
UV x Asian American vs. Hispanic/Latinx	0.07	0.26	.795	-0.39	0.32	.220	-0.01	0.26	.958	-0.23	0.29	.431	0.06	0.32	.845	-0.03	0.28	.920
UV x Generational status	-0.06	0.25	.816	-0.07	0.26	.795	0.23	0.23	.325	-0.33	0.27	.222	-0.15	0.28	.589	-0.03	0.24	.904
UV x Gender	0.25	0.22	.260	0.43	0.25	.082	0.12	0.21	.569	0.18	0.23	.419	-0.01	0.25	.962	0.03	0.21	.893
Two vs. One Letter UV x Asian American/Latinx vs. No	0.31	0.31	.315	0.19	0.33	.570	0.04	0.30	.906	-0.02	0.32	.955	0.05	0.33	.888	-0.12	0.28	.675
Two vs. One Letter UV x Asian American vs. Hispanic/Latinx	0.18	0.32	.568	-0.13	0.35	.716	0.15	0.30	.622	0.47	0.31	.135	0.35	0.34	.305	-0.15	0.29	.612
Two vs. One Letter UV x Generational status	0.04	0.28	.885	-0.27	0.32	.392	0.01	0.26	.963	0.10	0.29	.727	0.18	0.32	.569	-0.14	0.27	.621
Two vs. One Letter UV x Gender	-0.28	0.25	.267	-0.22	0.28	.428	0.07	0.25	.780	0.02	0.27	.934	-0.15	0.29	.604	0.25	0.24	.302
Baseline covariate	0.98	0.05	<.001	0.66	0.06	<.001	0.90	0.05	<.001	0.58	0.05	<.001	0.70	0.06	<.001	0.56	0.06	<.001

Note. The model on course grade controls for lecture section using fixed effects (dummy-coded contrasts), not presented. Baseline

covariate = perceived value for topic-specific perceived value, interest for unit-specific interest, college GPA for course grade, and the exact baseline measure of the outcome for each other outcome. Predictors are coded as follows: *UV* contrast (control = -.67, one-letter UV = +.33, two-letter UV = +.33), The *Two vs. One Letter UV* contrast (control = 0, one-letter UV = -.5, two-letter UV = +.5), generational status (FG, +.5, CG, -.5), gender (woman, +.5, man, -.5). Race/ethnicity contrasts are dummy coded (1, 0) with European American as the reference group. Each baseline covariate is standardized.

Table 20. Means and Standard Deviations by Condition for Outcomes in Study 3

Condition	Perceived value		Prosocial utility value		Interest		Unit-specific interest		Unit-specific perceived value		Course grade	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	5.12	1.46	5.67	1.32	5.36	1.39	4.74	1.46	5.50	1.26	2.85	1.14
One-Letter UV	5.16	1.42	5.76	1.26	5.55	1.29	5.05	1.32	5.63	1.23	2.99	1.05
Two-Letter UV	5.13	1.49	5.61	1.32	5.38	1.36	4.84	1.38	5.49	1.28	2.84	1.17



Table 21. Effects of Condition, Demographic Characteristics, Self-Construal, and College Motives in Study 3

Predictor	Perceived value			Prosocial utility value			Interest			Unit-specific perceived value			Unit-specific interest			Course grade		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p
UV contrast	0.01	0.12	.918	0.09	0.13	.501	0.04	0.11	.732	0.06	0.13	.659	0.19	0.13	.155	0.05	0.12	.703
Two vs. One Letter UV contrast	-0.12	0.14	.390	-0.19	0.15	.193	-0.16	0.13	.238	-0.09	0.16	.573	-0.09	0.16	.596	-0.25	0.13	.066
Asian American/Latinx vs. No	-0.13	0.12	.299	-0.11	0.14	.448	0.04	0.14	.776	-0.03	0.14	.803	0.03	0.15	.838	0.02	0.12	.859
Asian American vs. Hispanic/Latinx	0.06	0.13	.638	0.09	0.15	.542	-0.02	0.14	.885	-0.12	0.14	.415	-0.14	0.15	.353	0.28	0.14	.048
Generational status	0.01	0.11	.954	-0.09	0.13	.454	-0.16	0.11	.144	-0.03	0.12	.798	-0.06	0.13	.653	0.00	0.11	.975
Gender	-0.16	0.11	.129	0.09	0.12	.483	-0.04	0.11	.697	0.06	0.11	.624	0.02	0.13	.847	0.08	0.11	.463
UV x Asian American/Latinx vs. No	-0.19	0.27	.492	-0.34	0.29	.239	-0.43	0.25	.084	-0.52	0.28	.059	-0.47	0.29	.113	0.15	0.24	.529
UV x Asian American vs. Hispanic/Latinx	0.06	0.28	.838	-0.38	0.33	.251	-0.03	0.27	.923	-0.29	0.30	.332	0.10	0.34	.776	-0.13	0.29	.664
UV x Generational status	-0.02	0.25	.949	-0.05	0.26	.859	0.22	0.24	.351	-0.27	0.26	.312	-0.13	0.28	.650	0.01	0.24	.977
UV x Gender	0.25	0.22	.245	0.47	0.25	.062	0.12	0.22	.588	0.20	0.23	.381	-0.04	0.26	.891	0.09	0.21	.684
Two vs. One Letter UV x Asian American/Latinx vs. No	0.29	0.30	.336	0.15	0.34	.647	-0.01	0.30	.976	-0.03	0.32	.919	0.03	0.33	.939	-0.13	0.28	.644
Two vs. One Letter UV x Asian American vs. Hispanic/Latinx	0.10	0.33	.755	-0.24	0.36	.506	0.08	0.31	.798	0.33	0.32	.303	0.25	0.35	.477	-0.14	0.30	.638
Two vs. One Letter UV x Generational status	-0.06	0.29	.841	-0.28	0.33	.389	-0.01	0.26	.979	0.00	0.30	.999	0.12	0.32	.715	-0.13	0.28	.645
Two vs. One Letter UV x Gender	-0.33	0.26	.196	-0.24	0.28	.395	0.09	0.25	.731	-0.04	0.27	.875	-0.18	0.29	.535	0.21	0.24	.379
Interdependent self-construal	-0.06	0.06	.296	-0.04	0.06	.527	0.01	0.05	.792	-0.11	0.06	.088	-0.01	0.06	.897	-0.02	0.07	.771
UV x Interdependent self-construal	-0.02	0.12	.842	0.10	0.14	.485	0.09	0.12	.456	0.08	0.13	.536	-0.05	0.14	.733	0.11	0.11	.303
Two vs. One Letter UV x Interdependent self-construal	0.10	0.14	.485	0.05	0.16	.737	0.03	0.14	.839	0.23	0.14	.103	0.19	0.16	.230	0.12	0.14	.398
Independent self-construal	0.05	0.06	.373	-0.08	0.07	.231	0.00	0.06	.950	0.04	0.07	.543	0.02	0.07	.780	-0.05	0.06	.411
UV x Independent self-construal	-0.03	0.12	.789	0.04	0.14	.788	-0.01	0.11	.937	-0.07	0.13	.594	-0.09	0.15	.538	-0.01	0.12	.912
Two vs. One Letter UV x Independent self-construal	-0.17	0.15	.256	-0.17	0.15	.258	0.08	0.13	.552	-0.23	0.15	.127	-0.04	0.14	.773	-0.06	0.15	.706
Interdependent college motives	0.00	0.07	.975	0.01	0.07	.918	-0.09	0.06	.161	-0.03	0.07	.623	-0.11	0.07	.137	0.09	0.06	.179
UV x Interdependent college motives	0.05	0.13	.676	0.02	0.14	.899	0.10	0.13	.459	0.11	0.14	.435	0.18	0.15	.236	-0.09	0.13	.478
Two vs. One Letter UV x Interdependent college motives	-0.13	0.15	.394	-0.14	0.17	.403	-0.23	0.16	.148	-0.17	0.16	.281	-0.27	0.18	.136	0.05	0.15	.748
Independent college motives	-0.02	0.06	.704	0.06	0.07	.373	0.04	0.06	.442	0.04	0.06	.551	-0.03	0.07	.691	0.00	0.06	.998
UV x Independent college motives	-0.03	0.13	.835	0.09	0.14	.512	-0.01	0.12	.918	-0.05	0.13	.683	-0.02	0.15	.895	-0.11	0.13	.393
Two vs. One Letter UV x Independent college motives	0.35	0.15	.019	0.21	0.16	.192	0.28	0.15	.058	0.35	0.16	.027	0.42	0.17	.014	0.00	0.14	.996

Baseline covariate 0.99 0.06 < .001 0.69 0.06 < .001 0.91 0.05 < .001 0.61 0.06 < .001 0.72 0.06 < .001 0.55 0.06 < .001

*Note.* The model on course grade controls for lecture section using fixed effects (dummy-coded contrasts), not presented. Baseline

covariate = perceived value for topic-specific perceived value, interest for unit-specific interest, college GPA for course grade, and the exact baseline measure of the outcome for each other outcome. Predictors are coded as follows: *UV* contrast (control = -.67, one-letter UV = +.33, two-letter UV = +.33), The *Two vs. One Letter UV* contrast (control = 0, one-letter UV = -.5, two-letter UV = +.5), generational status (FG, +.5, CG, -.5), gender (woman, +.5, man, -.5). Race/ethnicity contrasts are dummy coded (1, 0) with European American as the reference group. All other variables are standardized.

