Is Seeing Believing? A Longitudinal Study of Vividness of the Future and its Effects on Academic Self-Efficacy and Success in College

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Abstract

This research followed students over their first two years of college. During this time, many students lose sight of their goals, leading to poor academic performance and leaving STEM and business majors. This research was the first to examine longitudinal changes in future vividness, how those changes impact academic success, and identify sex differences in those relationships. Students who started college with clear pictures of graduation and life after graduation, and those who gained clarity, were more likely to believe in their academic abilities, and, in turn, earn a higher cumulative GPA, and persist in STEM and business. Compared to men, women reported greater initial vividness in both domains. In vividness of graduation, women maintained their advantage with no sex differences in how vividness changed. However, men grew in vividness of life after graduation while women remained stagnant. These findings have implications for interventions to increase academic performance and persistence.

Keywords: Vividness of the Future; Academic Self-Efficacy; Academic Achievement; STEM & Business Persistence; Sex Differences

A college degree offers numerous future benefits including increased job opportunities, career flexibility, and financial well-being. However, more than 40 percent of students do not complete their degree after six years (National Center for Education Statistics, 2019). The present research investigated why some students persist through the pipeline to achieve their academic goals while others do not. According to a meta-analysis of 109 studies, the most powerful psychosocial predictor of academic success was a student's belief in their academic ability (i.e., academic self-efficacy; see Robbins et al., 2004). Students who believe in their abilities are more likely to succeed. Judgments of self-efficacy are determined in part by creating and achieving specific goals and/or observing the success of a similar other (e.g., role models; Bandura, 2000). We proposed that students who clearly visualized their distal future, specifically their future college graduation and life as a college graduate, would be more likely to believe in their academic abilities leading to their academic success and persistence. For example, imagine a first-year student who can visualize her college graduation—the excitement of the ceremony and the family celebrations—and has a vivid image of her life as a college graduate. This vivid image may facilitate her belief that a person like her (i.e., her future self) can achieve in academics. In other words, seeing may lead to believing.

Using a longitudinal design, we began by identifying how vividly students imagined their future as they entered college and how that vividness changed. We then explored the implications of future vividness by examining how both initial vividness, and its trajectory, predicted academic self-efficacy and, in turn, predicted two indicators of academic success: academic achievement (i.e., cumulative GPA) and persistence in STEM and business fields. To investigate the relationship between vividness of the future and sex differences in academic success, we focused on a vivid view of the future in two domains: college graduation and life

five years after graduation. A vivid view of life five years after graduation, including the future career, may be particularly important for female students in demanding, male-dominated fields (e.g., STEM and business) as they attempt to maintain focus on their future goals while managing present difficulties.

Ahead, we first presented a brief review of the literature on vividness of the future and academic self-efficacy. We then provided a rationale for how vividness of graduation and life after graduation may predict academic self-efficacy and objective academic outcomes.

Future Vividness

A vivid view of the future has implications for the salience of future rewards, decision-making, and behavior (Hershfield, 2011). College students are likely to perceive present rewards (e.g., going to a party) and barriers (e.g., difficulty paying tuition) as highly salient in comparison to distal rewards like college graduation and their career. Highly salient present rewards and barriers disproportionately influence decisions. However, individuals with a clear, vivid view of their future are likely to perceive future rewards as more salient, weighting them more heavily in decisions. Indeed, investigations of capacity to imagine the future and preference for delayed rewards found that adolescent boys with a vivid future image were more likely to choose larger, delayed rewards and exhibit fewer behavioral issues (Klineberg, 1968; van Gelder et al., 2015). In academic research, teenagers who imagined vivid, positive possible futures performed better academically and persisted in a difficult task (Leondari et al., 1998).

Additionally, future vividness increases the perceived connection between the current and future self (Hershfield, 2011). After viewing an aged simulation of their future self (i.e., a manipulation of vividness), participants felt more connected to their future and reduced monetary discounting (Hershfield et al., 2011). An individual’s connection to their future self predicts their

tendency to engage in temporal discounting which entails prioritizing short-term rewards over long-term goals (Bartels & Rips, 2010). For college students, connection to the future self predicts greater self-control and academic success (Adelman et al., 2017).

Much of the literature on future vividness focuses on a general view of the self at a certain future timepoint (e.g., van Gelder et al., 2015). However, studies on episodic future thinking consider an individual's capacity to imagine specific future events (e.g., D'Argembeau et al., 2010). Capacity for episodic thinking is associated with positive outcomes including ability to delay rewards and emotion regulation. We built on these two approaches to examine vividness of two specific future events at specific timepoints of a student's future. These events were vividness of college graduation (approximately four-to-five years in the future) and vividness of a typical week five years after graduation (approximately nine-to-ten years in the future). These domains represent critical markers for students. Vividness of college graduation represents a clear picture of achieving college's end goal. Further in the future, vividness of five years after graduation corresponds to a time when graduates in the U.S. experience important life changes, including establishing their career and potentially marrying and beginning a family (U.S. Census Bureau, 2019).

Academic Self-Efficacy

Self-efficacy influences behavior by guiding individuals' choices of activities, effort, persistence through difficulties, and skill level (Bandura, 1977, 1981; Schunk, 1984). Specific to academia, academic self-efficacy predicts striving for good grades (Zimmerman et al., 1992), motivation, self-regulation and time management, and lower academic disengagement (Liem & Martin, 2012). Students with high levels of academic self-efficacy are more likely to set higher academic goals. In turn, when students see progress in their goals, their academic self-efficacy

increases (Cervone et al., 1991). In a meta-analysis of 109 studies, academic self-efficacy was the most powerful psychological predictor of GPA and retention (Robbins et al., 2004).

Individual's perceptions of self-efficacy are derived from multiple sources (Bandura, 1982). Generally, results in previous performances provide individuals with the strongest cues about their self-efficacy. In order to appraise their performance, individuals must have a metric by which to judge their success. Creating and achieving goals provides a crucial source for evaluating one's performance and efficacy. Importantly, not all goals are created equally. The specificity and temporal proximity of the goal are important in determining its impact on self-efficacy. Specific and proximal goals, as compared to vague and distal goals, have greater impact (Bandura & Schunk, 1981). Beyond past performance, another crucial source of self-efficacy is social learning (Bandura, 1982). Through the observation of successful others (i.e., role models), individuals gain an example demonstrating skills, knowledge, and behaviors to overcome challenges (Bandura, 1997). Role models, especially those in similar circumstances to the individual, increase individuals' efficacy (Bandura, 2000). In academics, students with a successful, similar role model were more likely to believe in their ability to succeed (Wright & Carrese, 2003).

The Relationship between Vividness of the Future and Academic Self-Efficacy

We proposed that understanding the capacity to vividly imagine the future, and how that capacity changes over time, is an important factor in predicting academic self-efficacy and academic achievement in college. Despite growth in the research on future vividness, little research has directly considered the relationship with academic self-efficacy. However, the literature provides suggestive evidence for the hypothesized relationship. In the literature, it is evident that specific and salient goals, and observing the success of similar role models, are both

important factors in the development of self-efficacy (Bandura & Schunk, 1981). Unfortunately, for individuals transitioning into a new stage—such as students entering college—goals are often distal and vague. Imagine a student beginning college. This student likely has a plan for their future including graduating from college and developing a career. While these goals are for the distal future, the impact of the goals on self-efficacy may vary depending on how vividly students imagine them. With a vivid image of their future graduation and life, students are able to view their goals, even goals in the distal future, clearly and specifically. While a vivid view of the future enhances the clarity of future goals, vividness of the future may also support academic self-efficacy by providing students with a clear role model for success. Students with a vivid image of their graduation and future life are able to vividly imagine their success in earning their degree and beginning their life and career as a college graduate. Visualizing the success of this uniquely similar role model (i.e., the future self) may encourage students to believe that a person like them is able to achieve their academic and career goals.

