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Exposure to information increases motivation to learn more

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ABSTRACT

Low motivation to learn in undergraduate general education courses hinders learning. Research has identified strategies that increase motivation to learn before students are asked to learn content (e.g., outlining the utility of the course material for future careers). Extending this work, we propose that learning any material in a course may beget motivation to learn more, in line with the notion that the process of learning itself may spark curiosity and interest. Across three populations (college-aged individuals on mTurk, large public university students, and small private university students), we found that watching a TED Talk video (i.e., exposure to new information, learning) pertaining to any topic led to an increase in motivation to continue learning about that topic and other topics more generally. These results reveal a need to broaden models of motivation to consider the importance of exposure to content to increase motivation to learn.

1. Introduction

One of the difficulties that college and university instructors face is low motivation in students taking general education (GE) course requirements (Kim, Park, Huynh, & Schuermann, 2017). Students in higher education focus on the courses for their major so that they can obtain stable employment upon graduation (Carlson & Fleisher, 2002), and thus may fail to see the benefit of taking GE courses. However, low motivation in GE courses is a problem because it can lead to a lack of engagement and learning of broad knowledge that can support the goals of higher education: to produce creative and critical thinkers capable of transferring information across topics (National consensus in 2004: Association of American Colleges & Universities, 2004; Meacham & Gaff, 2006). Such thinking requires a well-rounded education that covers basic knowledge in various fields (e.g., Efland, 2002; Hetland, Winner, Veenema, & Sheridan, 2007; Klauer, 1989; Sawyer, 2011). Ironically, these same skills are also noted as most valued by employers (Rosenberg, Heimler, & Morote, 2012; Stewart, Wall, & Marciniec, 2016).

Past research has been dedicated to understanding student belief factors that affect motivation to learn. Proponents of self-determination theory argue that a key factor underlying human motivation is having their need for *autonomy* fulfilled (along with their need for relatedness and competence; Deci & Ryan, 2002; Ryan & Deci, 2000). In a classroom setting, students may be more motivated to learn when they perceive that they have some control over the material they are learning (Reeve, 2002), such as selecting the type of homework assignment they complete for a particular lesson (Patall, Cooper, & Wynn, 2010) or choosing specific topics to learn (Patall, 2013). Such choice may allow students to increase their sense of autonomy, which contributes to the overall level of

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motivation to learn that material.

Other theories emphasize the influence of perceived value, self-efficacy, and beliefs about ability. Expectancy-value theory (Eccles & Wigfield, 2002; Eccles, 2009) proposes that when students perceive a course to have *utility value* (i.e., it would be useful for their future), they are more motivated to engage with the material and persist in taking more advanced courses in that field (e.g., Harackiewicz, Rozek, Hulleman, & Hyde, 2012). Bandura's self-efficacy theory (Bandura & Schunk, 1981; Bandura, 1997) posits that greater levels of confidence in ability relate to greater motivation to learn. Supporting the application of this theory, direct and indirect mastery experiences such as reflecting on one's learning progress or observing others succeed might increase students' confidence, and subsequently, their motivation to learn (Camfield, Beaster-Jones, Miller, & Land, 2020). Other beliefs about performance, such as whether a student believes they can improve with effort (e.g., growth versus fixed mindset; Dweck, 1999, 2006; and personal locus of control; Patrick, Skinner, & Connell, 1993), can also influence motivation to learn.

Together these theories cover a wide range of belief factors that affect motivation to learn, yet one factor is largely missing: learning itself, independent of beliefs about one's ability to learn and succeed. Though some of the aforementioned theories do touch on mastery experiences as precursors for motivation that could be considered learning (e.g., self-efficacy theory) and that competence perceptions could be a consequence of such experiences, we propose that there is a more nuanced way of examining the role of learning in increasing motivation to learn. Typically, mastery experiences refer to situations in which students are tested on their ability to perform a certain task, where the outcome can be labeled as a success (which may increase self-efficacy and thus motivation) or failure (which may decrease motivation). Additionally, the influence of mastery experiences on motivation have been discussed as resulting in certain beliefs that result from these learning opportunities (e.g., "I am competent and capable of learning this material so I am motivated to do so"). However, we propose that learning itself, independent of demonstrating competence, experiencing success, and believing in one's capabilities to learn can increase motivation to learn. Indeed, recent work provides evidence that learning about a topic can increase motivation to learn more: when students who were initially not interested in pursuing a major took a class about that major in high school, they were more likely to pursue that major in college (Yu, Kuncel, & Sackett, 2020).

Motivation may increase via exposure to or acquiring new knowledge, especially if the knowledge is novel, surprising, or useful (Fletcher et al., 2001; Harackiewicz et al., 2012; Mezirow, 2000). Knowledge acquisition may drive feelings of curiosity and interest because it helps people identify gaps in their understanding, which they then seek to fill; this process creates a rewarding feedback loop that strengthens motivation to continue learning (Murayama, FitzGibbon, & Sakaki, 2019). Importantly, Murayama et al. (2019) argue that students may not engage in such knowledge-seeking behavior if they do not think they have the capability to do so (e.g., if they have not had mastery experiences with the topic in the past, or if the material is presented in an inaccessible manner). Thus, new information should be presented in a way that is interesting and accessible to students, so they are not immediately discouraged from engaging in knowledge-acquisition processes. In the context of undergraduate education, making students aware of the gaps in their knowledge through a brief exposure to content may pique their interest and increase their motivation to learn more. Thus, the question becomes: will students be more motivated to learn after they have been exposed to information that they initially are not motivated to learn?

