Future Self-Identification: Changes in Factor Structure Through College

by

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ABSTRACT

Perception of the future self (i.e., future self-identification) is an important indicator of outcomes over time and during different life-stages (e.g., adolescence, emerging adulthood, retirement). Although recent research established that future self-identification is comprised of three distinct but interrelated factors (i.e., relatedness, positivity, and vividness of the future self), the current research was the first to consider the stability of that factor structure (i.e., factorial invariance) over extended time and over the course of a major life-stage transition. Using a longitudinal design, this research investigated (1) longitudinal factorial invariance as young adults transitioned into, and became established in, their college education and (2) explored differences in factor stability across demographic groups (i.e., sex; college generation status). Results indicated that as students progressed through their first three semesters of college, future self-identification had a stable factor structure over the short-term. However, from the first week of college to when students were established in college, strong factorial invariance (i.e., invariance of the item intercepts) did not hold. In general, there were not differences in future self-identification factor structure by sex. However, from the first year of college to the second year, strict invariance was not supported (i.e., the item residual variances were not invariant between men and women). This sex difference appeared during the first stage of the transition into college and diminished as students became established in their college career. Finally, complete factorial invariance was established between first-generation and continuing-generation college students suggesting that the future self-identification factor structure did not differ based on college generation status. Findings provide crucial information regarding the validity of

mean comparisons of future self-identification across a transition into a life-stage and across demographic groups. Future research may build on this foundation to better understand the sources of factorial non-invariance.

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INTRODUCTION

Decisions we make today have the potential to impact us tomorrow and far into the future. These intertemporal decisions require the current self to weigh the rewards of the present against the rewards of the future. Issues arise when the interests of the present self are at odds with the interests of the selves to come (Hershfield, 2011). When faced with these conflicts, the question becomes, which interest will the present self prioritize? An emerging body of literature considers a key factor in answering this question: perception of the future self.

Perception of the future self, or *future self-identification*, is comprised of three distinct but interrelated factors: (1) relatedness between the present and future, (2) positivity about the future, and (3) vividness of the future (Hershfield, 2011; Bixter et al., 2020). The implications of this construct are vast and predicted outcomes cover a wide-array of domains. These include discounting of future rewards, delinquent behaviors in adolescence, procrastination, willingness to save for retirement, self-control, and academic success in college (Klineberg, 1968; van Gelder, Hershfield, & Nordgren, 2013; van Gelder, Luciano, Kranenbarg, & Hershfield, 2015; Blouin-Hudon & Pychyl, 2015; Ersner-Hershfield et al., 2009; Adelman et al., 2017). Importantly, these outcomes often focus on intertemporal decisions and span many different life-stages (e.g., adolescence, young adulthood, retirement). Based on the myriad of positive outcomes related to greater future self-identification, and evidence for the malleability of its factors (Hershfield, Goldstein, Sharpe, Fox, & Yeykelis, 2011), research in this field is moving to design interventions to experimentally increase future self-identification with the aim to achieve positive downstream consequences.

Despite this emphasis on temporal and life-stage specific outcomes, no research to date considers the stability of the factor structure over time or over the course of major life-stages. Given the strong temporal basis of this construct, the current research suggests that future self-identification may present differently depending on time within a life-stage (e.g., transitioning versus established).

As it stands, an open empirical question in this literature remains: Do individuals transitioning into a major life-stage express future self-identification differently than individuals who are established within that stage? In other words, is the factor structure of future self-identification stable over the course of a major life-stage? The answer to this question may have implications for both the validity of longitudinal and cross-sectional measurements of the construct and the optimal design for future interventions.

The current research sought to begin investigation into this question as it applies to young adults transitioning into, and becoming established in, their college education. Using a longitudinal sample, the primary aim of this research was to investigate the change in future self-identification factor structure over the first three semesters of college. This life-stage, known as "emerging adulthood," represents a time of identity exploration and formation (Arnett, 2000). In examining this life-stage, this research provides a strong test of factor stability through a period of developmental change.

In addition to testing the stability of the factor structure over time, the current research provides a valuable opportunity to explore factor invariance across demographic groups. Changes in future self-identification factor structure may vary based on membership within specific demographic groups. This research aimed to explore differences in factor structure for two sets of demographic groups: (1) males and female and (2) first-generation and continuing-generation college students. Results of this exploratory aim will provide insight for interventions aimed at increasing future self-identification in particular groups.

Below, I first provide a brief review of the existing literature on intertemporal choices and future self-identification. I then provide a rationale for the impact of time within life-stages on the future self-identification factor structure and the potential for differences in factor structure for specific demographic groups. Finally, I outline the methods and proposed analyses for a longitudinal analysis of factorial invariance in future self-identification over the course of the first three semesters of college. Through this study design, this research aimed to provide a strong test of invariance in the structure of future self-identification over a specific developmental period.

Perceptions of the Future: Future Self-Identification

Intertemporal choices—choices that impact both the present and future—necessitate consideration, and trade-offs between, present and future costs and benefits. In making these choices, individuals often prioritize present benefits and undervalue benefits in the future. In behavioral economics, this phenomenon is known as "temporal discounting" and is marked by the tendency to prioritize, and direct effort towards, short-term rather than long-term rewards (Frederick, Loewenstein, & O'Donoghue, 2002). Importantly, many long-term goals and rewards require substantial energy investment and persistence (e.g., graduating from college, saving money to retire). In order to achieve future rewards, individuals must direct effort to their long-term goals and overcome the temptations of immediate gratification and short-term rewards (Baumeister & Heatherton, 1996; Duckworth, Peterson, Matthews, & Kelly, 2007; Trope & Liberman, 2003).

Perception of the future self represents a mechanism by which to explain individual differences in temporal discounting. Research into the perception of the future self often stems from a philosophical theory of connection to the future posited by Derek Parfit. According to this theory, the self is a compilation of temporally distinct identities. Greater overlap between the present and future selves implies a stronger connection to the future (Parfit, 1971; 1984; 1986). Further, Parfit proposed that individuals who are less connected to their future self place more emphasis on current versus future rewards.

Prior research investigating the perception of the future self found that individuals who felt more overlap between the present and future self were more likely to value future rewards and were less prone to temporal discounting (Bartels & Urminsky, 2011; Bartels & Rips, 2010; Ersner-Hershfield, Garton, Ballard, Samanez-Larkin, & Knutson, 2009). Research on perceptions of the future self includes an array of outcomes relevant to many life-stages including adolescence, emerging-adulthood (i.e., college-aged), and middle and late adulthood. Specific to adolescence, similarity between the present and future self and a vivid view of the future were associated with greater self-control and fewer delinquent behaviors (Klineberg, 1968; van Gelder, Hershfield, & Nordgren, 2013; van Gelder, Luciano, Kranenbarg, & Hershfield, 2015). Within emerging-adulthood, perceptions of the future self were associated with self-control, downstream academic outcomes, and decreased academic procrastination (Bixter et al., 2020; Adelman et al., 2017; Blouin-Hudon & Pychyl, 2015). Finally, adults with greater overlap between the present and future self were less likely to support and engage in dishonest activities (Hershfield, Cohen, & Thompson, 2012), more likely to prepare for retirement (Ellen, Wiener, & Fitzgerald, 2012), and have more financial savings overall (Ersner-Hershfield et al., 2009).

After a comprehensive review of the literature on perceptions of the future self, Hershfield (2011) proposed a construct comprised of three distinct but interrelated factors: (1) similarity between the present and future self, (2) positivity about the future self, and (3) vividness of the future self. Although the literature includes several different terms to refer to this overarching construct and Hershfield's "similarity" component (e.g., future self-continuity: Ersner-Hershfield, Garton, Ballard, Samanez-Larkin, & Knutson, 2009; psychological connectedness: Bartels & Urminsky, 2011; Bartels & Rips, 2010), the current research employs the comprehensive terms proposed by Bixter et al. (2020). Therefore, this research will refer to the "similarity" component as "relatedness" and the overall construct as future self-identification. In a test of the factor structure of future self-identification as applied to first-year college students, Bixter et al. (2020) found support for a three-factor solution through both test-retest factorial invariance and cross-validation in a novel sample.

Factor Invariance and Time Within a Life-Stage

While Bixter et al. (2020) provided strong support for a three-factor model of future self-identification, the longitudinal analysis took place over a relatively short period of time with 5 weeks between the test and retest. Thus, the stability of this factor structure (i.e., factor invariance) over time remains an open empirical question. Future self-identification is inherently related to time. As such, its measurement is related to time and, as time passes, the factor structure of a measure of future self-identification may change. This may be especially likely in samples undergoing a crucial life-transition and settling into a new life-stage. The primary aim of the present research was to investigate the possibility that the future self-identification factor structure may be non-invariant for students at start of the college transition compared to students who are established within their college career.

Potential Differences for Demographic Groups

In addition to the potential longitudinal factor non-invariance, changes in factor structure may not be uniform across demographic groups. This research considered two sets of demographic groups: (1) males and females and (2) first-generation and continuing-generation college students. The current research focused on these specific groups for three significant reasons:

First, in the future self-identification literature, research has already begun to document differences between these groups in the longitudinal change and predictive ability of the future self-identification components. McMichael et al. (2021) found that women's vividness of the future grew at a slower rate than men's. Additionally, Adelman et al. (2017) found that relatedness to the future self had a weaker relationship to self-control for first-generation college students.

Secondly, these demographic groups differ in academic outcomes making them likely targets for interventions designed to increase future self-identification and influence academic outcomes. Men and women differ in terms of STEM retention. College-generation status is highly correlated with rates of college graduation. As the research literature for future self-identification grows, the field is moving toward interventions designed to increase future self-identification and facilitate positive downstream consequences. Therefore, in order to provide foundational information for interventions, this research aimed to explore the factor structure of future self-identification in these groups.

Finally, the current research suggests that characteristics specific to these demographic groups may lead to differences in the factor structure of future self-identification. For example, college-aged men and women encounter different social & biological expectations. During this life-stage, young women begin to face conflicting societal and biological demands to emphasize future family or career roles (Amatea, Cross, Clark, & Bobby, 1986). As women continue through this life-stage they may anticipate upcoming changes and conflicts within this stage. As a result, compared to men, the factor structure of future self-identification may present differently for women as they progress through college. Similarly, differences between first-generation and continuing-generation college students may lead to differences in factor structure. For example, first-generation students do not have immediate family members who graduated from college (i.e., lack of role models), are more likely to be a racial minority, and are more likely to be from a relatively low socioeconomic status. These substantial life differences may lead to differences in factor structure for first-generation students compared to continuing-generation college students.

Overview of the Research

This research aimed to provide an initial investigation into the stability of the future self-identification factor structure over the course of a life-stage and explore the potential impact of demographic variables. Specifically, the current research tested the following research questions:

Research Question 1: Did the factor structure of future self-identification change over the course of the first three semesters of college?

Research Question 2: Did the changes in factor structure differ for groups of students (i.e., men and women; first-generation and continuing-generation college students)?

In order to test these research questions, below, I outlined the method for an archival longitudinal study of factorial invariance in future self-identification.

CHAPTER 2

METHOD

Design

The data reported here is from an archival longitudinal study that began in Fall 2016. This study encompassed six waves of data collection over the first three semesters of college education. Figure 1 displays the study timeline.