In addition to the connections between a vivid view of the future and sources of academic self-efficacy described above, the hypothesized relationship is consistent with previous work on related constructs. Specifically, prior research suggested that imagining positive results in a future activity facilitates higher self-efficacy judgments (Cervone, 1989). Additionally, recent research found that imagining positive situations predicted higher levels of self-efficacy (Pop & Tiba, 2019). In further support of this proposed relationship, previous theorizing on self-efficacy suggested that imagining the self in a situation increases perceptions of competence (Bandura, 1986; Shell & Husman, 2001).

Overview of the Research

Our first aim was to examine how vividly first year students saw their graduation, and life five years after graduation, and how their vividness changed over the first three semesters of college. Students starting college are transitioning into a new life-stage. In industrialized nations, this time period, "emerging adulthood," is characterized by identity exploration and changes (Arnett, 2000). At this transition, we expected some students to begin with high vividness and others to lack that clear picture (i.e., significant individual differences). Over the first three semesters, we expected vividness to change as some students gained a clearer view of their future and others lost sight of their future.

Our second aim was to test whether initial vividness of these domains and their change trajectories predicted academic self-efficacy and, in turn, predicted academic outcomes. While academic self-efficacy is an established predictor of academic performance (Robbins et al., 2004), less is known about factors predicting academic self-efficacy. With a concrete and vivid view of their graduation and life as a college graduate, students can see where their goals will lead and envision themselves as capable of achieving them. Therefore, vividness of the accomplished future may positively reflect back on the current self and enhance one's self-efficacy. Importantly, vividness of the future is malleable (van Gelder et al., 2015). Therefore, students' vividness of the future at the beginning of college and changes in their vividness may both be linked to subsequent academic self-efficacy. That is, we hypothesized that students with a clear vision of their future at the start of college, and with positive vividness trajectories over the course of their first semesters, would have greater belief in their academic ability, and thus, would show positive academic outcomes (i.e., higher GPAs and greater persistence).

Finally, we capitalized on this longitudinal study to pursue an exploratory aim to examine sex differences in the trajectories of these vividness domains. Sex differences in academic outcomes (e.g., graduation rates; leaky-pipeline persistence) may suggest differences across the vividness domains. In terms of vividness of graduation, as women graduate college at a greater rate than men (National Center for Education Statistics, 2017), women may begin college with higher graduation vividness and maintain that advantage. In contrast, women, may be less likely to maintain a vivid view of their life and career five years after graduation. Women in college often encounter conflicting societal and biological demands to emphasize family or career roles. Entering college, these young women are at the beginning stages of envisioning their future with both a career and family. As they move through their tenure in college, future career aspirations and family plans may become more prominent and specific, further emphasizing the conflict between future life roles. Women, especially those in demanding, male-dominated STEM and business majors, may be unable to form a clear image of managing competing future life priorities or visualize how they will successfully juggle both paths. As a result, women's vividness of the future with both career and family after graduation may suffer and, in turn, impact their self-efficacy in STEM and business fields.

To recapitulate, this study addressed three questions: (1) When entering college, how vividly did students imagine graduation and their life five years after graduation and how did that change over the first three semesters of college? (2) In these two future domains, did initial vividness, and its change trajectory over the first three semesters of college, predict academic self-efficacy and, in turn, predict academic outcomes (cumulative GPA and persistence in STEM and business)? and (3) In these two future domains, did men and women differ in their initial vividness, its trajectory, or how they predicted academic self-efficacy and academic outcomes?

Methods

Study Design

The current research was part of a longitudinal study at a large, public university in the U.S. The research questions presented here were not preregistered. However, our longitudinal research was part of a research project funded by the Institute of Education Sciences (see the authors' note). In support of open scientific research, all federally funded research makes the proposal and the final data set available to the public. The current research encompassed five waves of data collected from participants through online surveys and three data collections from the University Records Office (URO; see Figure 1).

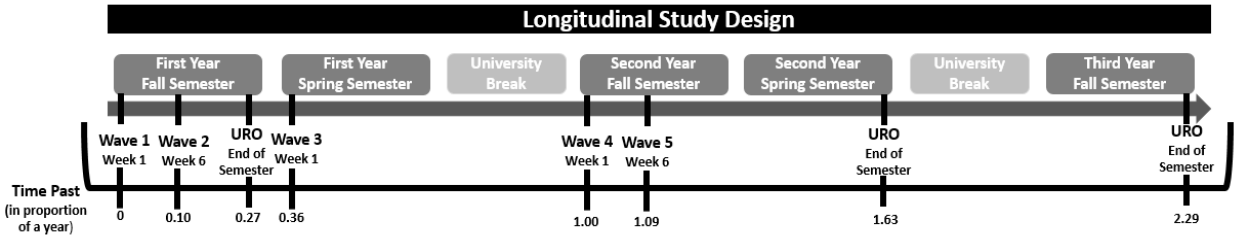

Figure 1. Participants completed five surveys and the University Records Office (URO) provided three data points. Survey data collection took place over the first three semesters of college. The first URO collection, which provided initial college major, was at the end of the first fall semester. The second URO collection took place at the end of the second year, providing cumulative GPA after two complete years. The final URO collection took place at the end of the fall semester of the third year and provided major after two complete years.

Primarily, this research aimed to address the role of initial vividness of the future, and its trajectory, in academic retention and achievement (e.g., students, especially women, leaving leaky-pipeline fields such as STEM and business) which occur over a student's academic career.

Therefore, the longitudinal design of this research was essential to our aims. The study design included three features to strategically assess future vividness trajectory: (1) The study began in the first week of college, meaning participants completed their first survey when they were first experiencing college providing a baseline measure of future vividness. (2) The second data collection took place during the sixth week when students received feedback from their first college exams. This feedback served as the first potential academic setback or success. (3) The study of vividness encompassed the first three semesters of college, which captured a period of adjustment for students as they settle into college. Additionally, we collected the academic outcomes after two years of college which is when many students change major (U.S. Department of Education, 2017).

Overview of Analysis

To test our hypotheses, we conducted growth curve and structural equation modeling using M*plus* (V.8.3; Muthén & Muthén, 2017). We handled missing data using full information maximum likelihood (Enders & Bandalos, 2001) and Monte Carlo numerical integration due to missing data on the mediator variable. This modeling method is particularly effective for estimating trajectories of change and provides information about change at both the group and individual levels. This analysis provides estimates of the mean intercept (i.e., initial score) and slope (i.e., change over time) and the variances around those means. The mean estimates provide information about the group while variance estimates illustrate degrees of individual differences. Growth modeling incorporates all available data, even with missing data, allowing us to include data from all participants within our inclusion criteria (see the "Participants" section).

In each model, we used the following specifications: (1) a linear representation of time since baseline for the slope factor, (2) the covariance between the intercept and slope was

estimated freely, (3) the mean and variance of the intercept and slope factors were freely estimated, (4) the intercepts of the vividness indicator variables were set at zero, and (5) the residual variances of the vividness indicator variables were freely estimated and held constant.