Table 22. Means and Standard Deviations by Letter Completion Group for Outcomes in Study 3

Condition	Perceived value		Prosocial utility value		Interest		Unit-specific interest		Unit-specific perceived value		Course grade	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	5.18	1.45	5.66	1.33	5.41	1.34	4.77	1.43	5.52	1.26	2.99	1.04
UV0L	5.24	1.41	5.65	1.31	5.68	1.13	4.95	1.32	5.60	1.20	2.69	1.08
UV1L	5.16	1.40	5.71	1.26	5.45	1.38	5.07	1.21	5.57	1.23	3.25	0.95
UV2L	5.18	1.47	5.68	1.31	5.47	1.27	4.90	1.44	5.63	1.27	3.21	0.84
UV3L	5.18	1.45	5.66	1.33	5.41	1.34	4.77	1.43	5.52	1.26	2.99	1.04

Table 23. Effects of Type and Number of Assignments Completed and Demographic Characteristics in Study 3

Predictor	Perceived value			Prosocial utility value			Interest			Unit-specific perceived value			Unit-specific interest			Course grade		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p
UV contrast	0.03	0.13	.841	0.15	0.14	.287	0.06	0.12	.600	0.15	0.13	.277	0.22	0.15	.139	0.09	0.11	.409
Any UV Letters vs. None contrast	-0.11	0.19	.568	-0.13	0.22	.552	-0.41	0.19	.029	0.04	0.20	.835	-0.03	0.21	.874	0.21	0.16	.191
Two UV Letters vs. One contrast	-0.18	0.17	.293	-0.20	0.20	.317	-0.21	0.16	.204	0.07	0.19	.694	-0.30	0.20	.135	-0.04	0.15	.803
Completed assignments	-0.02	0.08	.810	-0.08	0.08	.350	0.06	0.07	.393	-0.07	0.07	.373	0.00	0.09	.961	0.25	0.06	<.001
Asian American/Latinx vs. No Asian American vs. Hispanic/Latinx	-0.22	0.14	.116	-0.15	0.16	.328	0.04	0.14	.771	0.00	0.15	.984	0.05	0.17	.755	0.13	0.14	.344
Generational status	-0.05	0.15	.722	0.07	0.16	.642	-0.05	0.14	.739	-0.18	0.15	.220	-0.18	0.16	.258	0.17	0.14	.221
Gender	-0.04	0.14	.788	-0.24	0.15	.105	-0.18	0.13	.163	-0.17	0.14	.211	-0.16	0.15	.266	0.03	0.12	.823
UV x Asian American/Latinx vs. No	-0.09	0.13	.496	0.22	0.13	.093	0.09	0.11	.448	0.05	0.12	.682	0.03	0.14	.841	-0.02	0.11	.872
UV x Asian American vs. Hispanic/Latinx	-0.31	0.29	.274	-0.34	0.32	.288	-0.35	0.28	.215	-0.29	0.29	.326	-0.16	0.32	.623	0.02	0.26	.940
UV x Generational status	-0.04	0.30	.882	-0.42	0.34	.222	-0.20	0.29	.490	-0.16	0.33	.619	-0.02	0.34	.957	-0.01	0.25	.954
UV x Gender	-0.09	0.28	.754	-0.34	0.30	.261	0.11	0.26	.683	-0.58	0.28	.037	-0.46	0.31	.140	-0.06	0.23	.789
Any UV Letters vs. None x Asian American/Latinx vs. No	0.35	0.25	.165	0.51	0.27	.062	0.34	0.24	.148	0.16	0.25	.522	0.05	0.27	.862	0.04	0.21	.843
Any UV Letters vs. None x Asian American vs. Hispanic/Latinx	0.68	0.43	.114	-0.28	0.47	.550	0.09	0.43	.836	0.39	0.46	.394	0.26	0.49	.588	0.38	0.36	.294
Any UV Letters vs. None x Generational status	0.59	0.42	.163	0.11	0.46	.814	0.40	0.41	.324	0.16	0.43	.704	0.33	0.46	.475	0.19	0.34	.579
Any UV Letters vs. None x Gender	-0.34	0.39	.389	-0.48	0.42	.248	-0.01	0.38	.973	-0.06	0.41	.879	0.04	0.43	.928	-0.21	0.35	.557
Two UV Letters vs. One x Asian American/Latinx vs. No	-0.35	0.36	.332	0.01	0.39	.989	-0.33	0.34	.333	-0.09	0.36	.803	-0.16	0.40	.693	-0.27	0.28	.330
Two UV Letters vs. One x Asian American vs. Hispanic/Latinx	0.11	0.39	.767	-0.14	0.43	.739	-0.29	0.37	.441	0.22	0.42	.605	0.23	0.43	.594	-0.23	0.33	.479
Two UV Letters vs. One x Generational status	-0.01	0.42	.981	-0.36	0.46	.438	-0.06	0.39	.886	0.21	0.43	.629	0.08	0.47	.867	0.05	0.34	.889
Two UV Letters vs. One x Gender	0.10	0.36	.772	-0.66	0.39	.092	-0.17	0.34	.613	-0.28	0.37	.452	-0.21	0.39	.601	-0.05	0.29	.852
Completed assignments x Asian American/Latinx vs. No	-0.23	0.35	.508	0.07	0.38	.851	0.20	0.34	.543	-0.28	0.37	.449	0.10	0.39	.790	0.13	0.28	.653
Completed assignments x Asian American vs. Hispanic/Latinx	-0.08	0.16	.617	0.07	0.19	.703	-0.09	0.16	.557	0.07	0.18	.716	-0.20	0.19	.275	-0.05	0.13	.683
Completed assignments x Generational status	-0.09	0.16	.592	-0.25	0.18	.184	0.05	0.16	.736	0.08	0.16	.623	0.00	0.17	.985	-0.17	0.13	.197
Completed assignments x Gender	0.14	0.14	.312	0.18	0.15	.233	0.09	0.14	.509	-0.01	0.14	.924	0.03	0.15	.821	0.01	0.11	.909
Baseline covariate	0.13	0.13	.332	-0.12	0.15	.393	0.22	0.12	.073	0.08	0.14	.564	0.22	0.14	.136	-0.01	0.10	.908
	0.94	0.05	<.001	0.65	0.06	<.001	0.85	0.05	<.001	0.60	0.06	<.001	0.63	0.06	<.001	0.44	0.05	<.001

*Note.* The model on course grade controls for lecture section using fixed effects (dummy-coded contrasts), not presented. Baseline covariate = perceived value for topic-specific perceived value, interest for unit-specific interest, college GPA for course grade, and the exact baseline measure of the outcome for each other outcome. Predictors are coded as follows: *UV* contrast (control = -.75, UV0L = +.25, UV1L = +.25, UV2L = +.25), *Any UV Letters vs. None* contrast (control = 0, UV0L = -1, UV1L = +.5, UV2L = +.5), *Two UV Letters vs. One* contrast (control = 0, UV0L = 0, UV1L = -.5, UV2L = +.5), generational status (FG, +.5, CG, -.5), gender (woman, +.5, man, -.5). Race/ethnicity contrasts are dummy coded (1, 0) with European American as the reference group. Each baseline covariate is standardized.

Table 24. *Effects of Type and Number of Assignments Completed, Demographic Characteristics, Self-Constraint, and College Motives in Study 3*

Predictor	Perceived value			Prosocial utility value			Interest			Unit-specific perceived value			Unit-specific interest			Course grade		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	0.02	0.14	.906	0.18	0.15	.223	0.10	0.12	.436	0.16	0.13	.227	0.28	0.15	.064	0.07	0.11	.557
Any UV Letters vs. None contrast	-0.17	0.20	.395	-0.15	0.23	.506	-0.38	0.19	.047	0.01	0.20	.964	-0.05	0.22	.832	0.22	0.17	.199
Two UV Letters vs. One contrast	-0.21	0.18	.235	-0.21	0.20	.306	-0.18	0.17	.282	0.08	0.19	.655	-0.24	0.20	.219	-0.03	0.16	.837
Completed assignments	-0.02	0.08	.802	-0.08	0.08	.352	0.05	0.07	.473	-0.07	0.07	.366	0.00	0.08	.959	0.25	0.06	<.001
Asian American/Latinx vs. No	-0.24	0.14	.098	-0.17	0.16	.303	0.03	0.14	.805	-0.03	0.15	.845	0.06	0.17	.722	0.09	0.14	.519
Asian American vs. Hispanic/Latinx	-0.07	0.15	.627	0.05	0.16	.742	-0.12	0.15	.410	-0.19	0.16	.234	-0.25	0.17	.126	0.15	0.14	.285
Generational status	0.02	0.14	.878	-0.22	0.15	.145	-0.17	0.13	.184	-0.11	0.14	.412	-0.12	0.15	.402	0.05	0.13	.725
Gender	-0.01	0.13	.967	0.24	0.14	.086	0.11	0.12	.376	0.10	0.13	.445	0.10	0.14	.493	-0.05	0.11	.686
UV x Asian American/Latinx vs. No	-0.41	0.30	.167	-0.39	0.32	.230	-0.43	0.29	.134	-0.42	0.30	.158	-0.37	0.32	.258	0.05	0.28	.846
UV x Asian American vs. Hispanic/Latinx	-0.07	0.31	.825	-0.38	0.36	.292	-0.21	0.30	.484	-0.19	0.34	.578	0.06	0.35	.869	-0.17	0.26	.528
UV x Generational status	0.01	0.28	.972	-0.27	0.31	.394	0.10	0.27	.706	-0.47	0.28	.095	-0.42	0.31	.175	-0.02	0.24	.937
UV x Gender	0.44	0.26	.083	0.59	0.28	.039	0.34	0.25	.176	0.23	0.25	.366	0.03	0.27	.918	0.10	0.22	.658
Any UV Letters vs. None x Asian American/Latinx vs. No	0.75	0.44	.090	-0.22	0.48	.646	0.06	0.44	.895	0.46	0.46	.318	0.29	0.49	.557	0.37	0.37	.330
Any UV Letters vs. None x Asian American vs. Hispanic/Latinx	0.55	0.43	.196	0.04	0.47	.927	0.37	0.42	.378	0.18	0.43	.669	0.21	0.47	.654	0.18	0.35	.617
Any UV Letters vs. None x Generational status	-0.49	0.41	.228	-0.61	0.43	.158	-0.11	0.39	.781	-0.22	0.42	.593	-0.17	0.44	.710	-0.23	0.36	.525
Any UV Letters vs. None x Gender	-0.45	0.37	.223	-0.10	0.41	.809	-0.37	0.35	.294	-0.25	0.36	.482	-0.39	0.41	.333	-0.22	0.30	.449
Two UV Letters vs. One x Asian American/Latinx vs. No	0.07	0.39	.849	-0.15	0.43	.732	-0.32	0.38	.395	0.15	0.42	.718	0.17	0.43	.697	-0.29	0.33	.380
Two UV Letters vs. One x Asian American vs. Hispanic/Latinx	-0.23	0.44	.603	-0.43	0.48	.374	-0.19	0.42	.650	0.06	0.45	.894	-0.05	0.49	.922	0.00	0.35	.994
Two UV Letters vs. One x Generational status	0.11	0.37	.758	-0.67	0.40	.095	-0.22	0.35	.528	-0.24	0.38	.521	-0.24	0.40	.556	-0.01	0.30	.984
Two UV Letters vs. One x Gender	-0.22	0.36	.548	0.07	0.40	.865	0.21	0.35	.551	-0.36	0.37	.333	0.03	0.40	.935	0.15	0.30	.624
Completed assignments x Asian American/Latinx vs. No	-0.06	0.17	.727	0.03	0.20	.882	-0.06	0.16	.736	0.09	0.19	.629	-0.17	0.19	.376	-0.01	0.14	.916
Completed assignments x Asian American vs. Hispanic/Latinx	-0.03	0.17	.874	-0.21	0.19	.266	0.11	0.17	.544	0.11	0.16	.493	0.09	0.18	.624	-0.12	0.13	.358
Completed assignments x Generational status	0.12	0.15	.414	0.21	0.16	.199	0.09	0.14	.526	-0.05	0.14	.741	0.04	0.16	.821	0.00	0.12	.970