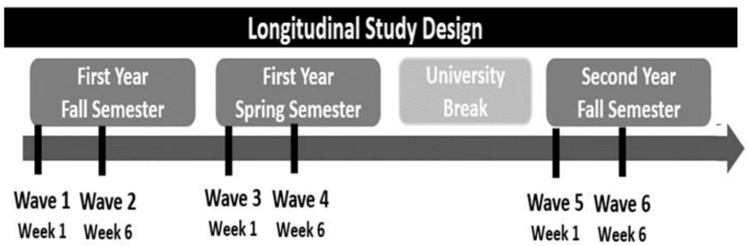

Figure 1. Longitudinal study design for future self-identification measurement invariance testing.

The study design included three features to strategically assess the longitudinal factorial invariance of future self-identification: (1) The first wave of the study took place within the first week of college. The participants completed the assessment during their first experience with college providing a baseline measure of future self-identification at the start of this transitional period. (2) The second wave of survey data was collected within the sixth week of the semester. This represents a crucial period for students at the sample university during which students receive scores from their first college midterms. These scores generally provide the first concrete feedback of college-level academic outcomes. (3) The longitudinal design includes the first three semesters of college education. During this time frame, college students undergo adjustments for as they leave high school, select and potentially change their major, and settle into their college career.

Power Analysis

The sample size for the archival study was determined based on a power analysis for an Institute of Education Sciences grant funded four-year longitudinal study of growth in future self-identification. The power analysis used Monte Carlo simulations of a growth model with six time points. Parameters in the simulation were based on a pilot study and the simulated samples included attrition of up to 40 percent total missing data over the course of the study. The power analysis suggested a sample size of approximately 900 students. The aim of the current study was to test longitudinal measurement invariance. Past research testing the necessary sample size for a well-powered measurement invariance test suggested approximately 200-400 participants per group (Meade, 2005). As such, the archival study was well-powered to test the current study's research questions.

Participants

Participants entered the study during their first-year of college studies at a large, public university. The total sample size was 889 (56% women). Participants were United States citizens, at least 18 years of age (M = 18.14, SD = 0.65), and enrolled in introductory courses for psychology (n = 391; 56% women) and chemistry (n = 498; 56% women). In terms of college-generation status, the sample mirrored the diversity of the U.S. post-secondary population. In the longitudinal sample, 30 percent of participants were first-generation college students. In comparison, 33 percent of all post-secondary students are first-generation (Cataldi, Bennet, & Chen, 2018)[1]. Considering ethnicity, 56

[1] In Cataldi et al., 2018, students were considered continuing-generation if at least one of their parents enrolled in college. In comparison, the current study coded students as continuing-generation only if they had a parent who earned a Bachelor's degree.

percent of the participants were White (non-Hispanic), followed by 23 percent Hispanic, 12 percent Asia/Pacific Islander, 3 percent Black, 1 percent American Indian, and the remaining 5 percent of unknown ethnicity. To ensure an adequate sample size, participants enrolled in the study at Wave 1 (n = 549) and Wave 2 (n = 340).

Measures

Future Self-Identification

To measure future self-identification, I used a 6-item scale developed by Bixter et al. (2020). This scale was designed to assess the three proposed factors of future self-identification: (1) relatedness between the present and future, (2) positivity about the future, and (3) vividness of the future. Using test-retest and cross-validation methods, previous research verified the internal reliability and three-factor structure of this measure (Bixter et al., 2020). Additionally, Bixter et al. (2020) tested the convergent, discriminant, and predictive validity of the construct. This scale includes two-items to represent each of the three factors (i.e., six items total): Relatedness (Similar, Connected), Positivity (Like, Positive), and Vividness (Vivid, Ease). Five of the six items were rated on a 7-point scale. The Positive item was rated on a 1 to 100 sliding scale. Prior to data analyses, I recoded the Positive item scores to create a scale with a maximum score of 7 (i.e., I divided all scores by 14.29). By rescaling the Positive item, all of the measured items had the same range of scores. This strategy facilitates model convergence using maximum likelihood estimation. See Appendix A for the full scale and response options.

College Generation Status

College generation status was assessed through two items: (1) mother's highest level of education and (2) father's highest level of education. For each of these items, participants selected one of the following response options: (a) less than high school, (b) high school diploma or equivalent (GED), (c) some college or a two-year degree (A.A.), (d) four-year college degree (B.A. or B.S. or B.F.A.), (e) master's degree (M.A. or M.S. or M.B.A.), or (f) graduate or professional degree (Ph.D., J.D., M.D.). Following the criteria for coding college generation status in previous future perception research, participants who selected that both their mother's and father's highest education was some college or a two-year degree or lower were coded as first-generation college students (Adelman et al., 2017). Participants who had at least one parent with a four-year degree or above were coded as continuing-generation college students.

Procedure

At the start of the Wave 1 and 2 survey periods (i.e., when enrollment was open to new participants), the course webpages included an invitation to complete the study. This invitation included a link to the Qualtrics survey. In all future waves, participants received an invitation and survey link through their provided e-mail. Participants first completed a consent form and indicated if they were at least 18 years of age. Participants over the age of 18 clicked the "Next" button to confirm their consent for participation. In each survey, participants completed the future self-identification measure. At the close of the surveys for Wave 1 and Wave 2, participants provided their demographic information including their sex, year in school, and mother's and father's education. The surveys took approximately 30 minutes to complete. After completing each survey, participants saw a debrief and were thanked for their ongoing participation in the research. In the Year 1 surveys (Wave 1-4), each participant received $10 for their participation. In the Year 2 surveys (Wave 5-6), each participant received $15.

Overview of Analyses

Attrition Analyses

To understand the overall patterns of participation and attrition, I assessed participant attrition patterns across the longitudinal study. The aim of these analyses was (1) to assess if the overall longitudinal attrition fell within the 40 percent total missing data indicated in the archival study's power analysis and (2) to determine if patterns of participation or missingness were related to the variables under study (i.e., not missing completely at random). To achieve these aims, I first created a variable indicating present or absent at each wave of survey collection. I then created an additional variable coding participants by their pattern of participation. See Appendix B for a frequency table presenting the portion of participants described by each possible pattern of participation. This table provides a summary of attrition in the longitudinal study. Overall, 39 percent of the data were missing. This pattern of attrition indicates that the study was well-powered. Additionally, to assess predictors of attrition, I tested the relationship between a participant's pattern of participation and the relevant study variables (i.e., baseline future self-identification items, sex, and college-generation status). The baseline future self-identification items and college-generation status were not significantly related to pattern of participation, *r*s ranged from -0.02 to 0.08. Sex was a weak predictor of pattern of participation such that female students were more likely to participate in more survey waves overall, *r*(872) = 0.14, $p < .001$. Taken together, these analyses suggest that the patterns of missing data were not dependent on the variables under study.

Invariance Testing

To conduct all invariance analyses, I used M*plus* software (Version 8.4; Muthén & Muthén, 2019) and full information maximum likelihood (FIML) to account for missing data points. The procedures and model specifications for the longitudinal and multiple-group invariance testing are described in the Analytic Approach for each research question in the Results section below.

CHAPTER 3

RESULTS

Appendix C provides the descriptive statistics for each of the six future self-identification items at each study wave for the full sample and by demographic group (i.e., sex and college generation status). For all of the items at every wave, the mean score was above the midpoint on the 7-point scale. Overall, the skew and kurtosis of the item distributions were minimal and within an acceptable range (i.e., absolute value of skew less than 0.5 and kurtosis between -2 and 2; George & Mallery, 2010). However, at each wave, the positive and like items had moderate, negative skew indicating that participants were more likely to rate their future self as more positive and indicate that they like their future self.

Research Question 1. *Did the factor structure of future self-identification change over the course of the first three semesters of college?*

Analytic Approach

Longitudinal Factorial Invariance

The primary aim of this research was to test if the factor structure of future self-identification was invariant from when the students started college (i.e., Wave 1) to when they progressively became established within their college life (i.e., the subsequent waves). As such, I tested factorial invariance for each wave as compared to the baseline (e.g., Wave 1 vs Wave 2, Wave 1 vs Wave 3). Additionally, as an exploratory analysis of factor structure changes over the relatively short term, I tested invariance between each set of consecutive waves (e.g., Wave 1 vs Wave 2, Wave 2 vs Wave 3). The longitudinal factorial invariance tests were conducted using the confirmatory factor analysis, nested model method (Jöreskog, 1971). This method involves specifying and comparing fit indices for multiple models, with increasingly stringent invariance restrictions. For each wave comparison, first, I established a base model for the data. This base model, or configural invariance model (Thurstone, 1947), specified the following across each timepoint: (1) the existence of three factors of future self-identification (relatedness, vividness, and positivity) and (2) the same pattern of factor loadings (see Figure 2 for a sample base model; Millsap & Cham, 2012). To set the scale for the latent variables (i.e., relatedness, positivity, vividness), following convention, I selected a reference variable for each factor and set the factor loading to 1 and the intercept to 0. Using this method to set the scale, the factor loading and intercepts for the reference variables are assumed to be invariant. As such, I selected the reference variables using the minimum modification index approach (see Jung & Yoon, 2017). This approach assists in selecting a truly invariant item as the reference variable. Beyond these specifications, the parameters were free to vary.

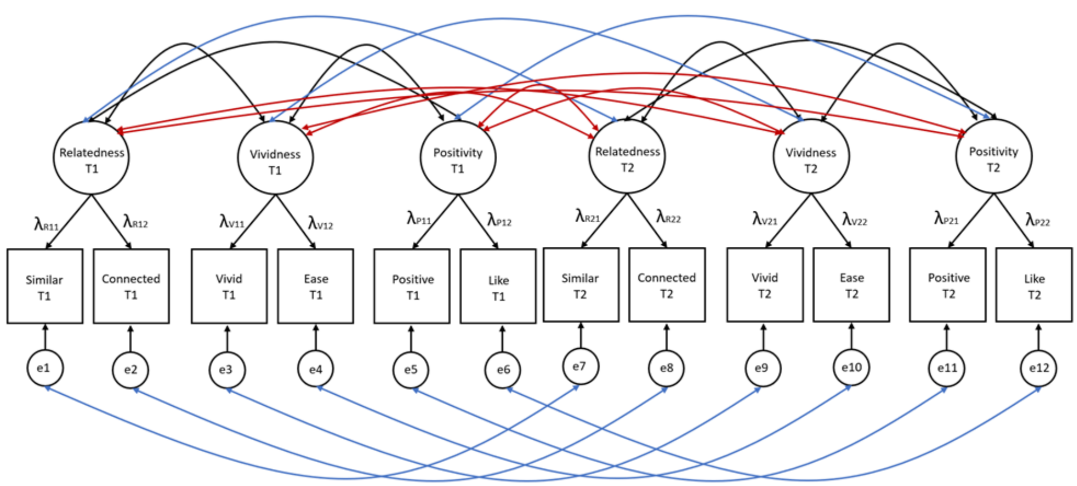

Figure 2. Example base model of future self-identification longitudinal factorial invariance. The base model specified three latent factors, each with two indicators. Each

indicator had a residual variance. Within each timepoint, there was a covariance between each of the three latent factors. Across each timepoint, there were (1) covariances between the residual of each indicator at Wave 1 and the residual of the same indicator at Wave 2, (2) covariances between each factor at Wave 1 and the same factor at Wave 2, and (3) covariances between each factor at Wave 1 and the other two factors at Wave 2.