Power Analysis

The target sample size was determined based on Monte Carlo simulations examining the power to measure change in a growth model with up to six timepoints. Simulation parameters were based on results of pilot studies of students in General Chemistry (N = 119). The simulated samples included attrition of 40 percent missing data. Specifying model reliability of .75 and sample size of 800, the power to detect a small overall rate of change (i.e., slope = .20 standard deviations) was .94. We ran additional simulations to test the power to predict outcomes from the growth analysis. These simulations predicted an outcome from the initial estimate (i.e., intercept) and the change estimate (i.e., slope). The power to detect a small effect from the intercept to an outcome was .78 and 1.00 for a medium effect. From the slope, the power to detect a small and medium effect was .38 and 1.00, respectively. To allow for potentially higher levels of attrition, we recruited 889 students (see Table 1 for the sample size per wave).

Participants

Participants were first-year students (56% female) at a large, public university in the U.S. Participants were at least 18 years old (M = 18.14, SD = 0.65), U.S. citizens, and recruited from Introduction to Psychology (n = 391; 56% female) and Introduction to Chemistry (n = 498; 56% female). The majority of the sample began college majoring in natural sciences (33%), engineering/mathematics (33%), and business (24%).[1] A small portion initially majored in social

[1] At this university, many STEM and business majors include a Social/Behavioral Sciences requirement. Introduction to Psychology is a popular course to complete that requirement.

science (including psychology; 6%),[2] humanities (2%), and other (e.g., exploratory, interdisciplinary; 2%). Our sample approximately represented the diversity of the U.S. post-secondary population in terms of college generation status. Thirty percent of participants, compared to 33 percent of all post-secondary students, indicated that they were first-generation (Cataldi et al., 2018). Based on university records, 56 percent of the participants were White (non-Hispanic), followed by 23 percent Hispanic, 12 percent Asian/Pacific Islander, 3 percent Black, 1 percent American Indian, and 5 percent unknown, resembling the composition of the U.S. post-secondary population (Institute of Education Sciences, 2017).

The current study was part of a grant-funded, four-year longitudinal study with a number of research questions. According to our power analysis above, and to account for attrition over the course of the study, we targeted a sample of approximately 900. Our recruitment at Wave 1 did not result in as large of a sample as we expected. To ensure adequate power, we enrolled a refreshment sample at Wave 2. Overall, 549 participants began the study at Wave 1 and 340 at Wave 2. At Wave 2, the participants who began in Wave 1 did not significantly differ from the refreshment sample in future vividness of either domain (Vividness of graduation: $t(707) = -1.35$, $p = .179$; Vividness of life five years after graduation: $t(707) = -0.99$, $p = .321$) or in academic self-efficacy, $t(707) = -1.70$, $p = .089$. In all analyses, we combined participants who began at Wave 1 and the refreshment sample. Overall, approximately 39 percent of the data was

[2] In some STEM classifications (e.g., National Science Foundation; Green, 2007), psychology is a STEM field. Our study aimed to determine whether the trajectory of future vividness predicted leaving traditionally male-dominated, leaky-pipeline fields. Psychology bachelor's degrees are female-dominated (National Center for Education Statistics, 2017). Thus, we included psychology with other social sciences.

missing.[3] Based on our power analyses, this pattern of missingness, coupled with our increased sample size, indicated sufficient power.

Measures

Vividness of the Future

We adapted the Vividness of Visual Imagery Questionnaire (VVIQ) to create measures of future vividness (Marks, 1973). Originally, the VVIQ included 16 items that measured the general capacity to visualize experiences (e.g., shopping; conversing) and high scores predicted accurate memory. We adapted the VVIQ to assess two future domains: (1) vividness of college graduation (approximately four-to-five years in the future) and (2) vividness of a week five years after college graduation (approximately nine-to-ten years in the future). Hereafter, we referred to vividness of a week five years after college graduation as vividness of post-graduation.

To assess participants' vividness of graduation, we asked them to think of their life at college graduation. We then asked them to imagine three graduation-related images (e.g., "Celebrating with my family and taking pictures in my cap and gown"). To assess vividness of post-graduation, we asked participants to think of their life five years after graduation. Again, we asked them to imagine three images, this time related to a typical week (e.g., "Whether in school or working, think about your career path and how you spend a typical weekday"). In both domains, participants rated vividness for each image on a 7-point scale (1- No image at all; I

[3] Students left the study after they started in the 1st or the 2nd wave: 77 out of 549 students participated in only Wave 1 and 119 out of 340 students participated in only Wave 2. To understand the differences between students who returned and those who did not, we tested group differences on our variables. *See the supplemental material for those comparisons.* Overall, there were no significant differences in the psychological variables of interest. However, the groups did significantly differ on cumulative GPA. Students who participated in only Wave 1 had a significantly lower GPA, $M = 3.19$, $SD = 0.56$, than students who returned, $M = 3.37$, $SD = 0.50$, $t(471) = 2.45$, $p = .015$. Likewise, students who participated in only Wave 2, had a significantly lower GPA, $M = 3.14$, $SD = 0.54$, than students who returned, $M = 3.36$, $SD = 0.47$; $t(293) = 3.53$, $p < .001$. We discussed the implications of these differences in our Discussion.

only know that I am thinking of the situation; 7- Perfectly clear and as vivid as normal vision). For both measures, we computed a mean rating of the three images for each participant within each wave (Graduation: α ranged from .88 to .95; Post-graduation: α ranged from .78 to .89).

Academic Self-Efficacy

We assessed academic self-efficacy using the 8-item Academic Self-Efficacy Scale (Chemers et al., 2001). In past research, scores on this scale were positively correlated with college GPA (r = .38) and retention (r = .26; Robbins et al., 2004). Participants rated each item on a 7-point scale (1- Very untrue; 7- Very true). A sample item is: "I know how to schedule my time to accomplish my tasks." We computed a mean rating of the 8 item scores for each participant (α ranged from .80 to .89). We collected academic self-efficacy ratings at each time point. In our analysis we used two academic self-efficacy timepoints: (1) baseline (i.e., first week of college; Wave 1) and (2) third semester (Wave 5). The rationale for including those two time points in our analysis was two-fold. First, Wave 1 (assessed in the participants' first week at the university) provided a clear baseline measure of academic self-efficacy and Wave 5 (collected early in the second year of college) provided an assessment of academic self-efficacy after completing over a year of college. In our model, we expected initial future vividness, and trajectory of vividness, to predict later academic self-efficacy (Wave 5) after controlling for the baseline self-efficacy (Wave 1). In other words, the academic self-efficacy outcome was not a purely downstream measure. It reflected students' residual academic self-efficacy at Wave 5 after controlling for their level when entering college. Henceforth, for ease of communication, we referred to the academic self-efficacy outcome as residual academic self-efficacy. Second, controlling for Wave 1 self-efficacy allowed us to take preliminary steps to ascertain the directionality of the relationship between future vividness and residual academic self-efficacy.

Academic Performance

As a measure of academic performance over two years, we used cumulative grade point average (CGPA) at the end of the second academic year (i.e., the fourth semester). The CGPA data was only available for participants enrolled at the university during the corresponding semester (n = 768). To better understand the outcomes for unenrolled students, our team conducted a follow-up survey (see the supplemental material).