1.1. *The present study*

As a critical first step in investigating how simply exposing students to information may increase motivation to learn more, the present study tested whether a brief exposure to a topic in which students had low motivation can increase motivation to learn more about that topic and other topics more generally down the road. We tested three naturally occurring groups of participants: college-aged individuals from across the United States (Experiment 1), and undergraduate students enrolled in a large public university (Experiment 2a) and small private university (Experiment 2b). The first sample was chosen to investigate whether motivational effects would occur in a heterogeneous sample of individuals whose primary occupation is not studying as an undergraduate student. The second two samples were chosen to investigate the effect in two different university settings (in terms of public vs. private, faculty-student ratio, 20:1 vs. 13:1, and typical class size, 20.7 % of courses fewer than 20 students vs. 50.1 %).

We investigated the impact of exposure to information about a low-motivation topic on 1) students' motivation to learn more about that topic, 2) students' motivation to learn about an unrelated topic, and 3) students' motivation to learn more broadly across a range of topics. Our study utilized a mixed pretest/posttest design in which participants' motivation to learn several different topics was measured immediately before and after watching a video. Importantly, the single video they watched was about either the specific topic that *each* participant reported as the topic they were least motivated to learn (experimental condition) or an unrelated topic (control condition). We could then detect whether an increase in motivation occurred for the topic they identified as their least motivated and/or across all topics more generally as a function of watching the selected video versus an unrelated video.

Based on research on curiosity and knowledge acquisition, we hypothesized that: 1) motivation to learn more about a topic would increase after exposure to any video, but would increase more after watching a video about that topic (experimental condition), compared to a video about an unrelated topic (control condition). We additionally hypothesized that: 2) exposure to information about a topic might lead to an overall increase in motivation to learn across a variety of topics, since exposure to information might lead to a realization that there is more to learn *in general*. Finally, we hypothesized that: 3) the effect would occur in all three populations similarly, which would suggest the broad applicability of such a knowledge-exposure intervention for a wide variety of students and potential students. The entire project was pre-registered on the Open Science Framework (OSF; https://osf.io/dau35), and IRB approval at the first author's home institution was obtained (IRB Protocol #: HS 18–154).

2. Experiment 1

Experiment 1 tested whether exposure to information about a topic would increase motivation to learn in a majority non-student, but generally college-aged sample. We recruited participants from the United States via Amazon's Mechanical Turk (mTurk). In this study, it was of interest to see whether a brief topic exposure intervention mentioned here would elicit an increase in motivation to learn about a specific topic (Hypothesis #1) and across a range of topics more generally (Hypothesis #2).

2.1. Method

2.1.1. Participants

A total of 120 traditional undergraduate-aged individuals (*median* = 21 yrs.; *range* = 18–30 yrs.) were recruited to participate in this study via Amazon's Mechanical Turk (mTurk). This number was chosen in order to have at least 10 participants per randomly-selected video (out of the 6 topics) in the control condition, and to then have an equivalent number of participants in the experimental condition. Participants were asked if they were between the ages of 18–22, but were not excluded from participating if they exceeded that range—this was to ensure that overall the participants were similar in age to students in higher education (this was confirmed via a question about their actual age—only 16 participants exceeded 22 years old). Demographic information about the participants is presented in Table 1. Participants were compensated with $1 for participation.

2.1.2. Materials and measures

2.1.2.1. Materials. Six TED Talk videos, freely available online at www.ted.com/talks, were used as stimuli in this study. The videos were selected to be reflective of short lectures in terms of length (range: 14−22 min.), reflective of a variety of STEM topics that Psychology majors and first-/second-year students may be less familiar with, and popular (at least 1 million views, used to approximate interestingness; see Table 2 for overview of the videos). Ratings provided by five undergraduate research assistants indicated that the videos were similarly interesting (one-way ANOVA; $p > .05$).

2.1.2.2. Measures. Self-report data about gender, age, and race/ethnicity were collected. Data on participant motivation before and after watching a video were collected by asking participants to "…rate [their] motivation to learn about each of the following topics on the scale described," which was from 1 = *not at all motivated* to 9 = *extremely motivated*. Reliability for the scores across each topic was strong (α = .89). Additionally, participants were asked to rank-order the topics according to their motivation to learn from 1 to 6 (or 1–5 in the control condition, described below): "Please rank order your motivation to learn each of these topics on a scale of 1–6, with 1 (top choice) indicating the topic that you are *most* motivated to learn, and 6 (bottom choice) indicating the topic you are *least* motivated to learn." This ranking portion of the experiment was to determine the topic that participants were least motivated to learn, since it was possible for participants to indicate that they had very low motivation (rating of 1) to learn all of the topics during the rating phase. Topic-specific motivation was measured as the single motivation score for the lowest-ranked video, and general motivation was measured as the average motivation score across the five other topics that participants were more motivated to learn.