Completed assignments x Gender	0.18	0.13	.182	-0.12	0.15	.400	0.25	0.12	.046	0.14	0.14	.319	0.28	0.15	.055	0.01	0.11	.952
Interdependent self-construal	-0.10	0.07	.174	-0.06	0.07	.461	0.02	0.06	.769	-0.14	0.07	.053	-0.04	0.08	.633	-0.01	0.06	.804
UV x interdependent self-construal	-0.04	0.13	.736	0.11	0.15	.466	0.06	0.12	.644	0.12	0.13	.367	-0.04	0.15	.769	0.14	0.10	.168
Any UV Letters vs. None x Interdependent self-construal	0.25	0.19	.176	0.58	0.21	.007	0.24	0.20	.224	0.41	0.20	.037	0.44	0.22	.048	0.07	0.16	.655
Two UV Letters vs. One x Interdependent self-construal	0.19	0.18	.276	0.22	0.19	.255	0.15	0.17	.378	0.48	0.18	.009	0.35	0.19	.065	0.12	0.15	.406
Completed assignments x Interdependent self-construal	-0.04	0.07	.630	-0.12	0.08	.125	-0.01	0.07	.920	-0.02	0.07	.784	-0.05	0.07	.469	0.02	0.05	.700
Independent self-construal	0.10	0.07	.153	-0.01	0.07	.908	0.04	0.06	.522	0.08	0.07	.277	0.08	0.07	.262	-0.05	0.05	.393
UV x independent self-construal	0.03	0.13	.824	0.14	0.14	.336	0.06	0.14	.672	-0.03	0.14	.810	-0.01	0.15	.962	-0.03	0.11	.771
Any UV Letters vs. None x Independent self-construal	-0.26	0.18	.141	-0.21	0.19	.273	-0.14	0.16	.384	-0.32	0.18	.073	-0.29	0.21	.165	-0.13	0.15	.362
Two UV Letters vs. One x Independent self-construal	-0.32	0.19	.091	-0.09	0.21	.667	0.08	0.18	.670	-0.31	0.20	.122	-0.05	0.21	.808	-0.06	0.16	.694
Completed assignments x Independent self-construal	0.13	0.07	.059	0.06	0.07	.441	0.09	0.06	.172	0.11	0.07	.107	0.17	0.07	.022	0.06	0.05	.200
Interdependent college motives	-0.09	0.08	.252	0.04	0.09	.648	-0.12	0.08	.129	-0.02	0.08	.777	-0.14	0.08	.101	0.02	0.06	.749
UV x Interdependent college motives	-0.06	0.15	.700	0.01	0.17	.938	0.00	0.15	.980	0.14	0.15	.374	0.14	0.17	.420	-0.18	0.14	.206
Any UV Letters vs. None x Interdependent college motives	0.23	0.22	.304	-0.10	0.24	.671	0.36	0.21	.079	0.17	0.22	.436	0.34	0.25	.177	0.10	0.18	.580
Two UV Letters vs. One x Interdependent college motives	-0.25	0.21	.234	0.05	0.23	.813	-0.20	0.20	.308	-0.08	0.21	.690	-0.13	0.23	.574	-0.15	0.19	.415
Completed assignments x Interdependent college motives	-0.03	0.09	.775	-0.04	0.10	.708	-0.07	0.08	.388	0.01	0.09	.916	-0.09	0.09	.357	0.05	0.07	.485
Independent college motives	0.01	0.07	.920	0.05	0.08	.562	0.08	0.07	.291	0.02	0.07	.801	-0.04	0.08	.667	0.04	0.06	.486
UV x Independent college motives	0.01	0.15	.963	0.08	0.16	.597	0.07	0.14	.637	-0.10	0.15	.506	-0.01	0.16	.971	0.01	0.13	.916
Any UV Letters vs. None x Independent college motives	0.13	0.21	.526	0.01	0.23	.962	-0.19	0.20	.348	0.07	0.22	.759	0.07	0.24	.761	-0.11	0.17	.526
Two UV Letters vs. One x Independent college motives	0.29	0.20	.147	0.03	0.22	.906	0.13	0.19	.491	0.16	0.20	.439	0.03	0.22	.875	0.03	0.18	.863
Completed assignments x Independent college motives	-0.01	0.08	.916	0.08	0.09	.339	0.03	0.08	.743	-0.04	0.09	.655	-0.01	0.08	.898	-0.09	0.06	.144
Baseline covariate	0.95	0.06	<.001	0.66	0.07	<.001	0.85	0.06	<.001	0.63	0.06	<.001	0.65	0.07	<.001	0.44	0.05	<.001

**Note.** The model on course grade controls for lecture section using fixed effects (dummy-coded contrasts), not presented. Baseline

covariate = perceived value for topic-specific perceived value, interest for unit-specific interest, college GPA for course grade, and the

exact baseline measure of the outcome for each other outcome. Predictors are coded as follows: *UV* contrast (control = -.75, *UV0L* =

+ .25, *UV1L* = +.25, *UV2L* = +.25), *Any UV Letters vs. None* contrast (control = 0, *UV0L* = -1, *UV1L* = +.5, *UV2L* = +.5), *Two UV*

*Letters vs. One* contrast (control = 0, UV0L = 0, UV1L = -.5, UV2L = +.5), generational status (FG, +.5, CG, -.5), gender (woman, +.5, man, -.5). Race/ethnicity contrasts are dummy coded (1, 0) with European American as the reference group. All other variables are standardized.

Table 25. Zero-Order Correlations and Descriptive Statistics for Linguistic Variables in Study 2

Variable	1	2	3	4	5	6	7	8
1. First-person singular pronouns (LIWC)								
2. Social words (LIWC)	.28***							
3. Family words (LIWC)	.34***	.58***						
4. Friend words (LIWC)	.18***	.31***	.07					
5. Analytical thinking (LIWC)	-.43***	-.68***	-.36***	-.25***				
6. Clout (LIWC)	-.03	.82***	.28***	.26***	-.42***			
7. Authenticity (LIWC)	.34***	-.10	-.01	-.02	-.07	-.31***		
8. Emotional tone (LIWC)	.06	-.01	-.21***	.06	.03	.10	.00	
<i>M</i>	0.87	6.91	0.61	0.10	76.90	65.15	21.59	45.89
<i>SD</i>	1.31	3.59	1.04	0.16	18.15	16.34	15.16	27.18

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

Table 26. *LIWC Content Variables as a Function of Actual Assignment Type in Study 3*

Predictor	First-person singular pronouns			Social words			Family words			Friend words		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	1.03	0.14	<.001	1.73	0.40	<.001	0.12	0.12	.316	0.14	0.01	<.001
Letter vs. Essay contrast	-0.10	0.16	.556	2.08	0.46	<.001	-0.02	0.14	.863	0.21	0.02	<.001

*Note.* Linguistic outcomes are only calculated from assignment 3. Predictors are coded as follows: *UV* contrast (control = -.67, utility-value essay = +.33, utility-value letter = +.33) *Letter vs. Essay* contrast (control = 0, utility-value essay = -.5, utility-value letter = +.5).

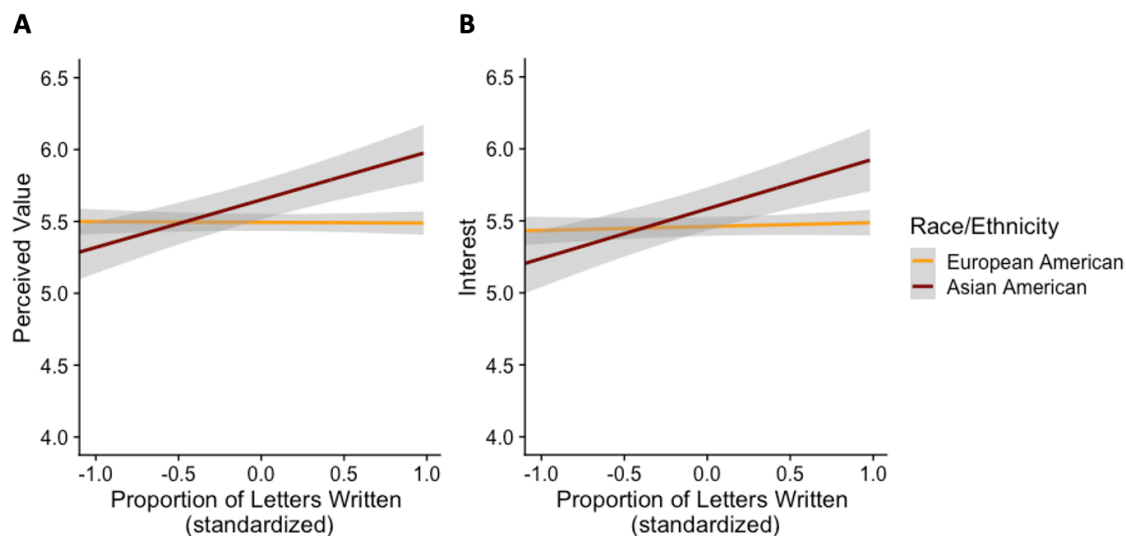
Table 27. *LIWC Style Variables as a Function of Condition in Study 3*

Predictor	Analytical Thinking			Clout			Authenticity			Emotional Tone		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
UV contrast	-11.68	2.00	<.001	6.15	1.78	.001	0.41	1.78	.816	9.91	3.11	.002
Letter vs. Essay contrast	-6.90	2.33	.003	13.39	2.05	<.001	-3.14	2.04	.125	10.87	3.55	.002

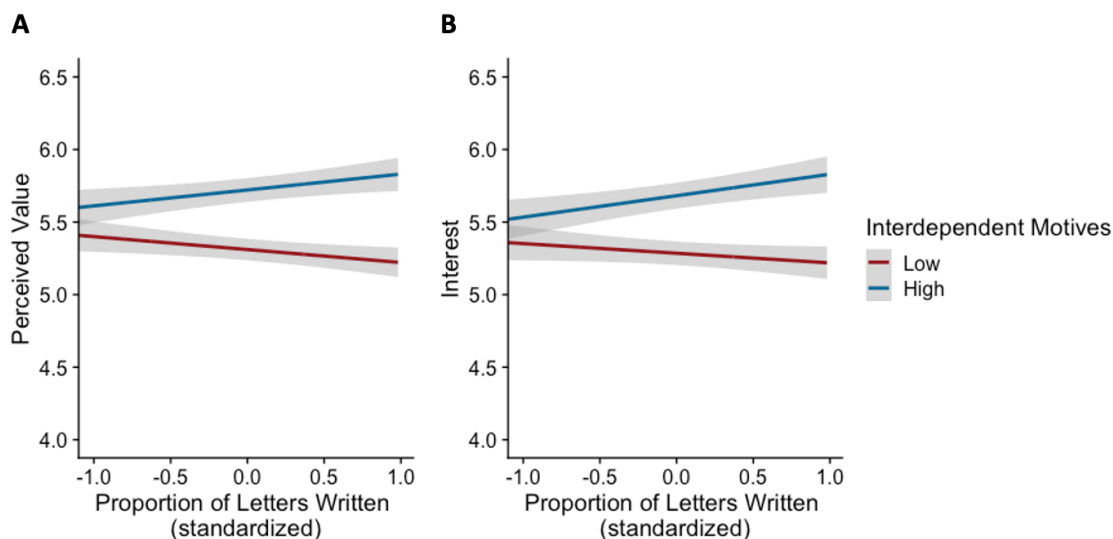
*Note.* Linguistic outcomes are only calculated from assignment 3. Predictors are coded as follows: *UV* contrast (control = -.67, utility-value essay = +.33, utility-value letter = +.33) *Letter vs. Essay* contrast (control = 0, utility-value essay = -.5, utility-value letter = +.5).