As all other models included additional constraints, and therefore would not provide a better fit for the data, I assessed the base model for good overall model fit (Millsap & Cham, 2012). Per established convention, I used the following model fit indices and cutoffs to establish good model fit: Comparative Fit Index (CFI) greater than 0.95, Root Mean Square Error of Approximation (RMSEA) less than 0.08 (including .05 in the 90% confidence interval), and the Standardized Root Mean Residual (SRMR) less than 0.08 (Hu & Bentler, 1999; Millsap & Cham, 2012). Additionally, the chi-square estimate should not be significant ($p > .05$). However, as this value is greatly impacted by sample size, I relied on CFI, RMSEA, and SRMR to establish good base model fit.

After establishing a base model, I then proceed to test a series of nested model comparisons with three additional models as outlined in Millsap and Cham (2012). Each model fit was compared to the fit of the prior model (e.g., Model 1 compared to base; Model 2 compared to Model 1). Significant change in model fit was assessed using three measures of change in model fit: (1) a significant change in chi-square ($p < .05$) given the change in degrees of freedom, (2) a change of -0.01 in CFI, and (3) a .015 change in RMSEA (Chen, 2007). If two or more measures supported significant change in model fit, the change was considered evidence for non-invariance. With each new model, if there was no significant change in model fit, there was evidence that invariance held and I then proceeded to the next, more stringent, comparison. Each new set of constraints were imposed in addition to the constraints of the previous models. The three models are described below:

(1) Metric Invariance: Constraining the factor loadings for each item to be equal across timepoints

(2) Strong Invariance: Constraining the intercepts to be equal across timepoints

(3) Strict Invariance: Constraining the measurement residuals to be equal across timepoints

Additionally, as suggested by Widaman and Reise (1997), in order to test for invariance in the covariances between the three factors across time, I included one further model comparison described below.

(4) Invariance of Covariances Between Factors: Constraining the covariances between the factors within each timepoint to be equal across timepoints

Partial Invariance Testing

If a model comparison resulted in a significant change in model fit (i.e., evidence for non-invariance), I then proceeded to test the model for partial invariance. Partial invariance testing attempts to identify which items are non-invariant across time. To test for partial invariance, I used the item-by-item Wald testing approach (see Jung & Yoon, 2017 for the M*plus* syntax). This procedure for partial invariance testing, paired with the minimum modification index procedure for selecting reference variables, minimizes false positive rates in detecting non-invariant items (Jung & Yoon, 2017). This approach conducts multiple tests to assess each of the items for non-invariance. Given the multiple test approach, I used a Bonferroni corrected critical value to assess significance (Jung & Yoon, 2017). For example, the current study includes six items, three of which were selected as reference variables. If I found evidence for non-invariance of the item intercepts, I would conduct three Wald tests (i.e., one per non-reference item) and use a corresponding Bonferroni corrected critical value (p = 0.05/3 = 0.017).

Below, I first report the results for the longitudinal factorial invariance testing, followed by the partial invariance testing results.

Research Question 1 Results

After fitting the base model (i.e., configural model) for each longitudinal comparison, the model fit statistics demonstrated good model fit. The CFI, RMSEA, and SRMR scores were all above the established cutoffs (CFIs ranged from 0.987 to 0.996; RMSEAs ranged from 0.021 to 0.048; SRMRs ranged from 0.020 to 0.027).[2] With configural invariance established, all of the base models were appropriate for additional invariance testing. All base model estimates for the items (i.e., factor loadings, intercepts, residual variances), the factors (i.e., latent means, variances), and the covariances between factors are included in Appendix D. Table 1 displays the results for each longitudinal comparison by level of invariance tested. For each pair of consecutive waves tested, the overall pattern of insignificant changes in model fit supported invariance at each level (i.e., metric, strong, strict, and factor covariances). This result suggests that as students progress through their first semesters of college, future self-identification has the same factor structure over relatively short, consecutive time periods. However, considering the invariance of factor structure from the first week of college (i.e., baseline)

[2] While all base models demonstrated good model fit based on the CFI, RMSEA, and SRMR fit statistics, based on the chi-square fit statistics, all of the base models (i.e., configural invariance models) would have been rejected for poor fit ($p < 0.05$). As noted above, the chi-square statistic is sensitive to sample size, so I relied on the CFI, RMSEA, and SRMR fit statistics for these analyses.

to downstream measurements (Waves 3 to 6), the pattern of results failed to support strong invariance. In other words, the item intercepts were not invariant as students progressed from their first week of college to farther into their college career (i.e., Semesters 2 and 3). As noted in Table 1, the base model comparing Waves 1 and 3 ran with a warning in M*plus* indicating that the model was too complex for the data at those timepoints ("The latent variable covariance matrix (PSI) is not positive definite.").[3] The estimates for that model are included to demonstrate the trend of results but those estimates should be interpreted with caution. Therefore, partial invariance was not tested in that comparison.

Table 1
Longitudinal Factorial Invariance Test Results

Waves Compared		Invariance Test											
		Metric			*Strong*			*Strict*			*Factor Covariances*		
Consecutive Waves	*n*	*Δχ² p*	*ΔCFI*	*ΔRMSEA*	*Δχ² p*	*ΔCFI*	*ΔRMSEA*	*Δχ² p*	*ΔCFI*	*ΔRMSEA*	*Δχ² p*	*ΔCFI*	*ΔRMSEA*
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)	889	0.490	0.000	-0.002	**<0.001**	-0.005	0.007	**< 0.001**	-0.005	0.003	**0.025**	-0.002	0.001
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)	772	0.359	0.000	-0.002	0.064	-0.001	0.001	0.623	0.000	-0.003	**0.002**	-0.003	0.004
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	600	**0.012**	-0.002	0.005	0.296	-0.001	0.001	**< 0.001**	-0.005	0.007	0.212	0.000	-0.001
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)	617	0.716	0.000	-0.002	0.254	0.000	-0.001	**0.059**	-0.002	0.002	0.580	0.000	-0.001
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	559	0.215	0.000	-0.001	0.248	0.000	-0.001	**0.005**	-0.004	0.002	0.615	0.000	-0.002
		Metric			*Strong*			*Strict*			*Factor Covariances*		
Compared to Baseline	*n*	*Δχ² p*	*ΔCFI*	*ΔRMSEA*	*Δχ² p*	*ΔCFI*	*ΔRMSEA*	*Δχ² p*	*ΔCFI*	*ΔRMSEA*	*Δχ² p*	*ΔCFI*	*ΔRMSEA*
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)	889	0.490	0.000	-0.002	**< 0.001**	-0.005	0.007	**< 0.001**	-0.005	0.003	**0.025**	-0.002	0.001
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	698	0.696	-0.004	0.006	**<0.001**	**-0.01**	**0.016**						
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	725	**0.002**	-0.004	0.006	**<0.001**	**-0.014**	**0.016**						
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	715	**< 0.001**	-0.006	0.006	**<0.001**	**-0.011**	0.009						
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	710	**0.005**	-0.004	0.007	**<0.001**	**-0.017**	**0.021**						

Note. Values in bold represent significant differences in model fit. Significance cutoffs: $\Delta\chi^2$ $p \leq 0.05$; ΔCFI ≥ 0.01; ΔRMSEA ≥ 0.015. **The Wave 1 vs Wave 3 base model ran with a warning in M*plus*: "The latent variable covariance matrix (PSI) is not positive definite."

Given the lack of support for strong invariance in the comparison to baseline models, I proceeded to identify the non-invariant item intercepts through tests of partial strong invariance. Table 2 provides the Wald test statistics and significance values. Using the Bonferroni corrected critical value (p = 0.017), the results suggest that the positive item (in Waves 4, 5 and 6) and the connected item (in Wave 6) had non-invariant

[3] Information regarding the source of the M*plus* warning is included in Appendix E.

intercepts over time. The intercept for the positive item was systematically higher at the later waves (i.e., Waves 4, 5, and 6) when compared the intercept at Wave 1. Similarly, at Wave 6, the intercept for the connected item was higher than at Wave 1. These significant differences in the intercepts suggest that, even with the factor mean held constant at zero, the expected score for the non-invariant items (i.e., positive and connected) were higher for students who were established in college than for students beginning their college career. The implications and potential sources of these differences are detailed in the discussion section below. In contrast, the results for the ease item were not significant, suggesting that the item's intercepts were invariant through this transitional period.

Table 2

Partial Strong Invariance Wald Test Results

Waves Compared	Intercept Constrained	Wald Test Value	*df*	*p*	Significant at Bonferroni Corrected *p* = 0.017
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	Connected	4.70	1	0.030	No
	Ease	4.06	1	0.044	No
	Positive	30.33	1	< 0.001	Yes
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	Connected	3.98	1	0.046	No
	Ease	0.20	1	0.655	No
	Positive	26.61	1	<0.001	Yes
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	Connected	11.86	1	<0.001	Yes
	Ease	0.17	1	0.683	No
	Positive	34.48	1	<0.001	Yes

Note. The Bonferroni critical value was corrected to account for three Wald tests per comparison (i.e., one test per item).

Research Question 2: *Did the changes in factor structure differ for groups of students (i.e., men and women; first-generation and continuing-generation college students)?*

Analytic Approach

Multiple-Group Factorial Invariance

In order to test for differences in changes in factor structure between demographic groups (i.e., men and women; first-generation and continuing-generation college students), I used multiple-group factor analyses (Millsap, 2011). For each longitudinal model described above, I specified two base multiple-group models: (1) men and women and (2) first-generation and continuing-generation college students. To set the scale for the latent variables (i.e., relatedness, positivity, vividness), I set the factor loading for the reference variables to 1 and the factor means for both groups at 0 (Muthén & Muthén, 2017, p. 547). The aim of the multiple-group factorial invariance analyses was to test the null hypothesis that an individual's group membership (e.g., first-generation or continuing-generation) did not provide additional information about their changes in future self-identification factor structure over time (Millsap, 2011). To achieve this aim, longitudinal invariance was assumed across the analyses (Kim & Willson, 2014). In other words, for each step of invariance testing (i.e., metric, strong, strict, factor covariances), I first established a model that constrained the parameters to be equal across time. Then, to determine if adding a constraint across the groups led to non-invariance, I added the additional group constraint. Compared to the constrained longitudinal model, if adding the group constraint significantly reduced model fit, there was evidence for group non-invariance. Cutoffs for establishing significant change in the fit indices were the same as described above for the longitudinal analyses. Again, with each new model, if there was no significant change in model fit, there was evidence that invariance held and I then proceeded to the next, more stringent, comparison.

Partial Invariance Testing

If a model comparison resulted in a significant change in model fit (i.e., evidence for group non-invariance), the approach for partial invariance testing for the multiple-group models was identical to that described above for the longitudinal models.