Switching from STEM and Business Fields

The University Records Office provided us with the initial major and major after completing two years of college. We excluded students no longer enrolled at the university at the end of the fifth semester because they had no data on downstream major.

We created the switching fields variable in two steps. First, based on the department, major descriptions, and required coursework, a team of 12 undergraduates coded majors into one of the following: natural science, engineering/mathematics, business, social science (including psychology), humanities, and education. Two independent coders classified each major with high reliability (First semester: κ = .94, p <.001; Fifth semester: κ = .92, p <.001). Disagreements were resolved using "major maps" which the university publishes detailing course requirements.

The coding team was unable to classify some majors. For example, the "interdisciplinary" major, which combines multiple fields of study (e.g., music and business), did not provide enough information to classify. As such, we excluded 26 cases at the end of the first semester and 21 cases at the end of the fifth semester, resulting in a total sample of 718. Of the 718, 638 students began college majoring in STEM or business fields.

Second, we created the switching fields variable by classifying students as either persisting as a STEM or business major or as switching to a different field (e.g., social sciences) after two years. The rate of switching from STEM and business fields was 13.2 percent (n = 84).

Procedure

At the opening of Wave 1 and 2, we posted an invitation on the course webpages and provided a link to the survey. In all subsequent waves, we e-mailed participants with the survey link. The first page of each survey contained the consent where participants indicated if they were at least 18 years of age and clicked the "Next" button to confirm consent. Participants consented for researchers to collect CGPA and major data from the University Records Office. In each survey, participants completed both measures of vividness (the vividness of graduation measure appeared first, followed by post-graduation). Later in the survey, participants completed a measure of academic self-efficacy. At the end of the Wave 1 and Wave 2, participants completed questions including their sex, year in school, and college generation. Each survey took approximately 30 minutes. Upon survey completion, we debriefed and thanked participants. Participants received $10 for their participation in Year 1 surveys (Waves 1-3) and $15 in Year 2 surveys (Waves 4 & 5). At the end of the first, fourth, and fifth semesters, we requested data from the University Records Office.

Results

In all waves, men and women were above the midpoint on the vividness of graduation, post-graduation, and academic self-efficacy scales (see Table 1). Additionally, the sample had a high CGPA, M = 3.33, SD = 0.51. Women were more likely than men to switch from STEM and business to a different field, χ^2 (1, N = 638) = 11.32, p = .001. Approximately 17 percent of the women, and 8 percent of the men, who started in STEM or business ended their second year in a different field (e.g., social sciences; education). Within STEM fields, 17 percent of women and 6

percent of men switched fields. Within business, 18 percent of women and 15 percent of men switched.

Table 2 shows the correlations among the variables based on the available data. Interpretations of these data may not be valid due to missing data. Below, we presented the analytic approach and results for each of our research questions.

Table 1

Descriptive Statistics

		Full Sample			Men			Women		
Variable	Wave	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
Vividness of Graduation										
	1	5.29	1.43	549	5.10	1.45	242	5.43	1.40	307
	2	5.36	1.53	709	5.13	1.64	297	5.52	1.42	412
	3	5.15	1.62	482	4.94	1.64	183	5.27	1.60	299
	4	5.25	1.56	489	5.00	1.58	187	5.41	1.53	302
	5	5.15	1.61	473	4.91	1.59	182	5.30	1.62	291
Vividness of Post-Graduation										
	1	4.41	1.36	549	4.30	1.31	242	4.50	1.39	307
	2	4.80	1.41	709	4.66	1.41	297	4.90	1.41	412
	3	4.58	1.50	482	4.60	1.50	183	4.57	1.51	299
	4	4.70	1.32	489	4.65	1.34	187	4.73	1.30	302
	5	4.77	1.37	473	4.75	1.33	182	4.79	1.39	291
Academic Self-Efficacy										
	1	5.61	.74	546	5.58	.76	242	5.64	.73	304
	5	5.41	.91	473	5.42	.90	182	5.40	.91	291
Cumulative GPA		3.33	.51	768	3.28	.54	335	3.37	.48	433
Switching Fields		.13	--	638	.08	--	347	.17	--	291

Note. Total N = 889. Switching fields: 0 = Did not switch out of STEM and business fields, 1 = Did switch. *M* = Mean. *SD* = Standard deviation. *n* = Sample size.

Table 2

Correlations Among Study Variables

	1	2	3	4	5	6	7	8	9
1. Vividness W1		.60**	.62**	.52**	.58**	.29**	.22*	-.06	.09
2. Vividness W2	.69**		.67**	.56**	.61**	.28**	.20**	-.08*	.07
3. Vividness W3	.65**	.68**		.59**	.69**	.27**	.23**	-.07	.00
4. Vividness W4	.56**	.62**	.69**		.70**	.26**	.32**	-.04	-.02
5. Vividness W5	.58**	.69**	.71**	.80**		.28**	.35**	-.08	.00
6. Academic Self-Efficacy W1	.26**	.32**	.34**	.25**	.32**				
7. Academic Self-Efficacy W5	.20**	.21**	.25**	.28**	.36**	.47**			
8. Cumulative GPA	-.08	-.05	.01	-.05	.00	.13**	.29**		
9. Switching Fields	.01	-.02	-.03	.06	.00	-.11*	-.08	-.20**	

Note. Vividness of graduation = Below the diagonal. Vividness of post-graduation = Above the diagonal. W1-W5 = Survey wave. ** $p < .01$, * $p < .05$

Analytic Approach

We used structural equation models to test our first two questions (see Figure 2). Our analysis used two identical models: one for vividness of graduation and one for vividness of post-graduation. We first specified a growth model for future vividness over the first three semesters of college (i.e., five waves). Then, to obtain estimates of their predictive ability, we included paths from both initial vividness, and estimated change, to later academic self-efficacy (Wave 5). The direction of the relationship between vividness of the future and academic self-efficacy is an open question. With our longitudinal data we were better able to account for the temporal order of the relationship by including initial academic self-efficacy (i.e., Wave 1) in the model. To control for baseline academic self-efficacy, we included Wave 1 academic self-efficacy as a predictor of later self-efficacy. We included additional covariances between initial self-efficacy and initial vividness and initial self-efficacy and change in vividness which accounted for the potential relationship between the vividness factors and self-efficacy when entering college (i.e., the exogenous factors in the model). To test the prediction of the academic outcomes, we included paths from residual academic self-efficacy to the academic outcomes.

The path from academic self-efficacy to switching fields, a binary outcome, was tested using logistic regression. Importantly, the direct effects of this model tested our hypothesized relationships between (1) initial future vividness and residual academic self-efficacy, (2) change in future vividness and residual academic self-efficacy, and (3) residual academic self-efficacy and the two objective academic outcomes. However, the direct effects did not provide information about the relationships between future vividness and academic outcomes. To test the hypothesized impact of future vividness and its trajectory on the academic outcomes, we tested the indirect effects of initial vividness and change in vividness on both outcomes through residual academic self-efficacy. The statistical scripts for the models are available via Open Science Framework (see the supplemental material for the link).