2.1.3. Design

This study utilized a 2 (motivation time point: immediate pretest vs. immediate posttest) × 2 (video type: low-motivation [experimental] vs. unrelated [control]) mixed design, with motivation assessed within participants and video type manipulated between participants. In the experimental condition, participants were presented with six STEM topics (cell biology, civil engineering, math, physics, entomology, computer science) and asked to rank-order them to identify which topic they were the least motivated to learn (see Table 2 for the count of participants choosing each topic as their least motivated). They were then assigned to watch the video of the topic that they identified as their least motivated. In the control condition, participants only ranked five of the topics (which five topics the participants saw was counterbalanced), and they were assigned to watch the video of the topic they did not rank

Table 1
Demographic Characteristics by Sample

Characteristic	Public, N = 73	Private, N = 34	mTurk, N = 120
Age M±SD (range)	19.25 ± 1.40 (18–28)	21.15 ± 5.67 (18–47)	22.04 ± 2.76 (18–30)
Gender, N for Fem./Male/Other	48/25/0 66 %/34 %/0 %	28/6/0 82 %/18 %/0 %	54/63/3 45 %/53 %/2 %
Race, N (approx. %)			
White	13 (18 %)	6 (18 %)	88 (73 %)
Black	5 (7 %)	1 (3 %)	7 (6 %)
Asian	25 (34 %)	19 (56 %)	4 (3 %)
Multiracial or Other	26 (36 %)	7 (19 %)	11 (9 %)
Decline to State	4 (5 %)	1 (3 %)	10 (8 %)
Ethnicity, N (approx. %)			
Hispanic	32 (44 %)	8 (24 %)	27 (23 %)
Non-Hispanic	39 (53 %)	23 (68 %)	90 (75 %)
Decline to State	1 (1 %)	3 (8 %)	3 (3 %)

Table 2
TED Talk Video Stimuli Descriptive Information

Topic	Presenter	Title	# of Views	Video Length	# of Participants Choosing as Least Motivated in the Exp. Condition
Cell Biology	Bonnie Bassler	How bacteria "talk"	2,454,273	18:04	12
Civil Eng.	Ian Firth	Bridges should be beautiful	1,141,490	14:02	20
Comp. Sci.	Fei-Fei Li	How we're teaching computers to understand pictures	2,498,295	17:59	10
Entomology	Deborah Gordon	The emergent genius of ant colonies	1,084,016	20:22	30
Mathematics	Robert Lang	The math & magic of origami	2,375,603	15:50	17
Physics	Brian Greene	Is our universe the only universe?	4,932,191	21:41	24

(i.e., a video that to them seemed entirely unrelated to the experiment).

2.1.4. Procedure

After providing their informed consent, participants read instructions that explained they would be participating in a study about learning and that they would be presented with material that they may later be tested on (though they were not tested—this instruction was provided to encourage them to pay attention to the video). They then completed the demographics questionnaire, rated and ranked their motivation, and watched the corresponding video (the lowest-ranked video in the experimental condition or a video they did not rank in the control condition). Participants were not able to move on from the video until the appropriate amount of time had elapsed to encourage participants to watch the entire video, without being able to skip ahead. Finally, participants were asked to rate their motivation to learn each of the topics a final time. Note that for all motivation rankings, participants could not move on from the screen until 10 s had passed, so they were encouraged to think about their answers rather than rush through the experiment as quickly as possible. Fig. 1 shows a flow chart of the experimental design. Participants were then debriefed and compensated $1 for their participation. The duration of the experiment took approximately 30 min.

2.2. Results

2.2.1. Topic-specific motivation

The first ANOVA tested whether being shown a video about a specific topic that a participant was not initially motivated to learn (compared to an unrelated topic) would increase motivation to learn more about that topic. A 2 (motivation time point: pretest vs. posttest) × 2 (video type: low-motivation vs. unrelated) mixed design ANOVA revealed a main effect of motivation time point such that motivation after watching a video in either condition was higher ($M = 6.03$, $SE = 0.24$) than before watching that video ($M = 5.27$, $SE = 0.25$; see Table 3 for average motivation across all experiments), $F(1, 120) = 20.20$, $p < .001$, $MSE = 1.76$, $\eta_p^2 = .14$ (See Fig. 2A). There was also a main effect of video type, such that participants who watched an unrelated video had higher overall motivation across both time points ($M_{pre/post} = 6.26$, $SE = 0.23$) than those who watched their low-motivation video ($M_{pre/post} = 5.18$, $SE = 0.25$), $F(1, 120) = 6.09$, $p = .02$, $MSE = 11.91$, $\eta_p^2 = .05$. Finally, there was a significant interaction: The pretest-posttest increase in motivation was greater for participants who watched a video related to their low-motivation topic ($M_{pre} = 4.51$, $SE = 0.35$, $M_{post} = 5.71$, $SE = 0.33$) than for participants who watched an unrelated video ($M_{pre} = 6.03$, $SE = 0.32$, $M_{post} = 6.36$, $SE = 0.33$), $F(1, 120) = 6.56$, $p = .01$, $MSE = 1.76$, $\eta_p^2 = .05$. These results support our first hypothesis: motivation to learn a low-motivation topic increased after watching any video, but the effect was greater when the video was related to the low-motivation topic.