Research Question 2 Results

Multiple-Group Factorial Invariance: Males and Females

The base multiple-group models (i.e., configural model) demonstrated good model fit. The CFI, RMSEA, and SRMR scores were above the established cutoffs (CFIs ranged from 0.982 to 0.994; RMSEAs ranged from 0.027 to 0.058; SRMRs ranged from 0.028 to 0.036). With configural invariance established, the base models were appropriate for further invariance testing. Appendix D includes the multiple-group model estimates. Table 3 includes the results for each longitudinal, multiple-group comparison by level of invariance tested. Complete invariance (i.e., metric, strong, strict, and factor covariances) between the men and women was supported for the vast majority of comparisons. This pattern of results suggests that, in general, the future self-identification factor structure held similarly over time for men and women. However, considering the invariance of factor structure from the first week of college (i.e., baseline) to the beginning of the second year of college (Wave 5), strict invariance was not supported. From the first year of college to the second year, the item residual variances were not invariant between men and women. As noted in Table 3, some base models ran with a warning in M*plus*. The warning suggests that the model was too complex for the data. Those results should be interpreted with caution.[4] In one model with a warning (Wave 1 vs Wave 3), strict invariance did not hold. Due to the M*plus* warning, I did not proceed to test partial strict invariance in that model.

Table 3

Multi-Group: Males and Females Factorial Invariance Test Results

Waves Compared			Invariance Test											
	n		*Metric*			*Strong*			*Strict*			*Factor Covariances*		
Consecutive Waves	*Females*	*Males*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	498	391	0.790	0.000	-0.001	0.063	-0.002	0.000	**0.033**	-0.003	-0.001	0.124	-0.002	-0.001
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	449	323	0.746	0.000	-0.001	**0.034**	-0.002	0.001	0.063	-0.002	0.001	0.096	-0.002	-0.001
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	358	242	0.674	0.000	-0.001	0.091	-0.002	0.000	0.224	-0.002	-0.003	0.124	-0.001	-0.002
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	369	248	0.357	0.000	-0.001	**0.004**	-0.005	0.004	**<0.001**	-0.007	0.005	**0.017**	-0.004	0.003
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	339	220	0.443	0.000	-0.001	**0.007**	-0.004	0.002	**0.002**	-0.006	0.001	**0.016**	-0.003	0.000
	n		*Metric*			*Strong*			*Strict*			*Factor Covariances*		
Compared to Baseline	*Females*	*Males*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)	498	391	0.790	0.000	-0.001	0.063	-0.002	0.000	**0.033**	-0.003	-0.001	0.124	-0.002	-0.001
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	403	295	**0.005**	-0.003	0.005	**0.001**	-0.007	0.004	**<0.001**	**-0.011**	0.005	**0.006**	-0.006	0.002
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	417	308	0.311	0.000	0.000	0.179	-0.001	-0.001	**0.039**	-0.004	-0.003	0.331	-0.001	-0.003
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	415	300	**0.014**	-0.003	0.003	**0.005**	-0.006	0.000	**<0.001**	**-0.011**	0.001	**0.007**	-0.006	0.000
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	409	301	0.146	-0.001	0.001	**0.035**	-0.003	-0.001	**0.001**	-0.008	-0.001	**0.032**	-0.004	-0.001

Note. Values in bold represent significant differences in model fit. Significance cutoffs: $\Delta\chi^2$ *p* ≤ 0.05; ΔCFI ≥ 0.01; ΔRMSEA ≥ 0.015. Base models marked with ** ran with a warning in M*plus* ("The latent variable covariance matrix (PSI) is not positive definite.").

As strict invariance did not hold for men and women from the start of college (Wave 1) to the second year (Wave 5), I proceeded to test which item residual variances were non-invariant. Table 4 provides the Wald test statistics and significance values.

[4] Appendix E includes further information regarding the source of the warnings.

Table 4

Partial Strict Invariance Between Men and Women Wald Test Results

Waves Compared	Residual Variance Constrained	Wald Test Value	*df*	*p*	Significant at Bonferroni Corrected p = 0.008
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	Connected	0.10	1	0.749	No
	Similar	1.44	1	0.230	No
	Ease	16.26	1	<0.001	Yes
	Vivid	10.38	1	0.001	Yes
	Positive	0.59	1	0.444	No
	Like	0.01	1	0.928	No

Note. The Bonferroni critical value was corrected to account for six Wald tests per comparison (i.e., one test per item).

For this set of partial invariance tests, all of the item residual variances (i.e., six total) were estimated and available to test for invariance. Using the Bonferroni corrected critical value (p = 0.05/6 = 0.008), the results suggested that the residual variances for both of the vividness factor indicators (i.e., the ease and vivid items) were non-invariant across men and women. As such, I examined the base model estimates for the item residual variances to understand the nature of the significant difference. Compared to females at the start of college (i.e., Wave 1), for male students, the ease item had less residual variance and the vivid item had more residual variance (Ease Wave 1 Residual Variance: Females = 0.451; Males = 0.139; Vivid Wave 1 Residual Variance: Females = 0.377; Males = 0.855). By the second year of college (Wave 5), the residual variances for the two vividness items stabilized across the sexes (Ease Wave 5 Residual Variance: Females = 0.326; Males = 0.381; Vivid Wave 5 Residual Variance: Females = 0.313; Males = 0.428). Taken together, these results suggest that during the first stage of the transition into college life, compared to females, the ease item (i.e., endorsing that the future self can be imagined with ease) measured male students' vivid and clear view of their future self with less unexplained variance. Contrastingly, for females, the vivid item (i.e., endorsing that the future self can be imaged vividly) measured with less unexplained variance. After becoming established as college students, the group differences diminished, suggesting that the two vividness items functioned similarly across the sexes. These implications for these results are detailed in the discussion section below.

Multiple-Group Factorial Invariance: First-Generation and Continuing-Generation Students

Testing invariance across college generation status, again, the base multiple-group models (i.e., configural models) demonstrated good model fit allowing for continued invariance testing (CFIs ranged from 0.986 to 0.999; RMSEAs ranged from 0.008 to 0.039; SRMRs ranged from 0.025 to 0.037). Table 5 includes the model fit comparison results for first-generation and continuing-generation college students. At each longitudinal comparison, the models demonstrated complete factorial invariance across college generation status.[5] The item factor loadings, intercepts, residual variances, and factor covariances were invariant across first-generation and continuing-generation college students. Importantly, this finding held for all of the longitudinal comparisons, suggesting invariance across the transition from starting college to becoming an established college student. On the whole, these results suggest that the future self-identification measure functions similarly for students regardless of college generation.

[5] As indicated in Table 5, some base models ran with a warning in M*plus*. The warning suggests that the models were too complex for the data. The model estimates are reported here but should be interpreted with caution. See Appendix E for additional information regarding the source of the warning in those models.

Table 5

Multi-Group: First-Generation and Continuing-Generation Factorial Invariance Results

Waves Compared			Invariance Test											
	n		*Metric*			*Strong*			*Strict*			*Factor Covariances*		
Consecutive Waves	*First Gen*	*Cont. Gen*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	273	605	0.675	0.000	-0.001	0.326	-0.001	-0.002	0.198	-0.001	-0.002	0.591	0.000	-0.003
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	237	524	0.137	-0.001	0.001	0.223	-0.001	0.000	0.088	-0.002	0.001	0.172	-0.001	0.000
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	185	407	0.903	0.001	-0.003	0.786	0.001	-0.004	0.510	0.000	-0.003	0.800	0.001	-0.004
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	186	422	0.846	0.000	-0.002	0.721	0.000	-0.003	0.381	0.000	-0.002	0.362	-0.001	-0.001
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)**	168	383	0.765	0.001	-0.002	0.855	0.001	-0.005	0.802	0.002	-0.005	0.778	0.001	-0.004
	n		*Metric*			*Strong*			*Strict*			*Factor Covariances*		
Compared to Baseline	*First Gen*	*Cont. Gen*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*	$\Delta\chi^2$ *p*	*ΔCFI*	*ΔRMSEA*
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)	273	605	0.675	0.000	-0.001	0.326	-0.001	-0.002	0.198	-0.001	-0.002	0.591	0.000	-0.003
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	213	475	0.460	0.000	-0.001	0.238	-0.001	-0.001	0.167	-0.002	-0.001	0.346	-0.001	-0.002
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	223	492	0.510	0.000	-0.001	0.702	0.001	-0.004	0.293	-0.001	-0.005	0 .591	0.001	-0.005
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	219	485	0.496	0.000	-0.001	0.355	-0.001	-0.002	0.114	-0.003	-0.003	0.443	0.000	-0.004
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	218	481	0.888	0.001	-0.003	0.353	0.000	-0.002	0.473	0.000	-0.006	0.500	0.001	-0.004

Note. Values in bold represent significant differences in model fit. Significance cutoffs: $\Delta\chi^2$ $p \leq 0.05$; ΔCFI ≥ 0.01; ΔRMSEA ≥ 0.015. Base models that ran with a warning in M*plus* ("The latent variable covariance matrix (PSI) is not positive definite.") are indicated by **.

CHAPTER 4

DISCUSSION

The growing literature on perception of the future self (i.e., future self-identification) suggests that it is an important indicator of outcomes across time and during diverse life-stages. Recent research on the factor structure of future self-identification established that it is comprised of three related but distinct factors (i.e., relatedness, vividness, and positivity), and that the factor structure was stable over a short period of time (e.g., five weeks; Bixter et al., 2020). However, the current research was the first to use an extended longitudinal study design to investigate the stability of the factor structure over the course of a major life-stage (i.e., entering, and becoming established in, college education).

Results of the longitudinal factorial invariance testing provided important information about the stability of future self-identification's factor structure over the short-term and over the course of the transition into college. First, the invariance results for the consecutive waves of data collection (e.g., Wave 1 vs Wave 2; Wave 2 vs Wave 3) supported complete factorial invariance (i.e., metric, strong, strict, and factor covariances). This finding held for each set of consecutive waves suggesting short-term invariance in factor structure even over the course of a life-stage transition. These results verified and extended past findings that the factor structure of future self-identification is stable over relatively short periods (Bixter et al., 2020).

However, when considering the invariance of factor structure from the beginning of the life-stage (i.e., the first week of college) to downstream measures (i.e., when students were established in college), the results consistently did not support strong invariance. This failure of strong invariance suggested that as students progress from entering college to becoming established in their college career, the item intercepts were significantly different across time. In determining the source of the non-invariance, partial invariance testing suggested that the intercepts for the positive (in Wave 4, 5, and 6) and the connected item (in Wave 6) were non-invariant over time. Specifically, compared to the first week of college, the positive item intercept was higher as students moved through college (i.e., in their second and third semesters). Similarly, compared to the baseline measure (i.e., the first week of college), the intercept for the connected item was significantly higher by the middle of the third semester. In contrast, strong invariance consistently held for the ease item suggesting that the intercepts for the ease item were invariant across the transition into college.

After establishing the significant differences in the positive and connected item intercepts across time, it is important to understand both the conceptual and potential practical implications of these results. In concrete terms, the intercept of the item represents the expected value for the item score (e.g., the connected item) when the latent factor mean (i.e., relatedness) is zero. Establishing strong invariance suggests that the center of the latent variable has the same scale across time which allows for factor mean comparisons (Millsap, 1998). As strong invariance did not hold for future self-identification from the start of college to later in the college career, factor mean comparisons across these time periods may not be valid.

Further probing this finding, the results of the partial strong invariance testing suggested that the intercepts for the positive and connected item were higher in the later waves compared to the first wave. In other words, even with the factor mean held constant at zero, the expected score for the non-invariant items were higher for students who were established in college than for students who were just beginning their college career. Compared to students at the start of college, students who were further along in their college career had a higher score on the non-invariant items (e.g., positive, connected) even if they had the same level of positivity or relatedness.