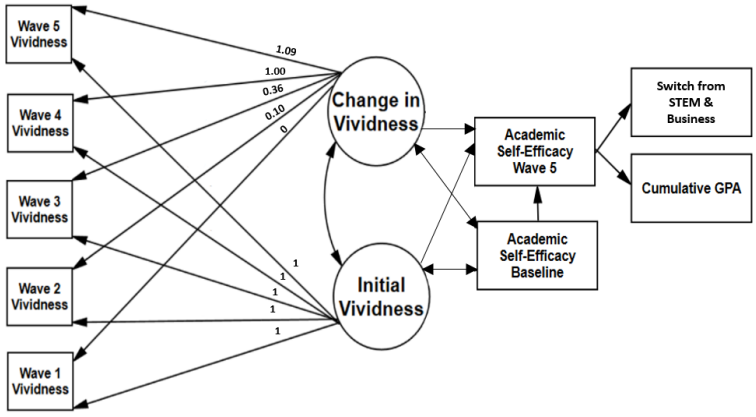

Figure 2. Structural equation model for vividness over the first three semesters predicting residual academic self-efficacy and academic outcomes after two years of college. The loadings for the slope factor were based on duration since baseline in years.

Research Question 1. *When entering college, how vividly did students imagine graduation and their life five years after graduation and how did that change over the first three semesters of college?*

Based on our model estimates, at the start of college, the mean vividness of graduation (M = 5.32, SE = 0.05, p < .001, 95% CI [5.23, 5.42]) and post-graduation (M = 4.61, SE = 0.05, p < .001, 95% CI [4.52, 4.70]) were above the midpoint. Over the course of the first semesters of college, our sample significantly decreased in vividness of graduation (M = -0.16, SE = 0.05, p = .001, 95% CI [-0.25, -0.06]) and significantly increased in vividness of post-graduation (M = 0.14, SE = 0.04, p = .002, 95% CI [0.05, 0.22]). The significant decrease in vividness of graduation was unexpected. Intuitively, vividness of graduation should increase as students progress through college. We returned to this finding in the discussion.

Considering individual differences, the variances around the initial and change estimates were significant for both domains (see Table 3). These variances indicated that there were significant individual differences in both initial vividness and change in vividness.

Table 3

Variances of Initial and Change in Vividness

	Variance of Initial Vividness	Variance of Change in Vividness
Vividness of Graduation	*Var* = 1.55, *SE* = 0.10, p < 0.001 95% CI [1.36, 1.75]	*Var* = 0.51, *SE* = 0.09, p < 0.001 95% CI [0.33, 0.69]
Vividness of Post-Graduation	*Var* = 1.27, *SE* = 0.09, p < 0.001 95% CI [1.10, 1.44]	*Var* = 0.27, *SE* = 0.08, p = 0.001 95% CI [0.12, 0.42]

Note. Var = Variance of the initial and change in the vividness factors; *SE* = Standard error; *CI* = Confidence interval

Research Question 2. *In these two future domains, did initial vividness, and its change trajectory over the first three semesters of college, predict academic self-efficacy and, in turn, predict academic outcomes (cumulative GPA and persistence in STEM and business)?*

In line with our hypotheses, higher initial vividness, as well as more positive growth in vividness, predicted greater residual academic self-efficacy after three semesters. In the vividness of graduation model, both the initial level of graduation vividness (b = 0.08, SE = 0.04, p = .022, 95% CI [0.01, 0.16], β = 0.11) and the change in vividness (b = 0.33, SE = 0.09, p < .001, 95% CI [0.15, 0.51], β = 0.25) significantly predicted residual academic self-efficacy. Similarly, in the vividness of post-graduation model, both the initial level of vividness (b = 0.15, SE = 0.05, p = .001, 95% CI [0.06, 0.25], β = 0.19) and change in vividness (b = 0.79, SE = 0.22, p < .001, 95% CI [0.35, 1.22], β = 0.44) significantly predicted residual academic self-efficacy. Importantly, even controlling for the impact of initial levels of academic self-efficacy, our vividness factors were significant predictors of residual academic-self-efficacy.[4, 5] Students who entered college with higher vividness of their graduation and life after graduation, and increased in vividness, were more likely to believe in their academic abilities and success. The vividness of graduation model accounted for 32 percent of the variance in residual academic self-efficacy (R^2 = 0.32) while the post-graduation model accounted for approximately 43 percent (R^2 = 0.43). In both models, residual academic self-efficacy was a significant predictor of CGPA and switching from STEM and business fields (see Table 4). After controlling for level of academic self-efficacy when entering college, students with greater belief in their academic abilities at the third

[4] In both models, we included direct paths from initial academic self-efficacy (i.e., Wave 1) to later self-efficacy (Wave 5). These paths controlled for efficacy levels when entering college. In both vividness domain models, these results indicated that initial levels of academic self-efficacy significantly predicted later self-efficacy (Vividness of graduation: b = 0.55, SE = 0.09, p < .0001, 95% CI [0.43, 0.68], β = 0.44; Vividness of post-graduation: b = 0.57, SE = 0.08, p < .0001, 95% CI [0.42, 0.72], β = 0.46).

[5] See the supplemental material for the analyses of the covariance paths from initial academic self-efficacy to estimates of initial vividness and change in vividness.

semester of college were more likely to have a higher CGPA and persist in STEM and business fields. Both models accounted for 10 percent of the variance in CGPA ($R^2 = 0.10$) and 5 percent of the variance in switching from STEM and business ($R^2 = 0.05$).[6]

Table 4

Effects of Residual Academic Self-Efficacy on Cumulative GPA and Switching from STEM and Business Fields

	Vividness of Graduation	Vividness of Post-Graduation
Residual Academic Self-Efficacy to Cumulative GPA	b = 0.18, SE = 0.02, p < .001, 95% CI [0.13, 0.22], β = 0.32	b = 0.18, SE = 0.02, p < .001, 95% CI [0.13, 0.22], β = 0.32
Residual Academic Self-Efficacy to Switching Fields	b = -0.44, SE = 0.14, p = .002, 95% CI [-0.72, -0.16], β = -0.22	b = -0.43, SE = 0.15, p = .003, 95% CI [-0.71, -0.14], β = -0.21

Note. The coefficients for cumulative GPA are linear regression coefficients. The coefficients for switching fields are logistic regression (log-odds) coefficients. *SE* = Standard error. *CI* = Confidence interval.

Table 5 provides the statistics associated with testing the indirect effects of initial and change in future vividness on the academic outcomes through residual academic self-efficacy. With the exception of the indirect effect of initial graduation vividness on switching fields which approached significance ($p = .065$), the remaining seven indirect effects were significant (all ps < .027). The indirect effects were positive when CGPA was the outcome, and negative when switching fields was the outcome. In other words, in both domains, higher initial vividness and increases in vividness predicted higher residual academic self-efficacy and, in turn, higher residual academic self-efficacy predicted higher CGPAs and reduced switching from STEM and business fields. These indirect effects suggest that a clear image of the future alone was not

[6] M*plus* calculates R^2 for categorical dependent variables based on the method described by Snijders and Bosker (2011).

enough to promote positive academic outcomes. However, that clear image of the future predicted students' beliefs about their academic abilities, and predicted their academic success. See the supplemental material for model fit information.