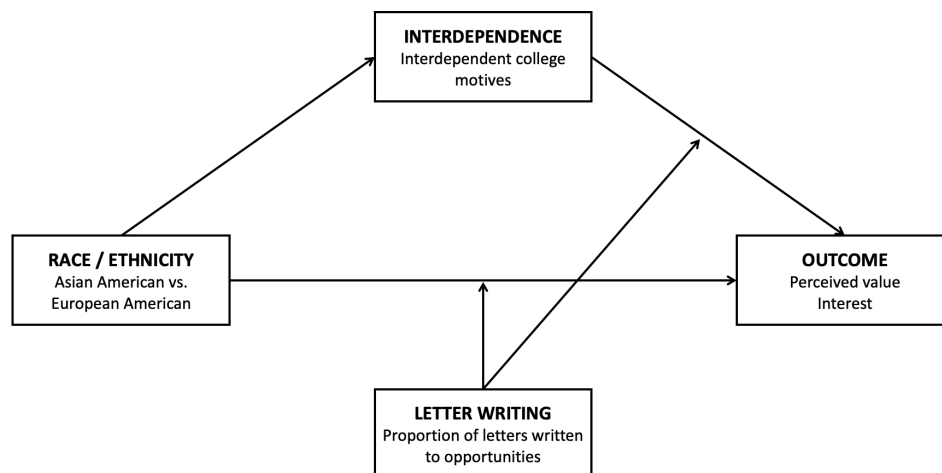
## Figures



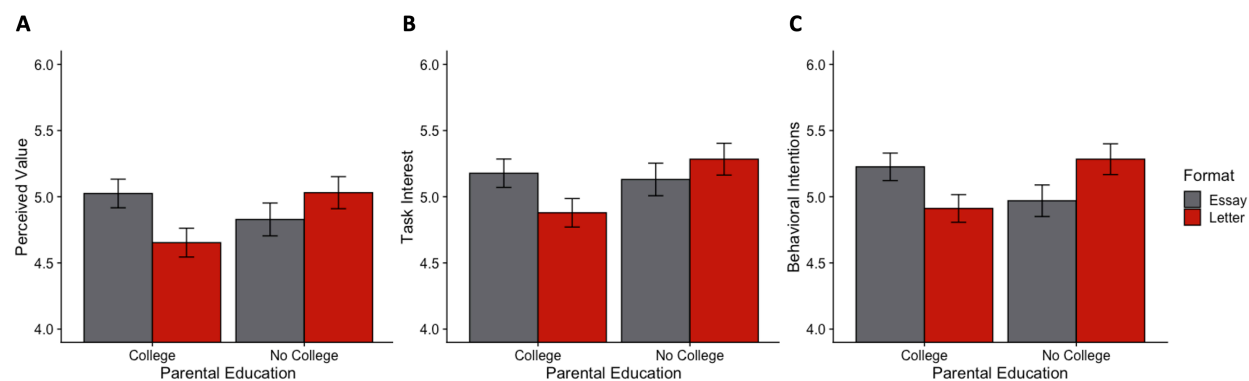
*Figure 1.* Perceived value (A) and interest (B) as a function of letter writing and race/ethnicity in Study 1. Predicted values from the regression equations are graphed for European American and Asian American students, and error envelopes represent  $\pm 1$  standard error of the estimate.



*Figure 2.* Perceived value (A) and interest (B) as a function of letter writing and interdependent college motives in Study 1. Predicted values from the regression equations are graphed from students with high (+1 SD) and low (-1 SD) interdependent motives, and error envelopes represent  $\pm 1$  standard error of the estimate.



*Figure 3.* Conceptual diagram of the moderated mediation model in Study 1. This model tests the effects of race/ethnicity on perceived value and interest via interdependent motives as a function of letter writing.



*Figure 4.* Perceived value (A), task interest (B), and behavioral intentions (C) as a function of assigned writing format (letter vs. essay) and parental education in Study 2. Predicted values are graphed from the regression equations, and error bars represent  $\pm 1$  SE of the estimate.

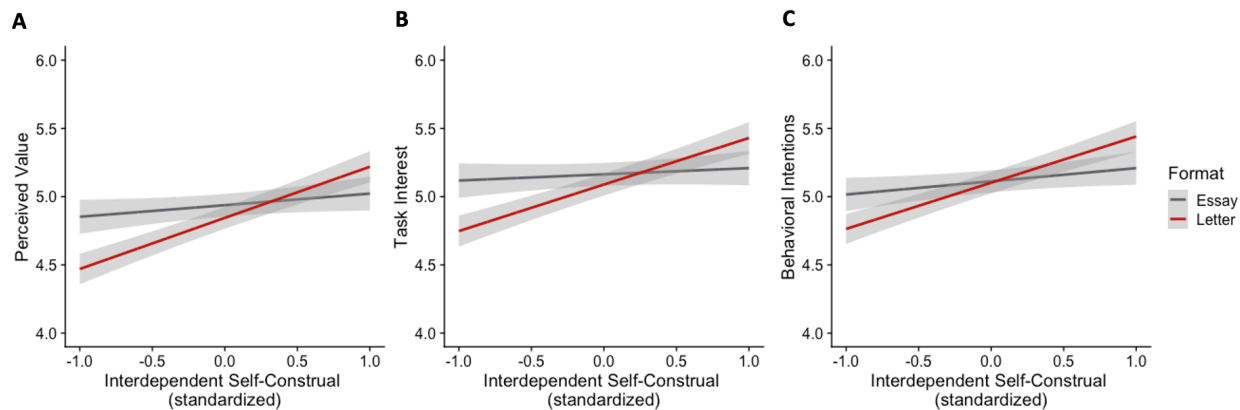


Figure 5. Perceived value (A), task interest (B), and behavioral intentions (C) as a function of assigned writing format (letter vs. essay) and interdependent self-construal in Study 2. Predicted values are graphed from the regression equations, and error envelopes represent  $\pm 1$  SE of the estimate.

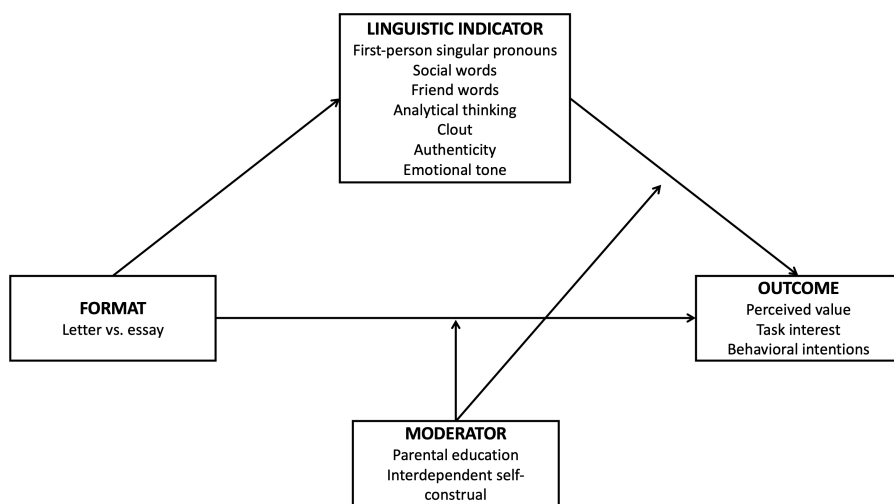
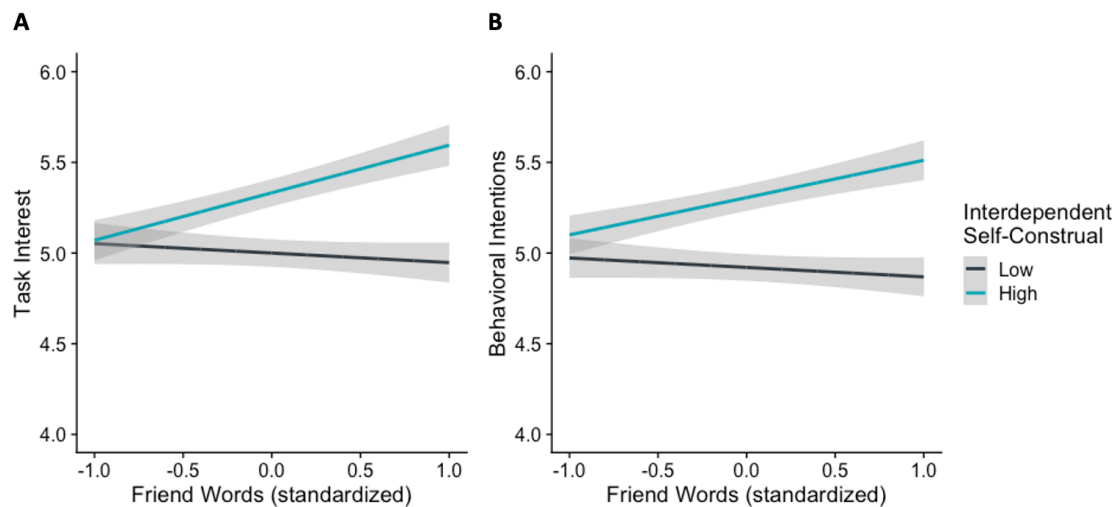
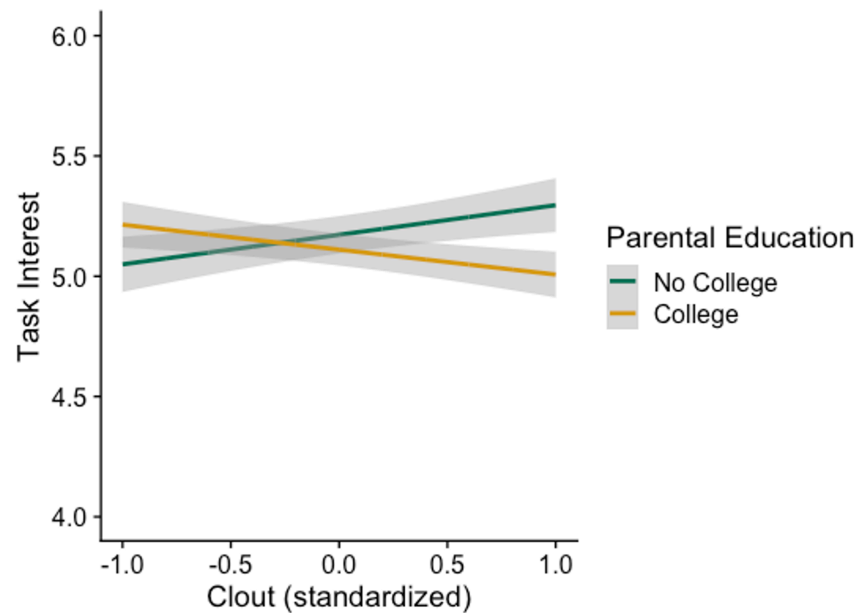


Figure 6. Conceptual moderated mediation model from Study 2.