The significant differences in item intercepts may be the result of various factors. For instance, the intercept differences may be due to measurement issues (e.g., students at the start of college may have a different response style to the positive and connected items than they do later in their college career). However, it is also possible that these differences may have theoretical significance. For example, because the current study used two items (e.g., positive, like) to indicate each latent variable (e.g., positivity), the non-invariant intercept results may suggest a difference in how the two items relate to each other at different stages in the transition into college. Specifically, in comparison to established students, for students entering college, feeling positively toward their future self may be more closely related to how much they like their future. In addition, for students starting their transition into college, feeling connect to their future self may be more closely related to how similar they feel to their future self than it is later in their college career. Future research should take additional steps to investigate the source of strong non-invariance from the start of college to becoming established in the college career. Results of that future research may assist researchers who aim to manipulate positivity and relatedness of the future self by providing those researchers with a greater understanding of the relationships between the aspects of positivity and relatedness at a given point in a life-stage.

Additionally, although strong invariance did not hold, future research should explore the practical significance of these intercept differences. For example, future research could use sensitivity analyses to address if the intercept differences lead to erroneous conclusions when conducting latent factor mean comparisons. Findings from this type of analysis would be beneficial to researchers in decisions about the validity of using the future self-identification measure to compare means across time. The results of the current research suggest that this may be especially important for researchers assessing future self-identification during a transitional life-stage.

Beyond testing longitudinal factorial invariance, this research was also the first to explore differences in the stability of future self-identification's factor structure by demographic groups. As detailed in the introduction, this research focused on two demographic groups—sex and college generation status—that past research suggested may differ in future self-identification factor structure across time. For men and women, the vast majority of the models supported complete factorial invariance. However, in one case — the comparison from the first week of college to the beginning of the second year of college— strict invariance, or invariance of item variances, was not supported. Probing this finding with partial strict invariance testing suggested that the residual variances for both of the vividness factor indicators (i.e., the ease and vivid items) were non-invariant across men and women. An item's residual variance is the variance that is unexplained by the latent factor. As such, the strict non-invariance findings suggest that, compared to female students at the start of college, the ease item (i.e., the future self can be imagined with ease) measured male students' vividness of their future self with less unexplained variance. Contrastingly, for female students, the vivid item (i.e., the future self can be imaged vividly) measured with less unexplained variance. After becoming established as college students, the differences in the residual variances diminished, suggesting that there were not sex differences in how the items functioned when students were established in college.

As with the strong non-invariance findings detailed above, the differences between the sexes in the vividness items' residual variances may be explained by multiple factors. Again, the differences may be a result of measurement issues. For example, at the start of college, male students may have responded in a more random fashion to the ease item and female students may have responded more randomly to the vivid item. However, these differences may also be the result of psychological differences between the sexes. Specifically, at the start of college there may be sex differences in how indicative the ease of imagining (i.e., the ease item) and clarity and concreteness of the image (i.e., the vivid item) are of the overall vividness of the future self. For example, compared to female students, for male students entering college, the variance in how they rated their ease of imagining was well-explained by their overall vividness of the future self. Variance in ease of imagining the future self may be more indicative of vividness of the future in males than in females. In contrast, in comparison to males, for female students, the vividness factor better accounted for the variance in the clarity of the image of their future. Variance in clarity of future self images may be more indicative of overall future vividness for females than males.

Importantly, vividness of the future self is a growing area of research where researchers are interested in manipulating vividness to lead to positive outcomes. The finding of the present research may suggest that, at the beginning stages of college, men may benefit more from interventions to guide them to more vividly imagine their future while women may benefit from a focus on connecting ease of imagining to perceptions of future vividness. Again, to provide a clear understanding of potential sex differences in measuring vividness of the future, future research should investigate the source of the sex differences reported here.

Finally, contrary to the hypothesis that the stability of the future self-identification factor structure would vary by college generation status, complete invariance held for all of the college generation status models. These results suggested that the future self-identification factor structure (i.e., the item factor loadings, intercepts, residual variances, and factor covariances) held similarly over time for continuing-generation and first-generation college students. This was true for both the short-term, consecutive wave comparisons and the comparisons from baseline, suggesting similar factor structure through the course of a major transition into a new life-stage. This level of invariance supports testing factor mean comparisons across college generation status and provides researchers with a level of assurance that significant differences in group means are not the results of inconsistencies in how future self-identification measure functions for students of different college generation statuses (Millsap, 2011).

Limitations and Future Directions

The research reported here was the first to test the longitudinal factorial invariance of future self-identification over the course of a transition into a new life-stage. This study focused on the transition into college as that life-stage (i.e., emerging adulthood) is characterized by exploration and identity formation. While the results suggest that the factor structure of future self-identification undergoes change as individual's move through a life-stage transition, this result may be specific to students entering college. Future research should test longitudinal factorial invariance over the course of other life-stages that are important to future perception research (e.g., adolescence; retirement).

As the aim of this study was to test factorial invariance over time, the archival data used for this study were longitudinal. As such, data were missing over the course of the study. Although the current research used best practices to account for missing data (i.e., full information maximum likelihood), for each wave-by-wave comparison, the sample sizes varied (*n*s ranged from 559 to 889). When comparing results from models of different wave comparisons (e.g., Wave 1 vs Wave 2 and Wave 1 vs Wave 6), it should be noted that the samples for each model were not identical. Although the attrition patterns were not significantly related to the variables of interest, it is still possible that students who remained in the study (i.e., were present in the models including the later waves) differed in some meaningful and unidentified way from the students who were only present in the early waves. The consistent pattern of results in this study (i.e., finding strong non-invariance across the baseline to downstream wave comparisons) provides confidence that the findings of the present research are not simply the result of differences in the sample. However, future research testing longitudinal factorial invariance in future self-identification should consider strategies to further limit study attrition over time and/or collect a larger sample in order to include all waves of data in one model to test factorial invariance.

Additionally, the current research used the validated future self-identification scale which includes two items as indicators of each of the three factors. Two indicators are sufficient for model identification when the factors are moderately-to-strongly correlated, as they were in this study (Bollen, 1989). However, three or more indicators per factor is the gold standard for confirmatory factor analyses. Future research should consider developing and validating additional indicators for inclusion in the future self-identification scale in an effort to avoid issues with model identification.

Finally, this study was the first to explore differences in the factor stability of future self-identification by demographic groups. Based on the results of past research, this research focused on two demographic groups (i.e., sex and college generation status). Overall, the results of this study suggested that there were minimal differences in how the factor structure of future self-identification changed over time across these groups. These results suggest that latent mean comparisons across the demographic groups are valid. However, the criteria used to code the college generation status variable may have contributed to the invariance findings in that group comparison. Specifically, the current research followed the example of past research on future perception and college generation status and coded students with at least one parent who earned a bachelor's degree or higher as continuing-generation status (Adelman et al., 2017). All other students were coded as first-generation. This strict criterion for continuing-generation status (i.e., having a parent with a bachelor degree) may have reduced the effect size leading to the findings of factorial invariance. Extensions of the present research should explore if including students who have a parent who completed at least some college (e.g., attended a four-year university but did not graduate; graduated with a two-year degree) as continuing-generation alters the invariance findings. Additionally, the current research cannot comment on how the factor structure of future self-identification may differ across other potentially important demographic groups. Future research may benefit from a focus on factorial invariance across other demographic factors such as race/ethnicity, socioeconomic status, or immigration status.

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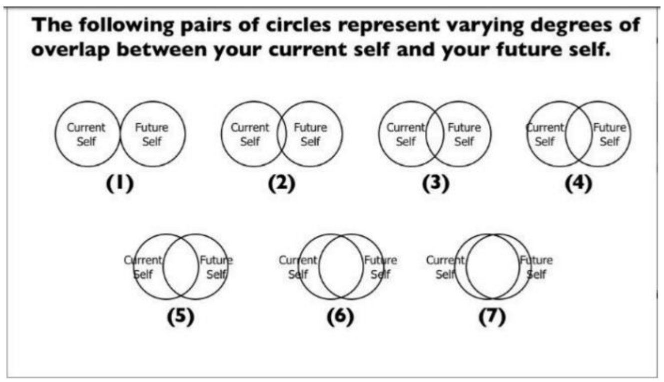
APPENDIX A

FUTURE SELF-IDENTIFICATION MEASURE (BIXTER ET AL., 2020)

Prompt: "The questions in the following sections pertain to who you will be in the future. In each section, you will be prompted to think about yourself five years after you graduate from college (if you're a first-year student, that's nine or ten years from now). Please keep that future self in mind as you answer the questions."

Relatedness (2-Items):



1. Similar: Please select which pair of circles best describes how similar you feel to your future self five years after graduating from college.

Response Scale: (1) Not at all similar to my future self; (7) Very similar to my future self

2. Connect: Please select which pair of circles best describes how connected you feel to your future self five years after graduating from college.

Response Scale: (1) Not at all connected to my future self; (7) Very connected to my future self

Positivity (2-Items):

1. Like: How much do you like your future self five years after graduating from college?

Response Scale: (1) Don't like at all; (7) Like as much as possible

2. Positive: When I think about the future, my future self feels…

Response Scale: Slider from 1-100 (Very Negative to Very Positive)

Vividness (2-Items):

1. Vivid: When you imagine your future self, how vividly do you picture it?

Response Scale: (1) Not at all vividly; I do not have a clear image in my head of my future self; (7) Very vividly; I have a very clear image in my head of my future self

2. Ease: How easy is it for you to visualize a mental picture of your future self?

Response Scale: (1) Very difficult; (7) Very easy

APPENDIX B

PATTERNS OF PARTICIPATION IN THE LONGITUDINAL STUDY

Patterns of Participation

	Frequency	Percent	Cumulative Percent
W1W2W3W4W5W6	188	21.15	21.15
W1W2W3W4W5	17	1.91	23.06
W1W2W3W4W6	15	1.69	24.75
W1W2W3W5W6	8	0.90	25.65
W1W2W4W5W6	20	2.25	27.90
W1W3W4W5W6	22	2.47	30.37
W2W3W4W5W6	94	10.57	40.94
W1W2W3W4	21	2.36	43.31
W1W2W3W5	6	0.67	43.98
W1W2W3W6	6	0.67	44.66
W1W2W4W5	4	0.45	45.11
W1W2W4W6	4	0.45	45.56
W1W2W5W6	12	1.35	46.91
W1W3W4W5	8	0.90	47.81
W1W3W4W6	2	0.22	48.03
W1W3W5W6	3	0.34	48.37
W1W4W5W6	13	1.46	49.83
W2W3W4W5	12	1.35	51.18
W2W3W4W6	5	0.56	51.74
W2W3W5W6	5	0.56	52.31
W2W4W5W6	15	1.69	53.99
W1W2W3	12	1.35	55.34
W1W2W4	13	1.46	56.81
W1W2W5	3	0.34	57.14
W1W2W6	4	0.45	57.59
W1W3W4	10	1.12	58.72
W1W3W5	3	0.34	59.06
W1W3W6	1	0.11	59.17
W1W4W5	1	0.11	59.28
W1W4W6	3	0.34	59.62
W1W5W6	11	1.24	60.85
W2W3W4	18	2.02	62.88
W2W3W5	3	0.34	63.22
W2W3W6	6	0.67	63.89
W2W4W5	8	0.90	64.79
W2W4W6	6	0.67	65.47
W2W5W6	19	2.14	67.60
W1W2	37	4.16	71.77
W1W3	14	1.57	73.34