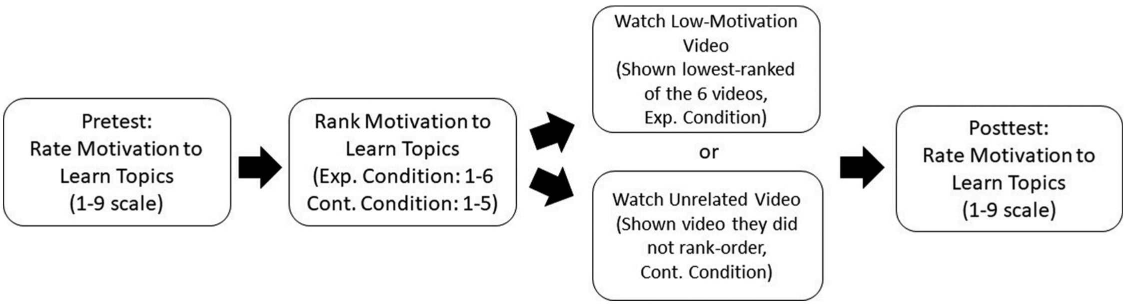

Fig. 1. Flow Chart of Experimental Design
Note. Participants rated their motivation to learn each of the six (experimental condition) or five (control condition) topics on a 1–9 scale (1=*not at all motivated*, 9=*extremely motivated*). Then, they rank-ordered the topics (1=*most motivated to learn*, 6/5=least-*motivated to learn*). Each participant in the experimental condition watched the video pertaining they ranked as their personal least-motivated to learn (nonrandom video assignment). Participants in the control condition were shown the sixth video that they did not rank-order, so it appeared to them as an unrelated topic.

Table 3
Motivation Across Experiments 1, 2a, & 2b

Experiment	Topic-Specific Motivation Pretest	Topic-Specific Motivation Posttest	General Motivation Pretest	General Motivation Posttest
1: mTurk				
Low-Motivation	4.51 (0.35)	5.71 (0.33)	5.84 (0.26)	5.83 (0.30)
Unrelated	6.03 (0.32)	6.36 (0.33)	6.85 (0.23)	6.98 (0.25)
2a: Large Public Uni.				
Low-Motivation	2.06 (0.27)	3.13 (0.28)	4.83 (0.29)	4.63 (0.27)
Unrelated	2.14 (0.21)	2.71 (0.25)	3.98 (0.23)	4.37 (0.21)
2b: Small Private Uni.				
Low-Motivation	1.94 (0.34)	3.63 (0.51)	4.25 (0.42)	4.66 (0.35)
Unrelated	2.33 (0.48)	3.17 (0.45)	3.73 (0.25)	4.07 (0.24)

Note: Standard error in parentheses.

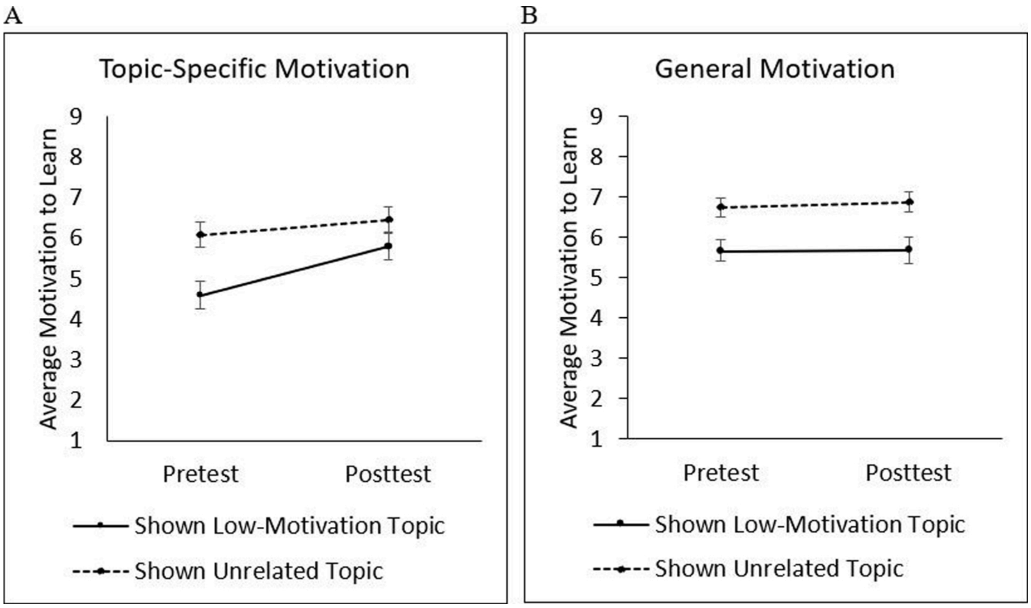

Fig. 2. Results from Experiment 1—mTurk Sample
Note. Topic-specific (Panel A) and general motivation (Panel B) before and after watching a video in the mTurk sample. Shown lowest motivation topic = experimental condition, shown unrelated topic = control condition. Error bars are 1 SEM.