Table 5

Indirect Effects of Initial Vividness and Change in Vividness on Cumulative GPA and Switching from STEM and Business Fields Through Residual Academic Self-Efficacy

	Outcome	Initial Vividness	Change in Vividness
Vividness of Graduation	*Cumulative GPA*	b = 0.02, SE = 0.01, p = 0.026, 95% CI [0.002, 0.03], β = 0.04	b = 0.06, SE = 0.02, p = 0.001, 95% CI [0.02, 0.09], β = 0.08
	Switching Fields	b = -0.04, SE = 0.02, p = 0.065, 95% CI [-0.08, 0.002], β = -0.03	b = -0.15, SE = 0.06, p = 0.021, 95% CI [-0.27, -0.02], β = -0.06
Vividness of Post-Graduation	*Cumulative GPA*	b = 0.03, SE = 0.01, p = 0.002, 95% CI [0.01, 0.04], β = 0.06	b = 0.14, SE =0.04, p = 0.002, 95% CI [0.05, 0.22], β = 0.14
	Switching Fields	b = -0.07, SE = 0.03, p = 0.025, 95% CI [-0.12, -0.01], β = -0.04	b = -0.34, SE = 0.15, p = 0.026, 95% CI [-0.63, -0.04], β = -0.09

Note. SE = Standard error. *CI* = Confidence interval.

Research Question 3. *In these two future domains, did men and women differ in their initial vividness, its trajectory, or how they predicted academic self-efficacy and academic outcomes?*

Analytic Approach

To test for potential sex differences, we used a three-step approach. We completed these steps independently, using an identical procedure, for both vividness domains. (1) First, we specified a multi-group (men and women) model, based on Figure 2. To establish a baseline model, we ran the model with all paths unconstrained and free to vary between men and women. Using this approach, we obtained separate model estimates for men and women. (2) Next, we conducted a model comparison to test for sex differences in initial vividness (i.e., differences in

the intercept). We compared the baseline model to a model with initial vividness constrained to be equal between the sexes. If constraining the initial vividness significantly decreased fit, we determined that initial vividness differed significantly between men and women. Significant decreases in model fit were determined based on the significance of the change in -2loglikelihood from base model to constrained model. The change in -2loglikelihood is distributed as a chi-square statistic (Grimm et al., 2017). (3) Finally, we replicated Step 2 to complete five additional model comparisons, each constraining a different parameter: (1) change in vividness (i.e., the slope factor), (2) the path between initial vividness and residual self-efficacy, (3) the path between change in vividness and residual self-efficacy, (4) the path between residual academic self-efficacy and CGPA, and (5) the path between residual academic self-efficacy and switching from STEM and business.

Research Question 3 Results

To highlight the hypothesized sex differences by vividness domain, below, we first present the results for vividness of graduation followed by post-graduation.

Vividness of College Graduation. At the mean level, both men and women began college with vividness of graduation above the midpoint (see Table 6). Over the first year of college, both men and women significantly decreased in vividness of graduation; women decreased by .16 points, and men by .17 points on the 7-point scale.

Table 6

Vividness of College Graduation: Multi-Group Growth Model Estimates

		Initial Vividness			Change in Vividness		
Women	*Means*	*M* = 5.48	*SE* = 0.06	*p* < .001	*M* = -0.16	*SE* = 0.06	*p* = .007
	Variances	*Var* = 1.39	*SE* = 0.12	*p* < .001	*Var* = 0.41	*SE* = 0.10	*p* < .001
Men	*Means*	*M* = 5.13	*SE* = 0.08	*p* < .001	*M* = -0.17	*SE* = 0.08	*p* = .039
	Variances	*Var* = 1.70	*SE* = 0.17	*p* < .001	*Var* = 0.68	*SE* = 0.17	*p* < .001

Note. M = Mean. *SE* = Standard error. *Var* = Variance.

Based on the relative model fits, we found that allowing the initial vividness to vary for men and women produced a significantly better fit (see Table 7). Therefore, women as a group began their college career with significantly higher vividness of graduation compared to men. Conversely, we found that allowing change in vividness to vary between men and women did not produce a significantly better fit. This analysis suggested that, while women began college with a more vivid view of their graduation, the change in vividness over the course of the first two years did not differ by sex. In terms of predictive ability, we found no significant differences between men and women in the ability to predict residual academic self-efficacy from initial graduation vividness and its change. Additionally, we found no sex differences in the relationships between residual academic self-efficacy and the academic outcomes.

Table 7

Model Comparisons for Sex Differences in Vividness of Graduation

Model	-2Loglikelihood	df	$\Delta\chi^2$ (1)	$\Delta\chi^2$ *p*
Baseline Model, Fully Unconstrained	13710.24	38	NA	NA
Constrained Intercept	13722.96	37	12.71	<.001
Constrained Slope	13710.25	37	0.004	0.950
Constrained Intercept to Residual Academic Self-Efficacy	13710.78	37	0.53	0.465
Constrained Slope to Residual Academic Self-Efficacy	13710.53	37	0.29	0.593
Constrained Residual Academic Self-Efficacy to Cumulative GPA	13711.02	37	0.77	0.380
Constrained Residual Academic Self-Efficacy to Switching Fields	13711.36	37	1.12	0.290

Note. Each path constrained was the only path constrained. df = Degrees of freedom.

Vividness of Post-Graduation. Similar to the findings for vividness of graduation, both women and men began college with vividness of post-graduation above the midpoint (see Table 8). Women did not significantly change in vividness at the group level while men significantly increased in vividness. Based on these estimates, over the course of a year, men gained .26 points whereas women gained only .06 points on the 7-point vividness of post-graduation scale. Importantly, during the first year of college, on average, women lost all of their initial advantage in vividness of post-graduation.

Table 8

Vividness of Post-Graduation: Multi-Group Growth Model Estimates

		Initial Vividness			Change in Vividness		
Women	*Means*	$M = 4.71$	$SE = 0.06$	$p < .001$	$M = 0.06$	$SE = 0.06$	$p = .332$
	Variances	$Var = 1.32$	$SE = 0.12$	$p < .001$	$Var = 0.32$	$SE = 0.10$	$p = .002$
Men	*Means*	$M = 4.48$	$SE = 0.07$	$p < .001$	$M = 0.26$	$SE = 0.07$	$p < .001$
	Variances	$Var = 1.17$	$SE = 0.12$	$p < .001$	$Var = 0.14$	$SE = 0.10$	$p = .134$

Note. M = Mean. SE = Standard error. Var = Variance.

Replicating the graduation finding, women as a group began college with significantly higher vividness of post-graduation than men (see Table 9). Constraining the initial vividness to be equal between the sexes produced a significantly worse model fit. In contrast with the graduation results, we found a significant sex difference in change of vividness of post-graduation. Over the course of the first year of college, men as a group changed positively in vividness of their post-graduation futures at a significantly higher rate than women. Additionally, we found no significant sex differences in the relationships between (1) initial vividness of post-graduation and residual academic self-efficacy, (2) the change in vividness and residual academic self-efficacy, or (3) residual academic self-efficacy and the academic outcomes. These findings suggest that the functional relationships between vividness, academic self-efficacy, and academic outcomes were the same for both sexes.

Table 9

Model Comparisons for Sex Differences in Vividness of Post-Graduation

Model	-2Loglikelihood	df	$\Delta\chi^2$ (1)	$\Delta\chi^2$ *p*
Base Model, Fully Unconstrained	13466.95	38	NA	NA
Constrained Intercept	13473.57	37	6.62	0.010
Constrained Slope	13472.05	37	5.10	0.024
Constrained Intercept to Residual Academic Self-Efficacy	13468.96	37	2.00	0.157
Constrained Slope to Residual Academic Self-Efficacy	13468.30	37	1.35	0.245
Constrained Residual Academic Self-Efficacy to Cumulative GPA	13468.12	37	1.16	0.281
Constrained Residual Academic Self-Efficacy to Switching Fields	13468.04	37	1.09	0.297

Note. df = Degrees of freedom.