*Figure 7.* Task interest (A) and behavioral intentions (B) as a function of friend words and interdependent self-construal in Study 2. Predicted values are graphed from the regression equations at  $\pm 1$  SD of interdependent self-construal, and error envelopes represent  $\pm 1$  SE of the estimate.



*Figure 8.* Task interest as a function of clout and parental education in Study 2. Predicted values are graphed from the regression equations, and error envelopes represent  $\pm 1$  SE of the estimate.

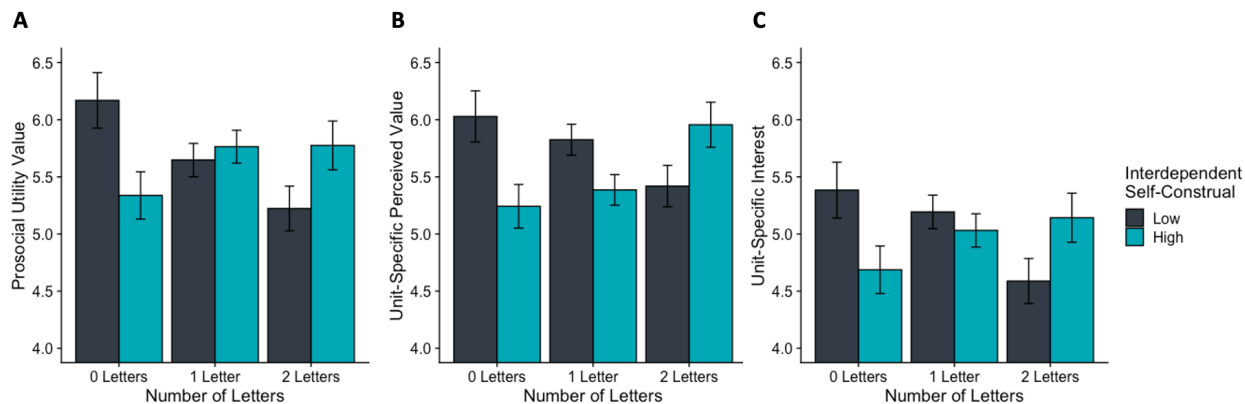


Figure 9. Perceived value (A), unit-specific perceived value (B), and unit-specific interest (C) as a function of number of letters and interdependent self-construal in Study 3. Predicted values are graphed from the regression equations, and error envelopes represent  $\pm 1$  SE of the estimate.

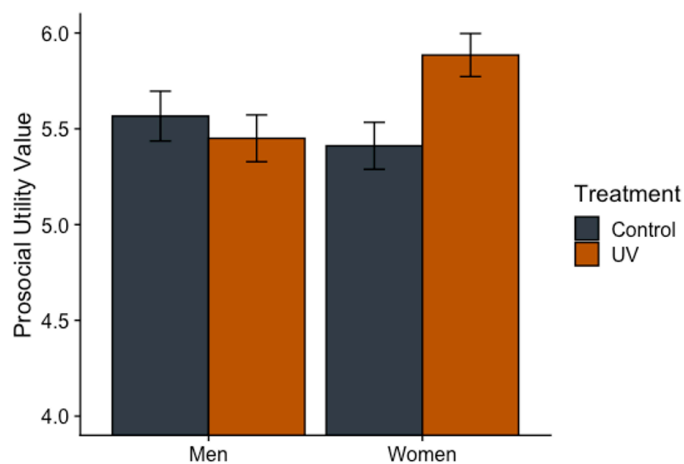


Figure 10. Prosocial utility value as a function of treatment (UV vs. control) and gender in Study 3. Predicted values are graphed from the regression equations, and error bars represent  $\pm 1$  SE of the estimate. UV = utility value.

## Appendix A: Study 2 Preregistration

I adhered closely to the preregistered plan for Study 2, but deviated in the following ways.

**Sample.** It was necessary to deviate slightly from my planned inclusion criteria. I planned to include all participants who (a) provided consent, (b) passed an attention check question, and (c) wrote at least 25 words and responded to the assigned writing prompt. Criteria a and b were followed exactly, but it became apparent after data collection that criterion c needed to be altered. Some participants wrote more than 25 words and responded to the prompt by copying and pasting large sections of the text about fungi that were provided to them. Other participants wrote fewer than 25 words, but showed clear engagement with the writing prompt. Therefore the 25 word limit was relaxed, and participants' whose writing assignments were not plagiarized and provided a coherent response to the writing prompt were included in the sample. In addition, although I preregistered that the sample would be 50% Asian and 50% European American, despite attempts to recruit equal numbers of each group, more European Americans completed the study and the sample ended up being 40% Asian and 60% European American instead.

**Analyses.** In addition to these deviations from the planned sample, I made some modifications to my preregistered analysis plan. First, I did not plan to examine parental education as a moderator of treatment effects. Because the study was not conducted exclusively among college students, I was not able to test the effects of being a first-generation (vs. continuing generation) college student. However, after preregistering the study, I realized that I could still test the effects of parental education, operationalized in terms of parental education (which I had measured). I thus included parental education as a factor in analyses of treatment

effects because it was a theoretically-relevant moderator (Stephens, Fryberg, et al., 2012; Stephens, Markus, et al., 2014).

In addition, in the preregistration, I planned only to include interdependent self-construal as a moderator of treatment effects. However, I also included independent self-construal in my analyses to ensure that any effects of interdependent self-construal were due to variance that was uniquely explained by interdependence and not by more general patterns of response to the self-construal items. I had also planned to include perceived competence and its interactions with treatment. However, instead, I controlled for baseline interest in biology in these models because baseline interest was more theoretically related to the primary outcomes (i.e., task interest, perceived value, and behavioral intentions). Consistent with previous research (Durik et al., 2015; Hecht et al., 2020), I opted to not include both perceived competence and interest in the same model because these measures tend to be highly correlated (Bong, 2001a; Hidi & Renninger, 2006; Marsh et al., 2005). However, all reported treatment effects are consistent including perceived competence and its interactions in the models.



(<http://credlab.wharton.upenn.edu>)



You are logged in as: **cameron.hecht@wisc.edu**

[HOME](#)

([index.php](#))

[See List](#)

([see\\_list.php](#))



[Change my AsPredicted email](#)

([update\\_email1.php](#))

[Log out](#)

([logout.php](#))

## As Predicted: "Testing UV interventions for interdependent individuals, S20 Panel Study" (#34811)

**Created:** 01/31/2020 07:36 AM (PT)

### Author(s)

Cameron Hecht (University of Wisconsin-Madison) - [cameron.hecht@wisc.edu](mailto:cameron.hecht@wisc.edu)

### 1) Have any data been collected for this study already?

It's complicated. We have already collected some data but explain in Question 8 why readers may consider this a valid pre-registration nevertheless.

### 2) What's the main question being asked or hypothesis being tested in this study?

In this study, we will examine the effects of variations of a utility-value (UV) intervention on perceptions of value and interest in an online learning task about the biology of fungi, examining how effects differ by cultural background and interdependent self-construal. We will also examine whether effects depend on perceived competence, which has been found to moderate UV intervention effects in prior research.

Hypothesis 1: Compared to European American individuals, Asian individuals will report higher levels of interdependent self-construal. We will also explore whether there are gender differences in interdependent self-construal.

Hypothesis 2 a-c: We predict that compared to the self-oriented UV conditions, Asian individuals will report higher levels of (2a) interest and (2b) perceived value in the other-oriented UV conditions (see details on conditions below). We will also explore whether there are such effects on (2c) test performance.

Hypothesis 3: We predict that compared to the self-oriented UV conditions, individuals with higher levels of interdependent self-construal will report higher levels of (3a) interest and (3b) perceived value in the other-oriented UV conditions. We will also explore whether there are such effects on (3c) test performance.

Hypothesis 4 (exploratory): We will examine whether any effects of other-oriented (vs. self-oriented) UV for Asian individuals (see Hypothesis 2) are mediated by these individuals' higher levels of interdependent self-construal.

Hypothesis 5 a-b (exploratory): We will examine whether (5a) Asian individuals and (5b) more interdependent



individuals report higher levels of interest and perceived value as a function of writing a UV letter (vs. UV essay), regardless of the target of the writing assignment.

Hypothesis 6 a-b (exploratory): We will examine whether positive effects of other-oriented UV writing for (6a) Asian individuals and (6b) more interdependent individuals (see Hypotheses 2-3) are amplified when such writing is in a letter (vs. essay) format.

Hypothesis 7 a-b (replication): We predict that, consistent with prior research (Canning & Harackiewicz, 2015; Hecht & Harackiewicz, under review), there will be the following effects on test score: (7a) a positive main effect of receiving a UV intervention, (7b) a negative UV intervention x perceived competence interaction.

### **3) Describe the key dependent variable(s) specifying how they will be measured.**

1. Interest (DV): Self-reported, 7-point scale
2. Perceived Value (DV): Self-reported, 7-point scale
3. Test Score (DV): Number of questions answered correctly on a 10-item test on the biology of fungi
4. Interdependent Self-Construal (DV, IV): Self-reported, 7-point scale. Standardized.
5. Race/Ethnicity (IV): Self-reported. Contrast coded, comparing European American individuals to Asian individuals
6. Gender (IV): Self-reported. Contrast coded, comparing women to men
7. Perceived competence (IV): Self-reported, 7-point scale. Standardized.

### **4) How many and which conditions will participants be assigned to?**

Individuals will be randomly assigned to one of five conditions in a 2 (other-oriented UV vs. self-oriented UV) x 2 (letter vs. essay) design with an appended control condition.

1. Control condition: Individuals will be prompted to write an essay summarizing the fungi material.
2. Other-Oriented Essay: Individuals will be prompted to write about the usefulness of the fungi material for a family member or friend in an essay.
3. Self-Oriented Essay: Individuals will be prompted to write about the usefulness of the fungi material for themselves in an essay.
4. Other-Oriented Letter: Individuals will be prompted to write about the usefulness of the fungi material for a family member or friend in a letter to that person.
5. Self-Oriented Letter: Individuals will be prompted to write about the usefulness of the fungi material for themselves in a letter to a family member or friend.

### **5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.**

Effects of treatment will be tested using a set of planned orthogonal contrasts: UV\_vs\_Control (Control = -4, all other conditions = +1), OtherUV\_vs\_SelfUV (Control = 0, each self-oriented condition = -1, each other-oriented condition = +1), Letter\_vs\_Essay (Control = 0, each essay condition = -1, each letter condition = +1), and TargetOfUV\_x\_Format (Control = 0, Other-Oriented Essay = -1, Self-Oriented Essay = +1, Other-Oriented Letter = +1, Self-Oriented Letter = -1).

Hypothesis 1 will be tested using a model regressed on interdependence. Terms in the model will include race/ethnicity and gender.