2.2.2. *General motivation*

We also tested whether exposure to information about a topic increases motivation to learn across several other topics more broadly. To do this, analyses were conducted on participants' motivation to learn averaged across the five unselected topics before and after watching a video. These five topics represent the topics that participants were initially more motivated to learn than the sixth topic (described previously).

A 2 (motivation time point: pretest vs. posttest) × 2 (video type: low-motivation vs. unrelated) mixed design ANOVA revealed a main effect of video type such that overall motivation was lower for participants who watched their low-motivation video ($M = 5.83$ $SE = 0.20$) compared to those who watched an unrelated video ($M = 6.92$, $SE = 0.17$), $F(1, 129) = 9.22$, $p = .003$, $MSE = 8.35$, $\eta_p^2 = .07$ (See Fig. 2B). The ANOVA failed to find a main effect of motivation timepoint, $F(1, 129) = 0.39$, $p = .54$, $MSE = 0.61$, $\eta_p^2 = .003$, or an interaction between motivation timepoint and video, $F(1, 129) = 0.34$, $p = .45$, $MSE = 0.61$, $\eta_p^2 = .004$. These findings do not support our second hypothesis: That being exposed to information would lead to an increase in motivation to learn across topics more generally.

3. Experiment 2a

Experiment 2a sought to replicate the findings from Experiment 1 in sample of undergraduate students enrolled at a large public university, rather than undergraduate-aged individuals who may differ from undergraduate students in important ways (e.g., mTurk participants' day-to-day lives may not revolve around learning in the way that undergraduate students' lives do).

3.1. Method

3.1.1. Participants

A total of 73 (*median* = 19 yrs.; *range* = 18–28 yrs.) undergraduate students enrolled in introductory Psychology courses at a large public university were recruited to participate in this study through the university participant pool. The number of participants was determined by a power analysis (G*Power) on preliminary data from the mTurk sample in Experiment 1. The power analysis determined that we would need at least 18 participants/group to detect a significant between-subjects within-between interaction (our most important comparison) at 80 % power based on an effect size of .112 (η_p^2), obtained from analysis of an early sample of participants. Demographic information about the participants' gender, race, and ethnicity were collected and are presented in Table 1. Participants were compensated with partial course credit.

3.1.2. Design, materials and measures, & procedure

The design, materials and measures, and procedure were all the same as in Experiment 1, except participants were brought into the lab and guided through the experiment by a research assistant. Reliability for the motivation scores in this experiment was good ($\alpha = .70$).

3.2. Results

3.2.1. Topic-specific motivation

A 2 (motivation timepoint: pretest vs. posttest) × 2 (video type: low-motivation vs. unrelated) ANOVA revealed a main effect of motivation timepoint, such that motivation after watching a video in either condition was higher ($M = 2.89$, $SE = 0.19$) than before watching that video ($M = 2.11$, $SE = 0.17$), $F(1, 71) = 19.02$, $p < .001$, $MSE = 1.26$, $\eta_p^2 = .21$ (See Fig. 3A). There was no main effect of video type, $F(1, 71) = 0.30$, $p = .59$, $MSE = 3.35$, $\eta_p^2 = .004$, nor an interaction, $F(1, 71) = 1.73$, $p = .19$, $MSE = 1.26$, $\eta_p^2 = .02$. Consistent with Experiment 1, these results provide support for our hypothesis that watching a video about any topic would increase motivation to learn that topic. However, these results run counter to our hypothesized and observed interaction from Experiment 1.

3.2.2. General motivation

A 2 (motivation timepoint: pretest vs. posttest) × 2 (video type: low-motivation vs. unrelated) ANOVA revealed an interaction effect such that motivation for participants in the control condition ($M_{pre} = 3.98$, $SE = 0.23$; $M_{post} = 4.37$, $SE = 0.21$) increased more after watching a video than for participants in the experimental condition ($M_{pre} = 4.83$, $SE = 0.29$, $M_{post} = 4.63$, $SE = 0.27$), $F(1, 71) = 8.21$, $p = .005$, $MSE = 0.38$, $\eta_p^2 = .10$ (See Fig. 3B). There was no main effect of video type, $F(1, 71) = 2.69$, $p = .11$, $MSE = 4.10$, $\eta_p^2 = .04$, or motivation timepoint, $F(1, 71) = 0.87$, $p = .35$, $MSE = 0.38$, $\eta_p^2 = .01$. These results do not support our hypothesis that watching a video about a topic would increase motivation to learn across other topics more broadly, as motivation to learn actually decreased for participants who watched the low-motivation video, and increased for participants who watched an unrelated video. This interaction was unexpected and does not replicate the findings of Experiment 1.

4. Experiment 2b

Since lack of motivation to learn is an issue for higher education across institutions, there is value in testing the same three hypotheses in a different university setting: a private university with a smaller faculty-student ratio and smaller class sizes. Thus, we replicated the study with students from such a university in Experiment 2b.

4.1. Method

4.1.1. Participants

A total of 79 (*median* = 20 yrs.; *range* = 18–47 yrs.) undergraduate students enrolled in a small private university were recruited to participate in this study through the university participant pool and compensated with partial course credit (sample size determined as describe in Experiment 2a). Demographic information about the participants are presented in Table 1.