W1W4	10	1.12	74.47
W1W5	8	0.90	75.37
W1W6	3	0.34	75.70
W2W3	6	0.67	76.38
W2W4	18	2.02	78.40
W2W5	12	1.35	79.75
W2W6	12	1.35	81.10
W1	67	7.54	88.64
W2	101	11.36	100.00
Total	889		

Note. W = Wave

APPENDIX C

DESCRIPTIVE STATISTICS

Descriptive Statistics

Item	Wave	*M*	*SD*	*n*	*S*	*K*	Item	Wave	*M*	*SD*	*n*	*S*	*K*
Connected	1	4.22	1.57	549	-0.08	-0.64	Ease	1	4.71	1.53	549	-0.40	-0.70
	2	4.34	1.47	709	-0.25	-0.15		2	4.67	1.58	709	-0.44	-0.57
	3	4.28	1.49	485	-0.15	-0.59		3	4.57	1.54	485	-0.43	-0.60
	4	4.42	1.32	527	-0.22	-0.26		4	4.53	1.47	527	-0.34	-0.55
	5	4.48	1.41	491	-0.21	-0.43		5	4.67	1.46	489	-0.38	-0.69
	6	4.51	1.30	474	-0.23	-0.41		6	4.80	1.39	474	-0.58	-0.20
Similar	1	4.09	1.27	549	-0.14	-0.24	Like	1	5.89	1.05	549	-0.92	0.53
	2	4.27	1.29	709	-0.18	-0.46		2	5.72	1.18	709	-0.88	0.59
	3	4.32	1.25	485	-0.19	-0.10		3	5.69	1.12	485	-0.80	0.52
	4	4.37	1.19	527	-0.13	0.14		4	5.53	1.23	527	-0.71	0.08
	5	4.40	1.25	491	-0.27	-0.01		5	5.65	1.14	491	-0.87	0.90
	6	4.53	1.17	474	-0.22	-0.09		6	5.62	1.05	474	-0.66	0.23
Vivid	1	4.61	1.59	549	-0.33	-0.58	Positive	1	5.52	1.10	548	-0.90	1.25
	2	4.68	1.60	709	-0.39	-0.50		2	5.51	1.15	709	-0.94	1.41
	3	4.52	1.54	485	-0.37	-0.41		3	5.60	1.11	485	-1.10	1.97
	4	4.54	1.46	527	-0.33	-0.30		4	5.52	1.13	527	-0.77	0.22
	5	4.59	1.48	489	-0.34	-0.52		5	5.61	1.10	489	-1.00	1.51
	6	4.72	1.36	474	-0.48	0.11		6	5.62	1.08	474	-1.05	1.29

Note. Connected and Similar are indicators of the Relatedness factor. Vivid and Ease are indicators of the Vividness factor. Like and Positive are indicators of the Positivity factor. S = Skewness; K = Kurtosis

Descriptive Statistics by Sex and College Generation Status

		Male			Female			First Gen			Cont. Gen		
Item	Wave	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
Connected	1	4.39	1.46	242	4.08	1.63	307	4.15	1.61	166	4.26	1.52	375
	2	4.39	1.43	297	4.31	1.51	412	4.32	1.48	215	4.37	1.46	483
	3	4.32	1.51	184	4.26	1.48	301	4.41	1.36	153	4.22	1.53	324
	4	4.49	1.32	207	4.37	1.32	320	4.40	1.35	162	4.43	1.29	359
	5	4.68	1.40	187	4.36	1.40	304	4.33	1.40	144	4.54	1.40	339
	6	4.53	1.28	182	4.49	1.32	292	4.57	1.30	145	4.50	1.30	321
Similar	1	4.17	1.28	242	4.03	1.26	307	3.97	1.34	166	4.15	1.21	375
	2	4.36	1.29	297	4.20	1.28	412	4.28	1.35	215	4.28	1.24	483
	3	4.42	1.27	184	4.26	1.23	301	4.27	1.20	153	4.35	1.24	324
	4	4.44	1.23	207	4.33	1.16	320	4.36	1.18	162	4.38	1.19	359
	5	4.57	1.24	187	4.30	1.25	304	4.38	1.26	144	4.43	1.23	339
	6	4.61	1.14	182	4.47	1.19	292	4.56	1.21	145	4.52	1.15	321
Vivid	1	4.60	1.55	242	4.62	1.61	307	4.69	1.47	166	4.58	1.61	375
	2	4.60	1.62	297	4.73	1.59	412	4.73	1.52	215	4.64	1.62	483
	3	4.42	1.60	184	4.57	1.50	301	4.55	1.45	153	4.52	1.58	324
	4	4.50	1.50	207	4.57	1.44	320	4.51	1.48	162	4.56	1.45	359
	5	4.57	1.46	187	4.60	1.50	302	4.56	1.42	144	4.61	1.51	337
	6	4.66	1.30	182	4.75	1.39	292	4.81	1.32	145	4.68	1.37	321
Ease	1	4.75	1.58	242	4.68	1.50	307	4.70	1.43	166	4.72	1.56	375
	2	4.67	1.58	297	4.67	1.59	412	4.70	1.48	215	4.65	1.62	483
	3	4.48	1.61	184	4.62	1.50	301	4.62	1.48	153	4.56	1.56	324
	4	4.43	1.51	207	4.60	1.44	320	4.49	1.51	162	4.55	1.44	359
	5	4.55	1.53	187	4.75	1.41	302	4.63	1.36	144	4.71	1.48	337
	6	4.68	1.32	182	4.88	1.43	292	4.85	1.37	145	4.80	1.40	321
Like	1	5.88	1.06	242	5.91	1.04	307	5.85	1.10	166	5.91	1.02	375
	2	5.69	1.23	297	5.74	1.14	412	5.69	1.21	215	5.73	1.16	483
	3	5.64	1.20	184	5.72	1.07	301	5.69	1.05	153	5.69	1.16	324
	4	5.52	1.26	207	5.54	1.22	320	5.51	1.33	162	5.55	1.19	359
	5	5.76	1.12	187	5.58	1.16	304	5.52	1.24	144	5.70	1.10	339
	6	5.54	1.05	182	5.68	1.05	292	5.65	1.04	145	5.61	1.07	321
Positive	1	5.61	1.05	241	5.45	1.13	307	5.46	0.94	166	5.54	1.12	374
	2	5.56	1.19	297	5.47	1.12	412	5.43	1.21	215	5.55	1.10	483
	3	5.70	1.12	184	5.54	1.09	301	5.49	1.15	153	5.65	1.09	324
	4	5.60	1.13	207	5.47	1.12	320	5.40	1.22	162	5.58	1.07	359
	5	5.69	1.11	187	5.55	1.09	302	5.50	1.22	144	5.67	1.03	337
	6	5.72	1.02	182	5.56	1.12	292	5.56	1.15	145	5.65	1.05	321

Note. Cont. = Continuing-generation

APPENDIX D

MODEL ESTIMATES

Item Estimates for Base Longitudinal Models

Waves Compared	Item	Wave	Loading	Intercept	R Variance
Consecutive Waves					
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)	Connected	1	2.48	-5.91	0.44
		2	2.00	-4.18	0.34
	Similar*	1	1.00	0.00	1.30
		2	1.00	0.00	1.18
	Vivid*	1	1.00	0.00	0.58
		2	1.00	0.00	0.40
	Ease	1	1.01	0.08	0.37
		2	1.00	-0.01	0.35
	Positive	1	1.14	-1.21	0.56
		2	1.24	-1.56	0.43
	Like*	1	1.00	0.00	0.62
		2	1.00	0.00	0.81
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)	Connected	2	2.03	-4.34	0.30
		3	1.89	-3.88	0.39
	Similar*	2	1.00	0.00	1.19
		3	1.00	0.00	1.04
	Vivid*	2	1.00	0.00	0.30
		3	1.00	0.00	0.38
	Ease	2	0.95	0.20	0.44
		3	1.01	0.03	0.36
	Positive	2	1.20	-1.38	0.47
		3	1.07	-0.51	0.55
	Like*	2	1.00	0.00	0.79
		3	1.00	0.00	0.66
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	Connected	3	1.90	-3.89	0.36
		4	1.40	-1.70	0.35
	Similar*	3	1.00	0.00	1.06
		4	1.00	0.00	0.69
	Vivid*	3	1.00	0.00	0.34
		4	1.00	0.00	0.38
	Ease	3	0.99	0.11	0.40
		4	0.99	0.03	0.44
	Positive	3	1.08	-0.55	0.55
		4	0.95	0.27	0.52
	Like*	3	1.00	0.00	0.68
		4	1.00	0.00	0.68
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)	Connected	4	1.42	-1.77	0.32
		5	1.34	-1.42	0.55
	Similar*	4	1.00	0.00	0.70
		5	1.00	0.00	0.78
	Vivid*	4	1.00	0.00	0.38
		5	1.00	0.00	0.28
	Ease	4	0.99	0.04	0.44
		5	0.94	0.37	0.43
	Positive	4	0.95	0.28	0.52
		5	0.93	0.37	0.54
	Like*	4	1.00	0.00	0.69
		5	1.00	0.00	0.54
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	Connected	5	1.43	-1.82	0.47
		6	1.35	-1.60	0.31
	Similar*	5	1.00	0.00	0.82
		6	1.00	0.00	0.61
	Vivid*	5	1.00	0.00	0.22
		6	1.00	0.00	0.28
	Ease	5	0.91	0.52	0.48
		6	1.00	0.08	0.39
	Positive	5	0.96	0.16	0.51
		6	0.97	0.16	0.53
	Like*	5	1.00	0.00	0.56
		6	1.00	0.00	0.43
Compared to Baseline					
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	Connected	1	2.40	-5.61	0.48
		3	2.04	-4.50	0.29

	Similar*	1	1.00	0.00	1.28
		3	1.00	0.00	1.09
	Vivid*	1	1.00	0.00	0.66
		3	1.00	0.00	0.38
	Ease	1	1.05	-0.12	0.29
		3	1.01	0.02	0.36
	Positive	1	1.13	-1.12	0.58
		3	1.08	-0.54	0.54
	Like*	1	1.00	0.00	0.61
		3	1.00	0.00	0.67
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	Connected	1	2.53	-6.13	0.42
		4	1.39	-1.64	0.35
	Similar*	1	1.00	0.00	1.29
		4	1.00	0.00	0.68
	Vivid*	1	1.00	0.00	0.64
		4	1.00	0.00	0.46
	Ease	1	1.04	-0.10	0.30
		4	1.04	-0.17	0.36
	Positive	1	1.10	-0.97	0.59
		4	0.99	0.06	0.48
	Like*	1	1.00	0.00	0.60
		4	1.00	0.00	0.72
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	Connected	1	2.60	-6.42	0.39
		5	1.42	-1.80	0.48
	Similar*	1	1.00	0.00	1.30
		5	1.00	0.00	0.82
	Vivid*	1	1.00	0.00	0.54
		5	1.00	0.00	0.35
	Ease	1	0.99	0.16	0.41
		5	0.98	0.20	0.37
	Positive	1	1.26	-1.89	0.51
		5	0.91	0.45	0.56
	Like*	1	1.00	0.00	0.66
		5	1.00	0.00	0.52
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	Connected	1	2.43	-5.71	0.49
		6	1.36	-1.66	0.31
	Similar*	1	1.00	0.00	1.28
		6	1.00	0.00	0.62
	Vivid*	1	1.00	0.00	0.58
		6	1.00	0.00	0.33
	Ease	1	1.01	0.07	0.37
		6	1.04	-0.10	0.34
	Positive	1	1.12	-1.11	0.58
		6	1.04	-0.24	0.48
	Like*	1	1.00	0.00	0.61
		6	1.00	0.00	0.47

Note. Items with a * are reference items. Their factor loadings were set to 1 and their intercepts were set to 0. ** indicates that the model ran with a warning in M*plus*. R Variance = Residual Variance.