Hypotheses 2a-2c will be tested using a model regressed on interest, perceived value, and test score. Terms in the model will include the four treatment contrasts, race/ethnicity, gender, perceived competence, and all two-way interactions between each of the four contrasts and each other term in the model. The OtherUV\_vs\_SelfUV x race/ethnicity interaction on each of the outcomes will correspond to Hypotheses 2a-2c.

Hypotheses 3a-3c will be tested using a model regressed on interest, perceived value, and test score. The model will be identical to the model used to test Hypotheses 2a-2c, except that interdependent self-construal and each contrast x interdependence interaction will be added to the model. The OtherUV\_vs\_SelfUV x interdependent self-construal interaction on each of the outcomes will correspond to Hypotheses 3a-3c.

Hypothesis 4 will be tested using path analysis to test for mediation of effects found in testing Hypothesis 2.

Significant indirect effects will provide evidence of mediation.

Hypotheses 5a-5b and 6a-6b will be tested using the same models used to test Hypotheses 2a-2c and 3a-3c.

The Letter\_vs\_Essay x race/ethnicity and Letter\_vs\_Essay x interdependent self-construal terms will correspond to Hypotheses 5a and 5b, respectively, and the TargetOfUV\_x\_Format x race/ethnicity and TargetOfUV\_x\_Format x interdependent self-construal terms will correspond to Hypotheses 6a and 6b, respectively.

Hypotheses 7a-7b will be tested using the same model used to test Hypothesis 2c. The effect of the UV\_vs\_Control contrast will correspond to Hypothesis 7a and the UV\_vs\_Control x perceived competence interaction will correspond to Hypothesis 7b.

**6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.**

Participants will be included in the final sample if they provide consent, pass an attention check question (“Please select ‘Not at all True’ for this question”), and show adequate engagement with the writing task (i.e., write at least 25 words and respond to the assigned writing prompt).

**7) How many observations will be collected or what will determine sample size?**

**No need to justify decision, but be precise about exactly how the number will be determined.**

We are collecting data from 600 online research panel participants (50% Asian, 50% European American).

**8) Anything else you would like to pre-register?**

**(e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)**

We will also explore effects on other self-reported outcomes including perceived competence, behavioral intentions, and a behavioral choice measure (i.e., ranking articles that vary in domain and interdependent focus for use in future studies).

We will also explore the moderating effects of other baseline variables, including baseline perceived value and interest.

Writing assignments will be coded for articulated utility value and a number of other themes using coding schemes with human coders, and with the LIWC software (Pennebaker, Booth, & Francis, 2007). We will also record the number of words in participants’ essays as a measure of engagement in the intervention. We will explore effects of the interventions on these essay-coding variables and word count (engagement) and explore correlations between these coding variables and each outcome. If we find significant treatment effects on test score, we will test for evidence of mediation through our additional self-report variables, word count (engagement), and essay-coding variables in separate mediation models.

Data collection is ongoing for this project, and data have not yet been analyzed. These preregistered analyses can therefore be considered valid.

## Appendix B: Fungi Learning Materials from Study 2

### KINGDOM OF FUNGI: PART I

#### INTRODUCTION

The study of fungi is known as *mycology*, which comes from the Greek word for mushroom. However, mushrooms make up only a portion of the over 50,000 known species of fungi, which also include yeasts, rusts, mildews, and molds. Historically, fungi were included in the plant kingdom, because like some plants, many fungi reproduce by spreading spores. However, because fungi lack chlorophyll as well as stems, roots, and leaves, scientists decided that they should constitute a separate kingdom.



#### ABSORBING NUTRIENTS

In order to have enough energy to grow, fungi need to take in nutrients from the environment. Unlike plants, which manufacture their own food, fungi are *heterotrophic*. This means they only gain energy by breaking down organic material directly from the environment. Fungi absorb their nutrients using one of three methods:

**Parasitism** involves growing on a living host organism and taking nutrients from it, usually harming the host organism in the process. Plants are more susceptible to this than humans and animals. In fact, in crop production, over half of potential crop yield may be lost to fungal disease each year. Animals and humans are less susceptible to parasitism because they have developed barriers to prevent infection. Our skin provides a physical barrier against fungal infection and also secretes fatty acids that shed off fungal infections. In addition, the human/animal immune system has specialized defenses to fight fungal infections. Most fungal infections occur because the immune system is suppressed due to illnesses or stress.



**Saprophytism** involves growing on a dead host organism and taking nutrients from it. This is the familiar process of decomposition. In fact, fungal decomposers are the main agents of the decay of cellulose wastes produced by plants. Fungi decompose this material into carbon dioxide and water. Humans now use these decomposers to clean up highly polluted areas or other toxic material. In a process called *bioremediation*, “white rot fungi” is placed on polluted soil to clear away all the pollutants.



Finally, **Symbiosis** involves growing together with another host organism. Both host and fungus benefit from a symbiotic relationship. The most common fungal symbiotic relationship is *Mycorrhiza*, which is a symbiotic relationship found between fungi and plant roots. The fungus invades the root and derives nutrients from it, but the presence of the fungi actually enhances the nutrient uptake of the roots, thereby benefitting the plant as well.



#### FUNGI IN EVERYDAY LIFE

Fungi are just about everywhere—in our bodies, in the air, even in the refrigerator. They are also responsible for initiating important processes. For example, they play a crucial role in the food chain, decomposing animal and plant waste. Fungi play a role in leisure activities—they are interesting additions to walks in the woods and help maintain healthy soil for gardening. Fungi are the basis of most prescription antibiotics. Truffles are delicacies in fine dining. Yeasts make bread rise and are essential in the production of beer, wine, and some cheeses. Ever wonder about the difference between ales and lagers? It’s caused by using different types of fungi in the brewing process!

**Fungi in Medicine:** Biochemists can use fungi to produce a wide variety of medications for lowering cholesterol, fighting infections, and more. The first and most famous fungus-derived medication was the antibiotic penicillin. Penicillin fights infections by entering the internal systems and feeding off the bacteria that cause infections. Its discovery revolutionized the way we treat infections. Today penicillin and other fungal antibiotics are most commonly used to fight strep throat or sinus infections.



**Fungi in the Soil:** In the natural world, fungi are unsung heroes. They are the ones who decompose animal and plant waste and turn it into carbon dioxide and water, which are actually beneficial for the soil. This makes fungi useful for composting, or turning plant and animal waste into fertilizer. This practice is key for organic farming and gardening, because it helps maintain healthy soil. As a result of fungi-driven composting, you get higher-quality, better-tasting fruits and vegetables, whether you grow them yourself or get them at the farmer’s market.



**Fungi in Food:** In addition to being useful for growing organic produce, fungi themselves are a great food source. Edible fungi such as mushrooms can provide an important source of dietary fiber and protein, so you can use them to maintain a healthy diet. Some mushrooms, such as shiitakes, are complete proteins—they contain all 9 essential amino acids necessary for the dietary needs of humans. Mushrooms are even used as a meat substitute in vegan and vegetarian foods because of their meaty flavor. Whether you are trying to eat healthy or just like to eat delicious food, mushrooms are a great addition to any diet.



#### CONCLUSION

Fungi can be found *everywhere* in our lives – in our homes, gardens, food, and medicine. They have also proven extremely beneficial to humans, such as aiding as a natural medicine and in organic food production. Although we may not be conscious of them, fungi affect almost every aspect of our lives.

## Appendix C: Experimental Writing Prompts from Study 2

### Control Prompt from Study 2

Now, it is time to engage in the writing task. Please take your time to read the activity objectives and task instructions. Then complete the following writing task.

---

### Science Writing Activity

Today, you will complete a science writing activity.

**Write about what you learned today.** Type a short essay (2-3 paragraphs in length) briefly **summarizing what you just learned**. Try to put the material in your own words and be as specific as possible.

*Please type your essay below. We're hoping you'll work on this writing task for **about 5 minutes**, as we have found that to be a sufficient amount of time for most people to write a well-thought-out essay. The arrow to advance the page will appear at the bottom of the page after four minutes.*

*If you want to refer back to the learning materials, click the following link to open the document in a new window: [Fungi learning materials](#)*

## Self-Essay Prompt from Study 2

Now, it is time to engage in the writing task. Please take your time to read the activity objectives and task instructions. Then complete the following writing task.

---

### Science Writing Activity

Today, you will complete a science writing activity.

**Write an essay about what you learned and how fungi could be useful to you in your own life.** Type 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** (e.g., fungi are used in many antibiotics, which can help with your health). Please be as specific as possible.

*Please type your essay below. We're hoping you'll work on this writing task for **about 5 minutes**, as we have found that to be a sufficient amount of time for most people to write a well-thought-out essay. The arrow to advance the page will appear at the bottom of the page after four minutes.*

*If you want to refer back to the learning materials, click the following link to open the document in a new window: [Fungi learning materials](#)*

## Other-Essay Prompt from Study 2

Now, it is time to engage in the writing task. Please take your time to read the activity objectives and task instructions. Then complete the following writing task.

---

### Science Writing Activity

Today, you will complete a science writing activity.

Please list a **specific family member or friend** for whom fungi (or knowledge about fungi) might be useful (Name, relation; e.g., Margaret, mother):

---

**Write an essay about what you learned and how fungi could be useful to the person you listed above in their own life.** Type 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 this person in their own life** (e.g., fungi are used in many antibiotics, which can help with your health). Please be as specific as possible.

*Please type your essay below. We're hoping you'll work on this writing task for **about 5 minutes**, as we have found that to be a sufficient amount of time for most people to write a well-thought-out essay. The arrow to advance the page will appear at the bottom of the page after four minutes.*

*If you want to refer back to the learning materials, click the following link to open the document in a new window: [Fungi learning materials](#)*

## Self-Letter Prompt from Study 2

Now, it is time to engage in the writing task. Please take your time to read the activity objectives and task instructions. Then complete the following writing task.

---

### Science Writing Activity

Today, you will complete a science writing activity.

Please list a **specific family member or friend** to whom you could write a letter about what you learned today (Name, relation; e.g., Margaret, mother):

---

**Write a letter to the person you listed above about what you learned today and how fungi could be useful to you in your own life.** Type a short letter (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** (e.g., fungi are used in many antibiotics, which can help with your health). Please be as specific as possible.

*Please type your letter below. We're hoping you'll work on this writing task for **about 5 minutes**, as we have found that to be a sufficient amount of time for most people to write a well-thought-out letter. The arrow to advance the page will appear at the bottom of the page after four minutes.*

*If you want to refer back to the learning materials, click the following link to open the document in a new window: [Fungi learning materials](#)*

## Other-Letter Prompt

Now, it is time to engage in the writing task. Please take your time to read the activity objectives and task instructions. Then complete the following writing task.

---

### Science Writing Activity

Today, you will complete a science writing activity.

Please list a **specific family member or friend** for whom fungi (or knowledge about fungi) might be useful (Name, relation; e.g., Margaret, mother):

---

**Write a letter to the person you listed above about what you learned and how fungi could be useful to them in their own life.** Type a short letter (2-3 paragraphs in length) briefly **summarizing what you just learned** and explaining how fungi (or knowledge about fungi) might be **useful to this person in their own life** (e.g., fungi are used in many antibiotics, which can help with your health). Please be as specific as possible.