A programming oversight resulted in grossly unequal numbers of participants being assigned across the single experimental condition (n = 16) compared to the control condition ($n = 63$). To compensate for this error, we randomly removed a total of 45 participants from the control group, yielding a final sample of 34 participants (16 in the experimental group, 18 in the control group[1]). Given no meaningful significant differences between the results from the full dataset and the corrected dataset, the smaller dataset still having enough power to detect a significant difference, and the smaller dataset being more appropriate for comparison given the similar sample sizes, the more conservative (corrected; smaller) dataset was used for all following analyses.[2]

[1] The unequal cell sizes resulted from our desire to control for item effects across the videos in the experiment. Three participants were assigned to each of the six videos for a total of 18 participants, compared to the 16 participants collected in the experimental condition.

[2] The full dataset and analyses are available upon request.

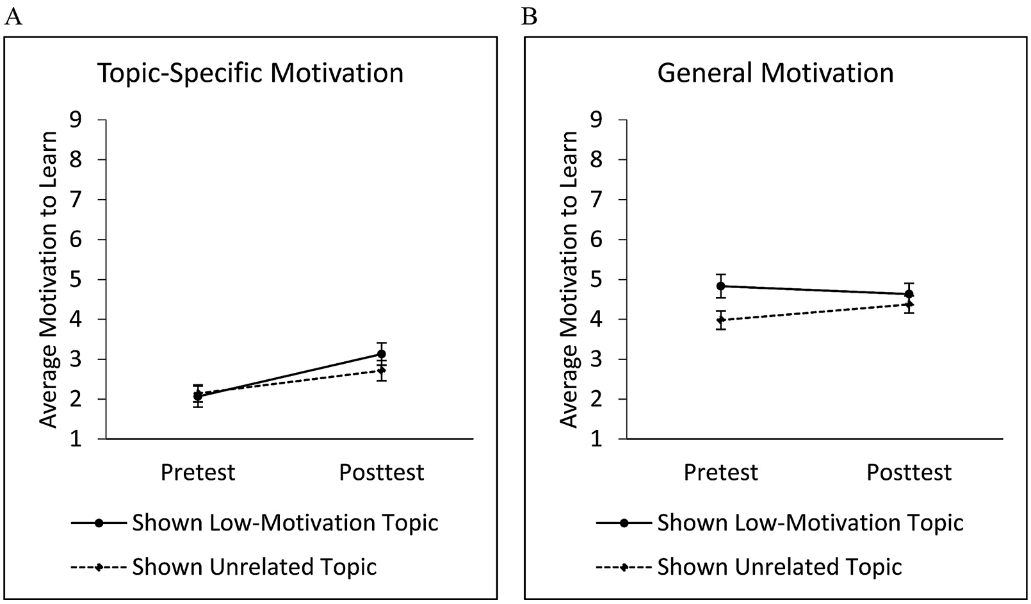

Fig. 3. Results from Experiment 2a—Large Public University Sample
Note. Topic-specific (Panel A) and general motivation (Panel B) before and after watching a video in the large public university sample. Shown lowest motivation topic = experimental condition, shown unrelated topic = control condition. Error bars are 1 SEM.

4.1.2. Design, materials and measures, & procedure

The design, materials and measures, and procedure are all the same as in Experiment 2a with the exception that all participants completed the study online, without guidance from an in-person experimenter. As in Experiment 1, the length of time that participants spent on each page was controlled so that they would not be able to rush through the experiment. Reliability for the motivation scores was good ($\alpha = .78$).

4.2. Results

4.2.1. Topic-specific motivation

A 2 (motivation time point: pretest vs. posttest) × 2 (video type: low-motivation vs. unrelated) mixed design ANOVA revealed a main effect of motivation timepoint, such that motivation after watching a video in either condition was higher ($M = 3.38$, $SE = 0.34$) than before watching that video ($M = 2.35$, $SE = 0.30$), $F(1, 32) = 21.02$, $p < .001$, $MSE = 1.28$, $\eta_p^2 = .40$ (See Fig. 4A). There was no main effect of video type, $F(1, 32) = 0.003$, $p = .96$, $MSE = 5.76$, $\eta_p^2 < .001$, nor an interaction, $F(1, 32) = 2.41$, $p = .13$, $MSE = 1.28$, $\eta_p^2 = .07$. This finding replicates that of Experiment 2a and supports our first hypothesis: exposure to any topic increased motivation to learn one's low-motivation topic. However, no differential effect of watching the low-motivation topic compared to an unrelated topic was found, similar to Experiment 2a.

4.2.2. General motivation

A 2 (motivation time point: pretest vs. posttest) × 2 (video type: low-motivation vs. unrelated) mixed design ANOVA revealed a main effect of motivation timepoint, such that motivation was higher after ($M = 4.35$, $SE = 0.21$) compared to before watching a video ($M = 3.98$, $SE = 0.24$), $F(1, 32) = 5.21$, $p = .03$, $MSE = 0.45$, $\eta_p^2 = .14$ (See Fig. 4B). There was no main effect of video type, $F(1, 32) = 1.76$, $p = .19$, $MSE = 2.96$, $\eta_p^2 = .05$, or interaction, $F(1, 32) = 0.06$, $p = .82$, $MSE = 0.45$, $\eta_p^2 = .002$. These results do not replicate from Experiment 2a and suggest that there may be differences in the way that exposure to a topic affects motivation to learn more generally across topics.