Examination of Table 8 reveals the individual variation of our estimates of vividness of post-graduation. While women as a group showed significant individual differences in both initial vividness of post-graduation and change over time, men as a group only showed significant individual differences in initial vividness. Within the group of men, the variance of the slope factor was not significant, implying that there were no significant individual differences in the trajectory of change. The sex differences in these change findings suggest two important points: (1) while women as a group showed non-significant mean change in vividness of post-graduation, there was significant variation around that mean, and (2) men, fairly uniformly as a group, experienced positive growth in vividness of post-graduation.

To further unpack this finding, we derived slope estimates for vividness of post-graduation for each student in M*plus*. To ascertain which slopes represented significant change, we computed reliable change indices for men and women (Ferguson et al., 2002). Reliable change

indices greater than or equal to 1.96 (i.e., the 95% confidence interval) were considered significant. Seventy-one percent of our total participants' slopes represented significant change (n = 635 out of 889 total participants). Overall, 13 percent of participants showed a significantly negative change, 58 percent showed a significantly positive change, and 29 percent did not change significantly. Breaking down the analysis by sex, men and women significantly differed in their likelihood of exhibiting negative, positive, or no change, χ^2 (2, N = 889) = 187.13, p < .0001. Specifically, women were more likely than men to show negative change (22.5 percent versus 2 percent; χ^2 (1, N = 120) = 79.21, p < .0001), and to show no change (39 percent versus 15 percent; χ^2 (1, N = 254) = 62.41, p < .0001. Contrastingly, 83 percent of men exhibited positive change while only 38 percent of women did, χ^2 (1, N = 515) = 176.89, p < .0001. Highlighting the sex differences even more starkly, women comprised 93 percent of the significant negative changes while 63 percent of the significant positive changes were men.

Discussion

This research was the first longitudinal study to explore the trajectory of future vividness in students and its relationship with academic outcomes. At the first week of college, students reported a relatively vivid mental representation of both their graduation and their post-graduation life (i.e., above the midpoint on a 7-point scale). There were substantial individual differences in their levels of initial future vividness and its growth. However, vividness of graduation significantly decreased while vividness of post-graduation significantly increased. The loss of clarity of college graduation was unexpected. Intuitively, as students progress through college, vividness of graduation should increase. The timing of the first vividness measurements may provide insight into this counter-intuitive result. Students gave their first vividness ratings during their first week college. These students were likely excited about

starting college, imagining their commencement with balloons dropping from the university auditorium, surrounded by family and friends. Graduation images are prevalent during Freshmen orientation and in the media (e.g., university webpages, social media). The availability of these vivid images may have led to students' high initial ratings of vividness of graduation (i.e., availability bias; Tversky & Kahneman, 1973). However, as these students continue through college, many face challenging experiences (e.g., financial difficulties; psychological distress) which may dampen their vision of graduating from college (McDaniel et al., 2015; Eisenberg et al., 2007).

Beyond understanding how vividness in these future domains changes through the transition into college, the results of this research supported our hypothesized indirect effects and have important implications. Previous research and theorizing suggested that imagining specific, positive situations predicted higher levels of self-efficacy (e.g., Bandura, 1986; Pop & Tiba, 2019). The results of the current study supported and extended this literature to directly consider the relationship between domains of future vividness (i.e., graduation and post-graduation), trajectories of vividness, and academic self-efficacy. In both domains, higher levels of vividness at the start of college and a positive change in vividness were predictive of greater academic self-efficacy. In turn, higher academic self-efficacy after at the beginning of the second year of college predicted cumulative GPA and persistence in leaky-pipeline fields.

Notably, in both future domains, women began college with higher vividness than men. Women maintained their advantage in vividness of graduation with no significant sex differences in how that vividness changed. However, in vividness of life five years after graduation, as a group, men significantly increased while women remained stagnant. In this crucial future domain, female students did not increase in vividness. Quite the contrary, compared to men,

women were more likely to lose vividness of their post-graduation life. Most of our sample started college in male-dominated STEM and business fields where women are likely to face unique social and biological pressures. Future research should explore if women in fields with greater equity exhibit different patterns of vividness. Taken together, these results may provide insight into sex differences across higher education. Greater vividness of graduation may correspond to trends of higher graduation rates for women. However, the sex differences in vividness of post-graduation may correspond to the relative disadvantage for women in persistence in leaky-pipeline fields. Women may decide to enter leaky-pipeline fields, in part, due to comparatively high initial vividness of their post-graduation life. However, as they continue through college, a diminishing view of their future life, balancing family and career, may contribute to women leaving these fields.

This research may have important implications for interventions focused on increasing academic performance and leaky-pipeline persistence. First, the findings highlighted future vividness as an important psychological factor to consider in efforts to enhance both student beliefs about their academic abilities and their academic success. Universities may consider focusing outreach on vividness of the future. For instance, to reach students starting college, universities might add a guided visualization exercise to orientations to encourage students to visualize their future success. This opportunity would allow students to solidify the image of their future as a college graduate. Additionally, the significant impact of change in future vividness suggested that the transitional first semesters of college may be a crucial time to bolster vividness. We found that students, on average, declined in graduation vividness by their third semester. It may be beneficial for interventions to reinforce initial vividness during this transition. For example, many universities offer interventions for students' career exploration

(e.g., career day) that are advertised to students nearing degree completion. To bolster vividness of the future, universities might consider advertising these supports for students in earlier stages of college.

In terms of sex differences, this research may suggest sex-specific approaches for effective interventions. For example, in comparison to women, men began college with less clarity of both their graduation and their life after graduation. Interventions to improve male graduation rates, may benefit from boosting future vividness in both domains at the start of college. Our finding that the vast majority of students who decreased in vividness of post-graduation were women is particularly noteworthy given the significant indirect relationship between positive change in future vividness and persistence in leaky-pipeline fields. Interventions focusing on supporting women in these fields might benefit from focusing on facilitating the growth of vividness of post-graduation.

Limitations and Future Directions

Although the longitudinal design of this study allowed us to better establish the temporal order of the relationship between vividness of the future and academic self-efficacy, we were unable to confirm the causal direction of the relationship. Future research should use an experimental design to test the causal relationship between future vividness, academic self-efficacy, and outcomes.

Given our longitudinal design, we anticipated and planned for missing data by employing full information maximum likelihood (FIML) in our analyses (Enders & Bandalos, 2001). Despite the use of FIML to account for missing data, the specific students who were missing data in our study represent a limitation. Specifically, in our attrition analysis, we found that students who began the study and did not return for future waves were significantly lower on cumulative

GPA compared to students who returned. The students who left the study might have had a steeper decline in vividness of the future resulting in subsequent poor performance. Alternative recruitment methods may increase the likelihood of retaining students at risk for poor academic performance in longitudinal projects. For example, researchers could cooperate with instructors to embed surveys of students' future vividness in the curriculum ensuring continued participation.