*Please type your letter below. We're hoping you'll work on this writing task for **about 5 minutes**, as we have found that to be a sufficient amount of time for most people to write a well-thought-out letter. The arrow to advance the page will appear at the bottom of the page after four minutes.*

*If you want to refer back to the learning materials, click the following link to open the document in a new window: [Fungi learning materials](#)*



### Appendix D: Study 3 Preregistration

As with Study 2, I adhered closely to the preregistered plan for Study 3, but deviated in the following ways.

**Sample.** I had intended to conduct Study 3 in both introductory biology and introductory physiology courses. Although I collected data in both courses, it became evident that data from these two courses should not be combined. First, the format of the introductory biology course was highly standardized across lecture sections (e.g., same units covered in the same order, same means of evaluation), whereas the structure of introductory physiology was left to the discretion of each instructor and varied greatly across lecture sections. Second, because units were not standardized across sections in physiology, it was not possible to collect unit-specific measures of perceived value and interest in this course. Third, there were strong significant differences in key variables between the two courses: measures of interest and perceived value were higher in introductory physiology than introductory biology. I opted to analyze only data from introductory biology because it had the larger sample of the two courses, it included unit-specific measures of perceived value and interest, and the content was more consistent than in Study 1 (as both samples were in introductory biology courses).

**Analyses.** As in Study 2, I made some modifications to my preregistered analysis plan. First, I preregistered testing the effects of interdependent self-construal and college motives, but as in Study 2, I also included independent self-construal and college motives in my analyses to account for general response patterns to the self-construal and college motives items. Second, although I preregistered that I would test the effects of race/ethnicity using dummy codes to compare each racial/ethnic group to European Americans, I instead opted to test these effects using orthogonal contrasts. These contrasts allowed me to compare the two theoretically

interdependent racial/ethnic groups to all other students, and to one another. However, as noted in the dissertation (footnote 8), treatment effects are consistent regardless of whether race/ethnicity is tested with these orthogonal contrasts or with dummy codes. Third, similar to Study 2, although I preregistered including perceived competence and prior performance as moderators in the treatment effect models, I opted instead to covary baseline measures that matched each outcome as closely as possible. However, as noted in the dissertation (footnote 9), I also tested models including these variables as moderators. These variables did not moderate treatment effects, and all reported treatment effects were consistent with these terms included in the models.

Finally, it became clear that the planned intent-to-treat analyses would not provide an informative test of my research questions given the poor fidelity in this study. As such, I also conducted an unplanned additional set of analyses testing the effects of the type and number of assignments students actually completed.



(<http://credlab.wharton.upenn.edu>)



You are logged in as: **cameron.hecht@wisc.edu**

[HOME](#)

([index.php](#))

[See List](#)

([see\\_list.php](#))



[Change my AsPredicted email](#)

([update\\_email1.php](#))

[Log out](#)

([logout.php](#))

## As Predicted: "*Testing UV interventions for interdependent students, F19 PCC*" (#31746)

**Created:** 11/25/2019 08:04 AM (PT)

### Author(s)

Cameron Hecht (University of Wisconsin-Madison) - [cameron.hecht@wisc.edu](mailto:cameron.hecht@wisc.edu)

Judith Harackiewicz (University of Wisconsin-Madison) - [jmharack@wisc.edu](mailto:jmharack@wisc.edu)

### 1) Have any data been collected for this study already?

It's complicated. We have already collected some data but explain in Question 8 why readers may consider this a valid pre-registration nevertheless.

### 2) What's the main question being asked or hypothesis being tested in this study?

In this study, we will examine the effects of variations of a utility-value (UV) intervention on course grade in undergraduate introductory biology and physiology courses at a two-year college, examining how effects differ by demographic background and interdependence. We will explore two measures of interdependence: interdependent college motives and interdependent self-construal. We will also examine whether effects depend on prior performance or perceived competence, both of which have been found to moderate UV intervention effects in prior research. Because this study is being conducted in a new context, we do not know which measure will be a more powerful moderator and therefore will examine both variables.

Hypothesis 1 a-c: Compared to European American students, (1a) Asian American students and (1b) Latinx students will report higher levels of interdependence. In addition, compared to continuing-generation students, first-generation (FG) college students will report higher levels of interdependence. This hypothesis will be examined using both measures of interdependence, and we will also explore whether there are other demographic differences in interdependence.

Hypothesis 2 a-b: We predict that compared to the one-letter UV condition, demographic groups that were higher in interdependence (see Hypothesis 1) will report higher levels of (2a) interest and (2b) perceived value in the two-letter UV condition. We will also explore whether there are such effects on (2c) course grade.

Hypothesis 3 a-c: We predict that compared to the one-letter UV condition, students with higher levels of interdependence will report higher levels of (3a) interest and (3b) perceived value in the two-letter UV condition. We will also explore whether there are such effects on (3c) course grade. This hypothesis will be examined using both measures of interdependence.

Hypothesis 4 (exploratory): We will examine whether any effects of two-letter (vs. one-letter) UV for particular demographic groups (see Hypothesis 2) are mediated by those groups' higher levels of interdependence.

Hypothesis 5 a-c (replication): We predict that, consistent with prior research (Harackiewicz et al., 2016), there will be the following effects on course grade: (5a) a positive main effect of receiving a UV intervention, (5b) a negative UV intervention x prior performance (or perceived competence) interaction, and (1c) a positive UV x FG x URM interaction.

### **3) Describe the key dependent variable(s) specifying how they will be measured.**

1. Interest (DV): Self-reported, 7-point scale
2. Perceived Value (DV): Self-reported, 7-point scale
3. Course Grade (DV): Biology or Physiology course grades (from institutional records, 4.0 scale)
4. Interdependent College Motives (DV, IV): Self-reported, check all that apply scale
5. Interdependent Self-Constraint (DV, IV): Self-reported, 7-point scale
6. Race (IV): Dummy-coded, comparing the following groups to European Americans: Asian American, Asian International, Black, Latinx, Native American
7. Underrepresented Minority Status (IV): Contrast code comparing Black, Latinx, and Native American students to all other students
8. First-Generation (FG) College Student Status (IV): Two items measure parental education: FG = neither parent has a four-year college degree
9. Gender (IV): Self-reported
10. Prior Performance (IV): A composite of college GPA and ACT or SAT scores, from self-report and institutional records
11. Perceived competence (IV): Self-reported, 7-point scale

### **4) How many and which conditions will participants be assigned to?**

Students will be randomly assigned to one of three conditions: Control, One-Letter UV, and Two-Letter UV within course sections. In each condition, students will be assigned three writing assignments, the content of which will be determined by condition:

1. Control condition: For each assignment, students will summarize course material.
2. One-Letter UV: For the first and third assignment, students will write an essay summarizing course material and writing about how the material could be useful to them in their own lives ("UV Essay"). For the second assignment, students will write a letter to a friend/family member, summarizing course material and writing about how the material could be useful to the recipient ("UV Letter").
3. Two-Letter UV: For the first assignment, students will write a UV Essay, and for the second and third assignments, students will write a UV Letter.

### **5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.**

If the lecture-section ICC is greater than 0.1, we will test all models as random-intercept models using hierarchical linear modeling (nesting students in lecture sections). Otherwise, we will test all models using OLS regression. All treatment effects will be tested using the following set of planned orthogonal contrasts: UV\_vs\_Control (Control = -2, One-Letter UV = 1, Two-Letter UV = 1) and Two\_vs\_OneLetterUV (Control = 0, One-Letter UV = -1, Two-Letter UV = 1). All continuous independent variables will be standardized and all dichotomous variables will be contrast coded (-1, 1).

Hypotheses 1a-1c will be tested using a model regressed on each measure of interdependence. Terms in the model will include race dummy codes, FG status, and gender.

Hypotheses 2a-2c will be tested using a model regressed on interest, perceived value, and course grade. Terms in the model will include the two treatment contrasts, all demographic terms (race dummy codes, FG status, and gender), perceived competence, prior performance, and all two-way interactions between the each of the two contrasts and each other term in the model.

Hypotheses 3a-3c will be tested using a model regressed on interest, perceived value, and course grade. The model will be identical to the model used to test Hypotheses 2a-2c, except that each measure of interdependence and each contrast x interdependence interaction will be added to the model.

Hypothesis 4 will be tested using path analysis to test for mediation of effects found in testing Hypothesis 2. Significant indirect effects will provide evidence of mediation.

Hypothesis 5 will be tested using a model regressed on course grade. The model will include the two treatment contrasts, underrepresented minority (URM) status, FG status, all two- and three-way interactions between each of the contrasts, URM status, and FG status, gender, each two-way contrast x gender interaction, prior performance, perceived competence, and the two-way interactions between each contrast and prior performance and perceived competence.

**6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.**

Students will be included in the final sample if they are at least 18, provide consent, complete the course, and are undergraduate students.

**7) How many observations will be collected or what will determine sample size?**

**No need to justify decision, but be precise about exactly how the number will be determined.**

We are collecting data for one semester from all consenting students in an introductory biology and/or introductory physiology course in fall 2019.

**8) Anything else you would like to pre-register?**

**(e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)**

We will also conduct an ancillary analysis in which we include all students who consented and had the opportunity to complete at least one writing assignment (whether or not they completed the course), and examine effects on DFW rates (i.e., withdrew or received a D or F in the course).

We will also explore effects on other self-reported outcomes including active engagement, exploration of science careers, perceived competence, competence valuation, field identification, perceived field affordances (communal and agentic), perceived science norms, and STEM degree and career plans.

We will also explore effects on topic-specific utility value and interest outcomes among biology students, testing the effect of writing a UV letter vs. a UV essay vs. a control essay about that particular topic.

Writing assignments will be coded for articulated utility value and a number of other themes using coding schemes with human coders, and with the LIWC software (Pennebaker, Booth, & Francis, 2007). We will also record the number of words in students' essays as a measure of engagement in the intervention. We will explore effects of the interventions on these essay-coding variables and word count (engagement), and explore correlations between these coding variables, course grade, and each outcome. If we find significant treatment effects on course grade, we will test for evidence of mediation through our additional self-report variables, word count (engagement), and essay-coding variables in separate mediation models.

We have already collected baseline questionnaires and assigned students to experimental conditions. However, we have not yet received the outcome data. Therefore, this preregistration can still be considered valid.