5. Discussion

This research was an important first step in examining the relationship between exposure to information and motivation to learn. Across three samples that represent different learning environments (nonstudents and students from different university settings), we investigated the role of exposure to information (via a TED talk video) on motivation to learn more about that topic, as well as other topics more generally. In all three samples, we found that motivation to learn about a low-motivation topic increased after watching a video—whether that video was related or unrelated to the low-motivation topic. This pattern of findings partially supported our first hypothesis: that exposure to any video would increase motivation to learn. However, we found that watching a video about a related topic increased motivation more than watching a video about an unrelated topic only in the mTurk sample.

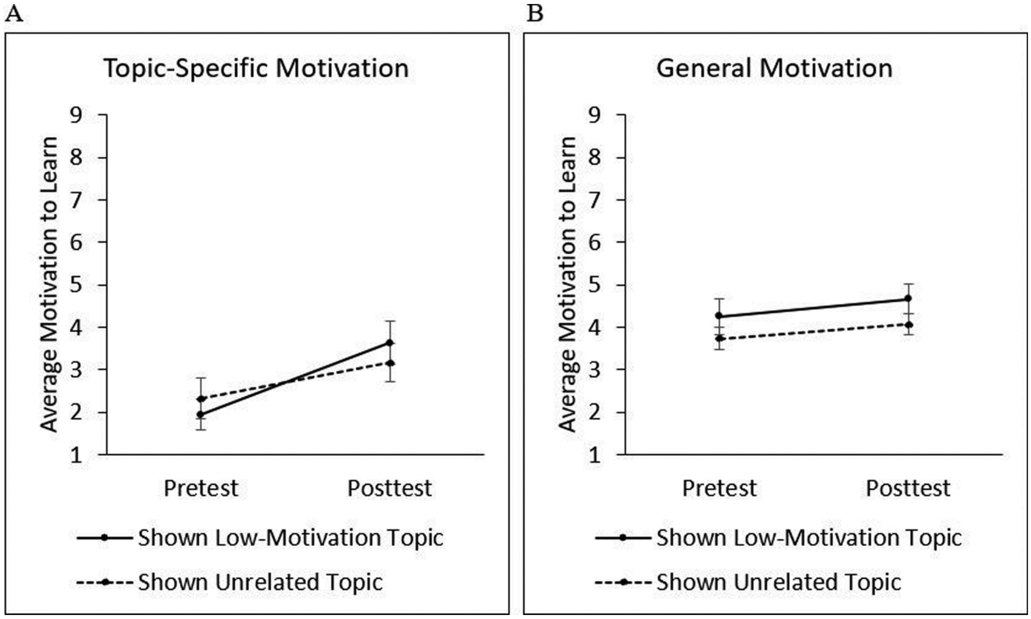

Fig. 4. Results from Experiment 2b—Small Private University Sample
Note. Topic-specific (Panel A) and general motivation (Panel B) before and after watching a video in the small private university sample. Shown lowest motivation topic = experimental condition, shown unrelated topic = control condition. Error bars are 1 SEM.

In contrast to the motivation increase for the low-motivation topic, the results about motivation to learn across other topics generally were not consistent across the three samples. There was no change in pre- to posttest motivation in the mTurk sample, motivation decreased after watching a low-motivation video but increased after watching an unrelated video in the large public university sample, and motivation increased after either video in the small private university sample. This inconsistent pattern of results did not support our second hypothesis, that motivation to learn across topics more generally would increase after watching a video. Together, the differences in patterns of results across the three samples do not provide support for the third hypothesis, that any observed changes in motivation would be similar across the three samples.

The different pattern of results across the three groups speaks to the idea that motivation may be differentially affected by information exposure as a function of sample characteristics. For example, the mTurk group had numerically higher levels of motivation across all conditions, perhaps reflecting the fact that mTurk workers are not generally students and are not required and expected to learn in the same way that undergraduate students are. As formal learning is a rarer experience for these participants, they may have higher overall intrinsic motivation to learn compared with the undergraduate students. Interestingly, our predicted interaction—-greater increased motivation after watching the low-motivation video compared to an unrelated video—was only evident in the mTurk sample. It is possible that a 15-minute knowledge exposure intervention is novel for nonstudents, but not novel for students (as such videos are sometimes used as instructional material in courses). It is also possible that nonstudents tend to have higher intrinsic motivation than students, who may rely on extrinsically-motivating factors (e.g., grades, structure of their major) to propel them through their coursework. Further study is needed to determine whether this difference between students and nonstudents is reliable and generalizable across all education levels, and if so, what the underlying mechanisms might be, and how much exposure a student (compared to a nonstudent) would need to demonstrate a change in motivation to learn.