Factor Estimates for Base Longitudinal Models

Waves Compared	Factor	Wave	Mean	Variance
Consecutive Waves				
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)	Relatedness	1	4.10	0.33
		2	4.27	0.45
	Vividness	1	4.61	2.04
		2	4.66	2.11
	Positivity	1	5.90	0.50
		2	5.71	0.57
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)	Relatedness	2	4.27	0.45
		3	4.33	0.50
	Vividness	2	4.66	2.30
		3	4.54	1.97
	Positivity	2	5.71	0.62
		3	5.71	0.59
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	Relatedness	3	4.29	0.52
		4	4.38	0.72
	Vividness	3	4.51	2.02
		4	4.55	1.76
	Positivity	3	5.69	0.58
		4	5.54	0.86
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)	Relatedness	4	4.37	0.71
		5	4.41	0.81
	Vividness	4	4.55	1.75
		5	4.63	1.93
	Positivity	4	5.54	0.85
		5	5.66	0.78
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	Relatedness	5	4.42	0.73
		6	4.53	0.76
	Vividness	5	4.63	1.95
		6	4.71	1.55
	Positivity	5	5.65	0.74
		6	5.63	0.70
Compared to Baseline				
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	Relatedness	1	4.10	0.34
		3	4.32	0.45
	Vividness	1	4.64	1.88
		3	4.53	1.95
	Positivity	1	5.89	0.48
		3	5.71	0.56
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	Relatedness	1	4.09	0.31
		4	4.38	0.71
	Vividness	1	4.63	1.87
		4	4.56	1.65
	Positivity	1	5.91	0.49
		4	5.56	0.78
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	Relatedness	1	4.10	0.30
		5	4.41	0.73
	Vividness	1	4.61	1.96
		5	4.63	1.82
	Positivity	1	5.89	0.43
		5	5.67	0.78
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	Relatedness	1	4.09	0.33
		6	4.53	0.75
	Vividness	1	4.63	1.92
		6	4.73	1.49
	Positivity	1	5.90	0.49
		6	5.63	0.64

Note. Mean = Latent Mean of the factor. ** indicates that the model ran with a warning in M*plus*.

Estimates for Covariances between Factors at the Same Wave from Longitudinal Base Models

Waves Compared	Wave	Covariances Between Factors		
		Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity
Consecutive Waves				
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)	1	0.17	0.33	0.63
	2	0.27	0.49	0.76
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)	2	0.30	0.51	0.84
	3	0.30	0.59	0.69
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	3	0.31	0.62	0.72
	4	0.49	0.73	0.78
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)	4	0.49	0.71	0.78
	5	0.54	0.80	0.75
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	5	0.47	0.74	0.72
	6	0.44	0.69	0.70
Compared to Baseline				
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	1	0.17	0.32	0.59
	3	0.27	0.56	0.67
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	1	0.16	0.30	0.59
	4	0.46	0.70	0.72
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	1	0.14	0.31	0.56
	5	0.50	0.72	0.72
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	1	0.17	0.32	0.60
	6	0.42	0.67	0.66

Note. ** indicates that the model ran with a warning in M*plus*.

Estimates for Correlations between Factors at the Same Wave from Longitudinal Base Models

Waves Compared	Wave	Correlations Between Factors		
		Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity
Consecutive Waves				
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)	1	0.42	0.40	0.63
	2	0.54	0.50	0.69
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)	2	0.57	0.50	0.71
	3	0.55	0.60	0.64
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	3	0.57	0.60	0.67
	4	0.62	0.65	0.64
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)	4	0.63	0.64	0.64
	5	0.68	0.64	0.61
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	5	0.65	0.62	0.60
	6	0.60	0.64	0.68
Compared to Baseline				
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3) **	1	0.42	0.40	0.62
	3	0.54	0.60	0.64
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	1	0.41	0.40	0.62
	4	0.61	0.64	0.63
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	1	0.39	0.40	0.60
	5	0.66	0.63	0.60
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	1	0.42	0.41	0.62
	6	0.60	0.64	0.67

Note. ** indicates that the model ran with a warning in M*plus*.

Item Estimates for Base Multi-Group Models: Males and Females

Waves Compared	Item	Wave	Female			Male		
			Loading	Intercept	R Variance	Loading	Intercept	R Variance
Consecutive Waves								
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	Connected	1	2.64	4.13	0.08	2.28	4.37	0.77
		2	1.77	4.31	0.64	2.62	4.38	-0.35
	Similar*	1	1.00	4.05	1.22	1.00	4.16	1.39
		2	1.00	4.21	1.10	1.00	4.36	1.30
	Vivid*	1	1.00	4.65	0.46	1.00	4.55	0.69
		2	1.00	4.73	0.42	1.00	4.56	0.34
	Ease	1	0.93	4.71	0.38	1.11	4.71	0.36
		2	1.03	4.66	0.31	0.95	4.63	0.42
	Positive	1	1.30	5.43	0.56	1.03	5.58	0.49
		2	1.22	5.47	0.46	1.28	5.55	0.36
	Like*	1	1.00	5.91	0.66	1.00	5.87	0.60
		2	1.00	5.74	0.76	1.00	5.68	0.87
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	Connected	2	1.89	4.32	0.57	2.17	4.37	-0.02
		3	1.95	4.30	0.40	1.80	4.32	0.38
	Similar*	2	1.00	4.22	1.15	1.00	4.34	1.22
		3	1.00	4.28	1.06	1.00	4.42	1.00
	Vivid*	2	1.00	4.73	0.34	1.00	4.56	0.24
		3	1.00	4.61	0.35	1.00	4.45	0.40
	Ease	2	0.99	4.67	0.39	0.91	4.62	0.51
		3	1.01	4.65	0.32	1.00	4.52	0.45
	Positive	2	1.22	5.46	0.48	1.19	5.54	0.44
		3	1.30	5.55	0.50	0.83	5.69	0.60
	Like*	2	1.00	5.74	0.75	1.00	5.67	0.84
		3	1.00	5.74	0.73	1.00	5.64	0.45
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	Connected	3	1.94	4.25	0.43	1.81	4.27	0.33
		4	1.42	4.35	0.40	1.38	4.53	0.25
	Similar*	3	1.00	4.22	1.07	1.00	4.38	1.03
		4	1.00	4.31	0.66	1.00	4.48	0.73
	Vivid*	3	1.00	4.58	0.33	1.00	4.40	0.37
		4	1.00	4.56	0.33	1.00	4.54	0.45
	Ease	3	0.99	4.62	0.34	0.98	4.46	0.49
		4	0.95	4.59	0.51	1.04	4.48	0.32
	Positive	3	1.29	5.53	0.50	0.85	5.67	0.58
		4	0.94	5.46	0.48	1.00	5.63	0.53
	Like*	3	1.00	5.73	0.74	1.00	5.62	0.49
		4	1.00	5.54	0.59	1.00	5.55	0.82

Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	Connected	4	1.42	4.35	0.38	1.43	4.52	0.21
		5	1.32	4.37	0.48	1.45	4.70	0.60
	Similar*	4	1.00	4.31	0.66	1.00	4.46	0.76
		5	1.00	4.31	0.72	1.00	4.57	0.91
	Vivid*	4	1.00	4.55	0.38	1.00	4.56	0.41
		5	1.00	4.64	0.23	1.00	4.62	0.43
	Ease	4	0.98	4.58	0.46	1.02	4.48	0.36
		5	0.88	4.80	0.40	1.08	4.60	0.37
	Positive	4	0.89	5.45	0.51	1.03	5.64	0.54
		5	1.05	5.56	0.35	0.76	5.68	0.77
	Like*	4	1.00	5.53	0.55	1.00	5.56	0.87
		5	1.00	5.58	0.57	1.00	5.78	0.51
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	Connected	5	1.49	4.39	0.32	1.35	4.67	0.68
		6	1.27	4.51	0.39	1.58	4.50	0.09
	Similar*	5	1.00	4.32	0.81	1.00	4.56	0.85
		6	1.00	4.48	0.58	1.00	4.59	0.67
	Vivid*	5	1.00	4.66	0.20	1.00	4.57	0.33
		6	1.00	4.75	0.24	1.00	4.65	0.36
	Ease	5	0.88	4.82	0.42	1.01	4.56	0.49
		6	1.01	4.87	0.35	1.01	4.67	0.40
	Positive	5	1.04	5.56	0.36	0.90	5.67	0.71
		6	1.05	5.69	0.51	0.86	5.71	0.50
	Like*	5	1.00	5.59	0.56	1.00	5.77	0.60
		6	1.00	5.69	0.43	1.00	5.53	0.42
Compared to Baseline								
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	Connected	1	2.40	4.08	0.31	2.40	4.41	0.70
		3	2.12	4.26	0.30	1.89	4.34	0.33
	Similar*	1	1.00	4.03	1.17	1.00	4.18	1.41
		3	1.00	4.24	1.10	1.00	4.44	1.05
	Vivid*	1	1.00	4.65	0.50	1.00	4.62	0.79
		3	1.00	4.58	0.34	1.00	4.44	0.48
	Ease	1	0.94	4.71	0.35	1.18	4.78	0.23
		3	1.00	4.62	0.33	1.03	4.51	0.38
	Positive	1	1.29	5.44	0.56	0.92	5.63	0.57
		3	1.39	5.56	0.44	0.76	5.72	0.66
	Like*	1	1.00	5.90	0.66	1.00	5.89	0.52
		3	1.00	5.73	0.76	1.00	5.66	0.39

Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	Connected	1	2.23	4.08	0.48	3.04	4.39	0.46
		4	1.40	4.37	0.41	1.37	4.53	0.27
	Similar*	1	1.00	4.03	1.14	1.00	4.17	1.45
		4	1.00	4.31	0.65	1.00	4.48	0.73
	Vivid*	1	1.00	4.66	0.48	1.00	4.60	0.80
		4	1.00	4.57	0.44	1.00	4.56	0.51
	Ease	1	0.94	4.72	0.36	1.18	4.75	0.21
		4	1.01	4.60	0.41	1.08	4.48	0.26
	Positive	1	1.25	5.46	0.59	0.94	5.63	0.57
		4	0.95	5.49	0.46	1.06	5.65	0.49
	Like*	1	1.00	5.92	0.64	1.00	5.90	0.54
		4	1.00	5.55	0.61	1.00	5.57	0.89
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	Connected	1	2.61	4.09	0.13	3.03	4.39	0.48
		5	1.44	4.37	0.37	1.37	4.69	0.70
	Similar*	1	1.00	4.03	1.21	1.00	4.18	1.45
		5	1.00	4.30	0.78	1.00	4.58	0.86
	Vivid*	1	1.00	4.64	0.38	1.00	4.59	0.86
		5	1.00	4.64	0.31	1.00	4.58	0.43
	Ease	1	0.90	4.70	0.45	1.23	4.75	0.14
		5	0.92	4.79	0.33	1.08	4.55	0.38
	Positive	1	1.33	5.45	0.55	1.08	5.61	0.49
		5	1.01	5.57	0.39	0.78	5.70	0.77
	Like*	1	1.00	5.91	0.66	1.00	5.88	0.61
		5	1.00	5.59	0.54	1.00	5.78	0.52
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	Connected	1	2.42	4.09	0.29	2.51	4.42	0.70
		6	1.30	4.49	0.37	1.45	4.52	0.23
	Similar*	1	1.00	4.03	1.17	1.00	4.18	1.42
		6	1.00	4.47	0.60	1.00	4.61	0.62
	Vivid*	1	1.00	4.64	0.47	1.00	4.62	0.73
		6	1.00	4.75	0.27	1.00	4.69	0.47
	Ease	1	0.93	4.71	0.37	1.14	4.77	0.30
		6	1.02	4.87	0.33	1.11	4.70	0.29
	Positive	1	1.27	5.46	0.58	0.89	5.61	0.59
		6	1.09	5.56	0.48	0.96	5.56	0.45
	Like*	1	1.00	5.92	0.64	1.00	5.88	0.49
		6	1.00	5.68	0.46	1.00	5.56	0.46

Note. Items with a * are reference items. Their factor loadings were set to 1. ** indicates that the model ran with a warning in M*plus*. R Variance = Residual Variance.