## Appendix E: Sample Writing Assignment Prompts from Study 3

### Sample Control Prompt from Study 3

Page 1

#### Writing Assignment #3

**Objective:** Writing about scientific principles and phenomena is an increasingly important skill in the 21<sup>st</sup> century. This assignment is designed to help you understand a major concept covered in this unit while also helping you develop your science writing skills. One key to effective science writing is summarizing scientific material in your own words. You'll do this in a 500-600 word paper. You should:

<b>1) Formulate and answer a question</b>	<b>Sample questions</b>
Select a major concept or topic covered in this unit and formulate a question. Use this question as the title of your essay.	<ul style="list-style-type: none"> <li>• <i>What</i> is the role of the mitochondria?</li> <li>• <i>When</i> does active transport occur?</li> </ul>
<b>2) Answer your question in an essay</b>	<b>Example of how to start an essay</b>
Write a 500-600 word essay <b>answering this question</b> , by summarizing the relevant information from class notes and the textbook and defining any key terms or concepts. You should attempt to organize the material in a meaningful way, rather than simply listing the main facts or research findings. Remember to summarize the material in your own words. Finally, in a separate section after the end of your essay, list what references (textbook page, lecture notes) you used to help you answer the question.	<ul style="list-style-type: none"> <li>• "The mitochondrion is an organelle that is found in most human cells. Known as 'the powerhouse' of the cell, the primary role of mitochondria is to generate a molecule called ATP. ATP serves as the energy currency for many processes in the body, powering everything from protein synthesis to muscle contraction and nerve impulse propagation. The number of mitochondria in a cell varies a lot by cell and tissue type and depends on the energetic needs of the cell."</li> </ul>

Page 2

<b>3) Structure your essay as suggested below</b>
<ul style="list-style-type: none"> <li>• State your question in the title.</li> <li>• <b>1<sup>st</sup> section:</b> Give an overview of the answer to your question.</li> <li>• <b>2<sup>nd</sup> section:</b> Provide the scientific details of the answer to your question. Be sure to select the relevant information from class notes and the textbook.</li> <li>• <b>3<sup>rd</sup> section:</b> Provide a conclusion.</li> <li>• <b>4<sup>th</sup> section:</b> Provide a reference section.</li> </ul>

This assignment requires that you formulate your own question and approach, so **do not use the sample questions or specific examples provided above for your paper**. Great ways to start questions that will help you think deeply in this class include: How do/does \_\_\_\_\_? Why is/are \_\_\_\_\_? What is the difference between \_\_\_\_\_?

For this assignment, work independently and do the best you can; you'll receive feedback on your work after it's turned in.

<b>Formatting</b>	Your paper should be 500-600 words, double-spaced and saved as a Word document (.doc or .docx, no PDFs). There are no formatting requirements for the reference section—you can use whatever format you're comfortable with (e.g., MLA, Chicago Manual, APA, etc.). References are not included in the word count.
<b>File Name</b>	To allow for anonymous grading, <b>please do not put your name in the document itself</b> . Canvas will link your name and ID to your assignment.
<b>Submission and Grading</b>	Upload your document by the deadline in the <b>Writing Assignment 3</b> submission portal Canvas. This assignment will be graded on the following: the quality of the question related to class content (covered in this course in weeks 9-12), the quality of the scientific reasoning used to answer the question, and organization of the paper.
<b>Plagiarism</b>	Scholars are honest writers. To receive credit for this assignment, you must submit your own written words. Although cutting and pasting great work found online might be tempting, using your own language prepares you for a successful college experience. <u>Suggest the following technique:</u> <b>1.</b> Read material first, <b>2.</b> Highlight and write yourself notes, and <b>3.</b> Write from your notes

## Sample Utility-Value Essay Prompt from Study 3

Page 1

### Writing Assignment #3

**Objective:** Writing about scientific principles and phenomena is an increasingly important skill in the 21<sup>st</sup> century. This assignment is designed to help you understand a major concept covered in this unit while also helping you develop your science writing skills. One key to effective science writing is explaining how science can be used in everyday life. You'll do this in a 500-600 word paper. You should:

<b>1) Formulate and answer a question</b>  Select a major concept or topic covered in this unit and formulate a question. Use this question as the title of your essay.	<b>Sample questions</b> <ul style="list-style-type: none"> <li>• <i>What</i> is the role of the mitochondria?</li> <li>• <i>When</i> does active transport occur?</li> </ul>
<b>2) Explain how this applies to your life</b>  Write a 500-600 word essay <b>answering this question</b> , and discuss <b>how the information could be useful to you in your own life</b> . Be sure to include some concrete information that was covered in this unit, explaining <i>why</i> the information is relevant to your life and useful for you. Be sure to explain <i>how</i> the information applies to you personally and give examples.	<b>Examples of applications</b> <ul style="list-style-type: none"> <li>• Mitochondria are important <b>in your own life</b> because they produce ATP to supply your skeletal muscle with the energy it needs when you do a cardio workout at the gym or go for a run.</li> <li>• Carbon monoxide can cause death by inhibiting the function of the mitochondria, preventing them from supplying the body with energy. You can protect your mitochondria from carbon monoxide <b>in your own life</b> by not cooking with a propane or charcoal grill in an enclosed space, like your apartment or garage, even if it's a rainy day.</li> <li>• Glucose from digested food enters your intestinal cells by active transport and is then transported around the body by the cardiovascular system. <b>In your own life</b>, eating a well-balanced breakfast on the day of an exam will ensure that enough glucose is delivered to the brain to produce ATP and support memory recall.</li> </ul>

Page 2

<b>3) Structure your essay as suggested below</b> <ul style="list-style-type: none"> <li>• State your question in the title.</li> <li>• <b>1<sup>st</sup> section:</b> Give an overview of the answer to your question.</li> <li>• <b>2<sup>nd</sup> section:</b> Provide the scientific details of the answer to your question. Be sure to select the relevant information from class notes and the textbook.</li> <li>• <b>3<sup>rd</sup> section:</b> Make it personal. Explain why this information is relevant to your life or useful for you and give examples.</li> </ul> <p>Since you will be writing about science from a personal perspective, you can use personal pronouns (I, we, you, etc.).</p>
--

This assignment requires that you formulate your own question and approach, so **do not use the sample questions or specific examples provided above for your paper**. Great ways to start questions that will help you think deeply in this class include: How do/does \_\_\_\_\_? Why is/are \_\_\_\_\_? What is the difference between \_\_\_\_\_?

For this assignment, work independently and do the best you can; you'll receive feedback on your work after it's turned in.

<b>Formatting</b>	Your paper should be 500-600 words, double-spaced and saved as a Word document (.doc or .docx, no PDFs). You do not need to cite the textbook or other class materials (e.g., notes, lectures). However, if you decide to use any outside sources (e.g., websites), or use direct quotes, you should cite them in a separate section at the end of the essay. There are no formatting requirements for the citations of outside sources in the reference section—you can use whatever format you're comfortable with (e.g., MLA, Chicago Manual, APA, etc.). References are not included in the word count.
<b>File Name</b>	To allow for anonymous grading, <b>please do not put your full name in the document itself</b> . Canvas will link your name and ID to your assignment.
<b>Submission and Grading</b>	Upload your document by the deadline in the <b>Writing Assignment 3</b> submission portal Canvas. This assignment will be graded on the following: the quality of the question related to class content (covered in this course in weeks 9-12), the quality of the scientific reasoning used to answer the question, and organization of the paper.
<b>Plagiarism</b>	Scholars are honest writers. To receive credit for this assignment, you must submit your own written words. Although cutting and pasting great work found online might be tempting, using your own language prepares you for a successful college experience. <u>Suggest the following technique</u> : <b>1.</b> Read material first, <b>2.</b> Highlight and write yourself notes, and <b>3.</b> Write from your notes

## Sample Utility-Value Letter Prompt from Study 3

Page 1

### Writing Assignment #3

**Objective:** Writing about scientific principles and phenomena is an increasingly important skill in the 21<sup>st</sup> century. This assignment is designed to help you understand a major concept covered in this unit while also helping you develop your science writing skills. One key to effective science writing is explaining how science can be used in everyday life. You'll do this in a 500-600 word paper. You should:

<b>1) Formulate and answer a question</b>	<b>Sample questions</b>
Select a major concept or topic covered in this unit and formulate a question. Use this question as the title of your letter.	<ul style="list-style-type: none"> <li>• <i>What</i> is the role of the mitochondria?</li> <li>• <i>When</i> does active transport occur?</li> </ul>
<b>2) Explain how this applies to a friend or family member</b>	<b>Examples of applications</b>
Write a 500-600 word letter to a family member or close friend, <b>answering this question</b> , and discuss <b>how the information could be useful to this person in their own life</b> . Be sure to include some concrete information that was covered in this unit, explaining <i>why</i> the information is relevant to this person's life and useful for this person. Be sure to explain <i>how</i> the information applies to this person and give examples.	<ul style="list-style-type: none"> <li>• Mitochondria are important <b>in your own life</b> because they produce ATP to supply your skeletal muscle with the energy it needs when you do a cardio workout at the gym or go for a run.</li> <li>• Carbon monoxide can cause death by inhibiting the function of the mitochondria, preventing them from supplying the body with energy. You can protect your mitochondria from carbon monoxide <b>in your own life</b> by not cooking with a propane or charcoal grill in an enclosed space, like your apartment or garage, even if it's a rainy day.</li> <li>• Glucose from digested food enters your intestinal cells by active transport and is then transported around the body by the cardiovascular system. <b>In your own life</b>, eating a well-balanced breakfast on the day of an exam will ensure that enough glucose is delivered to the brain to produce ATP and support memory recall.</li> </ul>

Page 2

### 3) Structure your letter as suggested below

- State your question in the title.
- Begin your letter by addressing your recipient: Dear \_\_\_\_\_,
- **1<sup>st</sup> section:** Give an overview of the answer to your question.
- **2<sup>nd</sup> section:** Provide the scientific details of the answer to your question. Be sure to select the relevant information from class notes and the textbook.
- **3<sup>rd</sup> section:** Make it personal. Explain why this information is relevant to this person's life or useful for them and give examples.

Since you will be writing about science from a personal perspective, you can use personal pronouns (I, we, you, etc.).

This assignment requires that you formulate your own question and approach, so **do not use the sample questions or specific examples provided above for your paper**. Great ways to start questions that will help you think deeply in this class include: How do/does \_\_\_\_\_? Why is/are \_\_\_\_\_? What is the difference between \_\_\_\_\_?

For this assignment, work independently and do the best you can; you'll receive feedback on your work after it's turned in.

**Formatting** Your paper should be 500-600 words, double-spaced and saved as a Word document (.doc or .docx, no PDFs). You do not need to cite the textbook or other class materials (e.g., notes, lectures). However, if you decide to use any outside sources (e.g., websites), or use direct quotes, you should cite them in a separate section at the end of the letter. There are no formatting requirements for the citations of outside sources in the reference section—you can use whatever format you're comfortable with (e.g., MLA, Chicago Manual, APA, etc.). References are not included in the word count.

**File Name** To allow for anonymous grading, **please do not put your full name in the document itself**. Canvas will link your name and ID to your assignment.

**Submission and Grading** Upload your document by the deadline in the **Writing Assignment 3** submission portal Canvas. This assignment will be graded on the following: the quality of the question related to class content (covered in this course in weeks 9-12), the quality of the scientific reasoning used to answer the question, and organization of the paper.

**Plagiarism** Scholars are honest writers. To receive credit for this assignment, you must submit your own written words. Although cutting and pasting great work found online might be tempting, using your own language prepares you for a successful college experience. Suggest the following technique: **1.** Read material first, **2.** Highlight and write yourself notes, and **3.** Write from your notes