The results in this paper are consistent with and extend prior theoretical work that proposes learning itself can promote motivation for subsequent learning (Fletcher et al., 2001; Murayama et al., 2019). Adding to prior work on increasing motivation through increasing student choice, knowledge of utility, and self-efficacy, the present study focused on how exposure to low-ranked topics can kickstart a positive learning cycle. One possible explanation for our finding could be that watching a video primes learning by arousing interest, and students interpret this aroused interest into a feeling of increased motivation to learn. Thus, our findings may be may be especially relevant for students who have so little knowledge about a topic that they don't yet have an awareness of what they do not know (i.e., how much more there is to learn). But, this is only one possible explanation for the mechanism that underlies how learning increases motivation. Future work can further examine the exposure and learning mechanisms that can trigger a positive learning cycle. For example, it is of critical importance to test whether the gain in knowledge from watching the videos (i.e., learning) mediates the motivation effect. Perhaps those who learn more (as evidenced by higher performance on a test), and more deeply (as evidenced by performance on surface-level versus transfer questions) from the videos may show larger motivation increases. Self-report data on awareness of lack of knowledge (i.e., identification of knowledge gaps) will also contribute to our understanding of this phenomenon. It is also worth mentioning that positive emotion (i.e., interest) might be a potential mediator of this effect; when students feel interested in what they are learning, it encourages them to continue learning more. Such an idea is posited by the broaden-and-build theory of positive emotions (Fredrickson, 2004). More work is needed to expand this crucial first step in understanding the role of learning in driving motivation to learn.

Our study has a couple of important caveats to note. First, TED talks are not representative of all forms of lectures that students encounter. Indeed, TED talks may be especially engaging, and prior work has demonstrated the importance of interest for engagement and motivation to learn (e.g., Cromley, Perez, & Kaplan, 2016; Wade, Buxton, & Kelly, 1999). The use of TED talks in this study was intentional, as it is a crucial first step in testing our theory. If even interesting videos did not yield a change in motivation for participants' lowest-ranked topic, then there would be little hope for learning the content itself increasing motivation. Critically in our study, interest cannot be the sole explanatory factor, given that we would have seen increases in motivation in every condition if this were the case. It is important that future work try to disambiguate the effects of mere exposure to information and interest, as we did not formally test it here. Second, we acknowledge that the increase from the lowest-motivation condition as a function of information exposure could be a case of regression to the mean; however, the lack of an increase in motivation in the control condition of the mTurk sample suggests that this may not be the case. Future work should formally test this idea by including a condition in which participants watch a video that does not have anything to do with learning (e.g., a snippet of a cartoon) to see if an increase in motivation occurs in such a case.

Despite these caveats, the results we present here lay the groundwork for addressing low motivation in general education courses in higher education. Based on our findings, it may be possible to show students an interesting and engaging video about topics that they are not initially motivated to learn—either before enrolling in those GE courses or once they are already enrolled (perhaps on day 1)—and see a change in their motivation to learn more about that topic. Such a small "intervention" could have a large impact on students' willingness to engage with courses they might not otherwise take. However, it remains to be seen whether such an exposure to a short video will have lasting effects. Future work should aim to study how long the change in motivation is sustained to best identify when and how often to introduce such knowledge exposures.

Additionally, further study should be conducted to understand the conditions under which such an intervention might increase motivation to learn more broadly (and not just for a low-motivation topic), as lifelong learning outside of one's field is an important skill. For example, perhaps if instructors draw students' awareness to the fact that learning increases motivation to learn a low-motivation topic, it might also increase motivation to learn more broadly. Increasing students' metacognitive awareness of the potential effects of learning may have change the way that learning increases motivation; such a notion is in line with principles of transparency in teaching and learning, in which instructors reveal their rationale for making instructional decisions to their students. Such teaching practices have been shown to increase academic performance (Felten & Finley, 2019; Howard, Winkelmes, & Shegog, 2020). Finally, future work should seek to identify if there are any behavioral changes that accompany students' change in motivation; for example, do they study the class material for longer than those who do not watch a video, or do they report seeking out additional information outside of class? Answering these questions will be incredibly important for our understanding how to engage learners in courses outside of their majors, which is important for the ability to think creatively (e.g., Sawyer, 2011).

Though motivation is often considered a precursor to learning, the results presented here suggest that perhaps motivation can be a consequence of learning as well. Our findings may help address the issue of low motivation in required general education courses in higher education, with implications for increasing motivation for learning outside of university as well (i.e., lifelong learners). Additionally, our results may be particularly relevant in the time of emergency remote instruction as a result of COVID-19, as online videos may represent the type of learning people are currently engaging in both in and out of formal higher education. Educators might consider encouraging their students to engage with other courses, as they might develop motivation to learn in disciplines they previously did not consider.

Author note

Information in this manuscript has previously been presented at an undergraduate conference at the first author's home institution (Spring 2020).

Open practices statement

All three experiments reported in this article were formally preregistered on the Open Science Framework and can be accessed at https://osf.io/dau35. Neither the data nor the materials have been made available on a permanent third-party archive; requests for the data or materials can be sent via email to the lead author at annied@ucr.edu.

CRediT authorship contribution statement

Annie S. Ditta: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization, Supervision, Project administration. **Carla M. Strickland-Hughes:** Validation, Writing - review & editing, Project administration. **Cecilia Cheung:** Writing - review & editing. **Rachel Wu:** Conceptualization, Methodology, Validation, Writing - review & editing, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

The author(s) declared no conflicts of interest with respect to the authorship or the publication of this article.

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