The participants in this study were traditional-aged, first-year students (M = 18.14, SD = 0.65), most of whom began college in competitive, high-drop out fields (i.e., STEM and business). This sample allowed us to track growth in future vividness over this transitional period and understand its relationship to leaky-pipeline persistence. However, these sample characteristics limited our ability to generalize our findings. Students from different backgrounds (e.g., non-traditional students; humanities students) may exhibit varying trends in initial levels of vividness and its change. For example, in fields where students may face fewer challenges in their first semesters (i.e., fields with lower drop-out), it is possible that psychological resources (e.g., vividness of the future; academic self-efficacy) are less crucial to retention and success. These students may be less likely to show a decline in future vividness during their transition into college. Nevertheless, future studies should consider if the trajectory of vividness for these students changes as they progress in college. These students may experience a decline in vividness as they plan for a career in fields with more limited career opportunities. Additionally, future studies may use an extended longitudinal design to explore additional aspects of the relationship between vividness of the future and academic outcomes. The present research focused on the first three semesters of college because this time period represents a crucial period for students, where students are the most likely to switch majors and dropout. As such, the

trajectory of vividness findings may be specific to this time period and may not generalize to other periods of time during college. An interesting direction for future research is to address how students' future vividness changes after they change major.

While we assessed the vividness of future images, we did not assess whether student's future visions were realistic. Some students may imagine an overly positive, unrealistic future. Maladaptive daydreaming is certainly not good. However, overly positive illusions are a mixed-blessing in the literature (see Kwan et al., 2004; Taylor & Brown, 1988). Thus, it is an open question under what conditions unrealistic visions of the future enhance or undermine academic self-efficacy and outcomes.

Another interesting future direction may explore the relationship between vividness of the future and identity. According to the identity based motivation (IBM) model (Oyserman, 2009), individuals' perceived salience of their different future identities influenced perceptions of difficult tasks (Oyserman & Destin, 2010). Individuals perceive tasks that are both difficult and identity congruent (i.e., similar to a salient self) as meaningful. In contrast, for identity incongruent tasks, individuals are more likely to perceive the task as "not for people like me" and/or insurmountable. Vividness of the future self, especially in specific domains such as college graduation or post-graduation life, may increase the perceived salience of that future self. In line with the IBM model, increased salience of the self as a college graduate or in a career, may improve their persistence and success.

Finally, this study was the first to explore sex differences in trajectories of future vividness. While our results pointed to distinct sex differences in initial future vividness in both

domains,[7] and in how vividness of post-graduation changed, our research was exploratory and cannot comment on the origins of those differences. Identifying factors that influence the observed sex differences will be vital to the design of future vividness interventions aimed at diminishing academic disparities across the sexes.

[7] The vividness of post-graduation items, were designed to allow participants to imagine unique views of their future after graduation. As a result, the items included fewer concrete details compared to the graduation items. This difference in specificity was present for both sexes and should not impact the sex difference findings. Future research should limit specificity differences.

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Is Seeing Believing? A Longitudinal Study of Vividness of the Future and its Effects on Academic Self-Efficacy and Success in College

Supplemental Material

Follow-Up Study for Unenrolled Students

Cumulative grade point average and major data were only available for those students currently enrolled (at the first semester: $n = 872$; at the fourth semester: $n = 768$; at the fifth semester: $n = 739$). Participants did not enroll due to a number of reasons including dropping out of college or transferring to another university. Out of our total sample of 889, 150 students were no longer enrolled at the university by the fifth semester. Although the University Records Office data indicated the students were not enrolled, the data did not distinguish between possible reasons for unenrollment (e.g., transfer to another university, transfer to community college, no longer in higher education).

In order to better understand the outcomes for unenrolled students, our research team conducted a follow-up survey. We contacted each of these students by phone and text message. Thirty-nine students (26%) participated in the survey. Therefore, we do not know the whereabouts of the remaining students at the time of writing this report. Of participants who responded to our message, the most common outcomes were transferring to another four-year university (39%) and no longer enrolled in higher education (31%). Other outcomes included transferring to a community college/specialty school and completing their degree. Within students who transferred to a four-year university, 93 percent of students began their college studies majoring in a STEM or business major. After transferring, 86 percent remained in a STEM or business major at their new university while 14 percent changed to a non-STEM or business major. Within those who were no longer enrolled in higher education, 83 percent were in STEM or business majors prior to unenrolling and 17 percent were in other fields of study.

Based on the findings of our follow-up survey, a large portion of students who left the study and the university were no longer in higher education. Therefore, the range of our

academic outcomes in our report may be truncated leading to underestimates of our hypothesized effects. For example, students who leave higher education may be those with low grade point averages and low persistence in their major fields.

Open Science Framework (OSF)

The statistical scripts for the models used in this research are available on the Open Science Framework at the following link:

https://osf.io/atydn/?view_only=2fbe7158aa934a2192cead2c0bc93270

Mean Comparisons for Missing Data Analysis

Students left the study after they started in the 1st or the 2nd wave: 77 out of 549 students participated in only Wave 1 and 119 out of 340 students participated in only Wave 2. To understand the differences between students who returned and those who did not, we tested group differences on our variables. Students who began at Wave 1 and did not return for the later waves of surveys did not significantly differ from those who returned on any of the psychological variables at Wave 1 (i.e., Vividness of graduation, $t(547) = 0.64$, $p = .521$; Vividness of post-graduation, $t(547) = 0.92$, $p = .360$; Academic self-efficacy, $t(544) = 1.48$, $p = .140$; Switching fields, χ^2 (1, $N = 391$) = 0.01, $p = .904$). Similarly, students who began at Wave 2 and did not return for the later waves of surveys did not significantly differ from those who returned on any of the psychological variables of interest at Wave 2 (i.e., Vividness of graduation, $t(210.83) = 1.59$, $p = .113$; Vividness of post-graduation, $t(338) = 1.70$, $p = .090$; Switching fields, χ^2 (1, $N = 247$) = 0.83, $p = .364$).

Research Question 2 Model Fit Information

Model Fit Statistics for the Vividness Models

Model	Loglikelihood	df
Vividness of Graduation	- 6271.81	20
Vividness of Post-Graduation	- 6145.34	20

Note. Using maximum likelihood estimation with a dichotomous dependent variable in M*plus*, the loglikelihood H0 value (i.e., the loglikelihood of the specified model) and its information criteria statistics (AIC, BIC) are the only fit information provided (Grimm et al., 2017, p. 333). The loglikelihood H0 value is not a global fit index and does not provide concrete information about the goodness-of-fit for the model. When comparing nested models, a larger loglikelihood H0 value indicates better fit.

Analyses of Covariance Paths

In our models, we included covariance paths from initial academic self-efficacy to our estimates of initial vividness and change in vividness to account for the potential relationship between these factors. In both vividness domain models, the covariances between initial self-efficacy and initial vividness of the future were significant (Vividness of graduation: *Cov* = 0.31, *SE* = 0.05, $p < .0001$, 95% CI [0.23, 0.40]; Vividness of post-graduation: *Cov* = 0.29, *SE* = 0.04, $p < .0001$, 95% CI [0.21, 0.37]). These results suggest that, at the start of college, high levels of vividness of the future and high academic self-efficacy go hand-in-hand. Students high in one are likely to be high on the other. Contrastingly, in both models, the covariance between initial academic self-efficacy and change in vividness was not significant (Vividness of graduation: *Cov* = 0.04, *SE* = 0.04, $p = 0.381$, 95% CI [-0.05, 0.13]; Vividness of post-graduation: *Cov* = -0.02, *SE* = 0.04, $p = 0.561$, 95% CI [-0.10, 0.06]). Levels of initial academic self-efficacy were not significantly related to how future vividness changed. In the transition through their first semesters of college, regardless of their initial academic self-efficacy, students may gain a clear view of their future or lose some of their initial clarity.