Factor Estimates for Base Multi-Group Models: Males and Females

Waves Compared	Factor	Wave	Female		Male	
			Mean	Variance	Mean	Variance
Consecutive Waves						
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	Relatedness	1	0.00	0.37	0.00	0.27
		2	0.00	0.52	0.00	0.34
	Vividness	1	0.00	2.17	0.00	1.89
		2	0.00	2.06	0.00	2.20
	Positivity	1	0.00	0.43	0.00	0.59
		2	0.00	0.53	0.00	0.62
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	Relatedness	2	0.00	0.48	0.00	0.43
		3	0.00	0.47	0.00	0.55
	Vividness	2	0.00	2.21	0.00	2.41
		3	0.00	1.88	0.00	2.12
	Positivity	2	0.00	0.56	0.00	0.68
		3	0.00	0.41	0.00	0.97
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	Relatedness	3	0.00	0.48	0.00	0.59
		4	0.00	0.68	0.00	0.78
	Vividness	3	0.00	1.94	0.00	2.12
		4	0.00	1.77	0.00	1.75
	Positivity	3	0.00	0.42	0.00	0.91
		4	0.00	0.91	0.00	0.76
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	Relatedness	4	0.00	0.68	0.00	0.74
		5	0.00	0.83	0.00	0.70
	Vividness	4	0.00	1.71	0.00	1.80
		5	0.00	1.99	0.00	1.73
	Positivity	4	0.00	0.95	0.00	0.71
		5	0.00	0.76	0.00	0.76
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	Relatedness	5	0.00	0.72	0.00	0.68
		6	0.00	0.83	0.00	0.63
	Vividness	5	0.00	2.03	0.00	1.75
		6	0.00	1.66	0.00	1.34
	Positivity	5	0.00	0.76	0.00	0.64
		6	0.00	0.69	0.00	0.73
Compared to Baseline						
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	Relatedness	1	0.00	0.41	0.00	0.25
		3	0.00	0.41	0.00	0.52
	Vividness	1	0.00	2.17	0.00	1.61
		3	0.00	1.89	0.00	2.00
	Positivity	1	0.00	0.42	0.00	0.60
		3	0.00	0.38	0.00	1.01

Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	Relatedness	1	0.00	0.43	0.00	0.18
		4	0.00	0.69	0.00	0.76
	Vividness	1	0.00	2.01	0.00	1.63
		4	0.00	1.62	0.00	1.65
	Positivity	1	0.00	0.43	0.00	0.58
		4	0.00	0.86	0.00	0.66
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	Relatedness	1	0.00	0.37	0.00	0.18
		5	0.00	0.76	0.00	0.65
	Vividness	1	0.00	2.17	0.00	1.56
		5	0.00	1.95	0.00	1.60
	Positivity	1	0.00	0.40	0.00	0.52
		5	0.00	0.80	0.00	0.70
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	Relatedness	1	0.00	0.41	0.00	0.23
		6	0.00	0.81	0.00	0.65
	Vividness	1	0.00	2.09	0.00	1.71
		6	0.00	1.66	0.00	1.12
	Positivity	1	0.00	0.43	0.00	0.63
		6	0.00	0.65	0.00	0.63

Note. Mean = Latent Mean of the factor. Following the Mplus User's Guide, the latent means for the factors were fixed at 0 in both groups (V.8; Muthén & Muthén, 2017, p. 547) ** indicates that the model ran with a warning in M*plus*.

Estimates for Covariances between Factors at the Same Wave from Multi-Group Base Models: Males and Females

Waves Compared	Wave	Female			Male		
		Covariances Between Factors			Covariances Between Factors		
		Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity	Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity
Consecutive Waves							
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	1	0.17	0.32	0.66	0.15	0.33	0.58
	2	0.31	0.56	0.79	0.20	0.36	0.72
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	2	0.32	0.56	0.85	0.28	0.46	0.82
	3	0.25	0.57	0.60	0.39	0.62	0.86
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	3	0.26	0.60	0.62	0.42	0.68	0.92
	4	0.48	0.74	0.80	0.48	0.72	0.74
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	4	0.50	0.73	0.81	0.47	0.68	0.75
	5	0.51	0.82	0.74	0.53	0.71	0.74
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	5	0.46	0.76	0.75	0.43	0.71	0.66
	6	0.47	0.78	0.75	0.36	0.53	0.62
Compared to Baseline							
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	1	0.18	0.35	0.64	0.28	0.15	0.54
	3	0.21	0.53	0.55	0.38	0.63	0.89
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	1	0.19	0.36	0.64	0.11	0.23	0.53
	4	0.46	0.71	0.74	0.44	0.68	0.68
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	1	0.16	0.32	0.62	0.10	0.22	0.48
	5	0.50	0.77	0.75	0.46	0.66	0.69
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	1	0.18	0.34	0.64	0.14	0.29	0.57
	6	0.45	0.78	0.73	0.36	0.48	0.52

Note. ** indicates that the model ran with a warning in M*plus*.

Estimates for Correlations between Factors at the Same Wave from Multi-Group Base Models: Males and Females

Waves Compared	Wave	Female			Male		
		Correlations Between Factors			Correlations Between Factors		
		Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity	Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity
Consecutive Waves							
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	1	0.42	0.36	0.69	0.39	0.46	0.55
	2	0.60	0.54	0.76	0.43	0.41	0.62
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	2	0.62	0.55	0.76	0.51	0.45	0.64
	3	0.57	0.61	0.68	0.54	0.58	0.60
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	3	0.58	0.62	0.68	0.57	0.60	0.66
	4	0.61	0.68	0.64	0.63	0.62	0.65
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	4	0.63	0.68	0.63	0.65	0.59	0.51
	5	0.64	0.64	0.61	0.72	0.65	0.64
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	5	0.62	0.62	0.60	0.66	0.65	0.62
	6	0.62	0.67	0.70	0.54	0.58	0.63
Compared to Baseline							
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	1	0.43	0.37	0.67	0.38	0.45	0.55
	3	0.54	0.60	0.65	0.53	0.62	0.63
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	1	0.44	0.38	0.68	0.34	0.42	0.55
	4	0.60	0.67	0.62	0.63	0.61	0.66
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	1	0.42	0.36	0.67	0.34	0.42	0.54
	5	0.64	0.63	0.60	0.68	0.65	0.65
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	1	0.44	0.37	0.67	0.36	0.47	0.54
	6	0.62	0.67	0.70	0.55	0.56	0.62

Note. ** indicates that the model ran with a warning in M*plus*.

Item Estimates for Base Multi-Group Models: College Generation Status

Waves Compared	Item	Wave	First-Generation			Continuing-Generation		
			Loading	Intercept	R Variance	Loading	Intercept	R Variance
Consecutive Waves								
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	Connected	1	2.75	4.18	-0.38	2.38	4.28	0.84
		2	2.50	4.31	0.22	1.81	4.36	0.43
	Similar*	1	1.00	3.95	1.42	1.00	4.17	1.23
		2	1.00	4.28	1.48	1.00	4.28	1.02
	Vivid*	1	1.00	4.70	0.69	1.00	4.57	0.52
		2	1.00	4.70	0.30	1.00	4.63	0.43
	Ease	1	1.08	4.72	0.29	0.99	4.72	0.40
		2	0.97	4.67	0.27	1.01	4.64	0.41
	Positive	1	1.09	5.45	0.44	1.18	5.53	0.57
		2	1.39	5.39	0.44	1.17	5.55	0.40
	Like*	1	1.00	5.84	0.73	1.00	5.90	0.60
		2	1.00	5.66	0.92	1.00	5.74	0.75
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	Connected	2	3.80	4.30	-0.68	1.78	4.37	0.45
		3	2.69	4.46	-0.39	1.80	4.24	0.58
	Similar*	2	1.00	4.27	1.61	1.00	4.29	1.00
		3	1.00	4.30	1.15	1.00	4.36	0.99
	Vivid*	2	1.00	4.70	0.26	1.00	4.64	0.31
		3	1.00	4.60	0.36	1.00	4.53	0.38
	Ease	2	0.96	4.66	0.30	0.95	4.64	0.52
		3	0.99	4.68	0.47	1.00	4.57	0.33
	Positive	2	1.35	5.39	0.51	1.16	5.54	0.42
		3	1.21	5.49	0.55	1.05	5.66	0.52
	Like*	2	1.00	5.67	0.90	1.00	5.73	0.74
		3	1.00	5.71	0.57	1.00	5.71	0.73
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	Connected	3	2.21	4.40	0.03	1.92	4.19	0.45
		4	1.37	4.41	0.32	1.36	4.44	0.40
	Similar*	3	1.00	4.26	1.11	1.00	4.30	1.05
		4	1.00	4.36	0.57	1.00	4.39	0.72
	Vivid*	3	1.00	4.56	0.40	1.00	4.50	0.32
		4	1.00	4.53	0.41	1.00	4.57	0.36
	Ease	3	1.02	4.63	0.43	0.97	4.54	0.39
		4	1.02	4.51	0.44	0.97	4.57	0.44
	Positive	3	1.21	5.49	0.53	1.05	5.63	0.53
		4	0.91	5.43	0.53	1.00	5.58	0.52
	Like*	3	1.00	5.70	0.48	1.00	5.69	0.74
		4	1.00	5.53	0.54	1.00	5.56	0.76

Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	Connected	4	1.32	4.39	0.35	1.46	4.44	0.30
		5	1.35	4.37	0.38	1.36	4.55	0.63
	Similar*	4	1.00	4.35	0.54	1.00	4.38	0.78
		5	1.00	4.40	0.72	1.00	4.44	0.79
	Vivid*	4	1.00	4.51	0.47	1.00	4.58	0.31
		5	1.00	4.62	-0.06	1.00	4.66	0.39
	Ease	4	1.05	4.49	0.38	0.94	4.57	0.49
		5	0.76	4.69	0.65	1.00	4.77	0.33
	Positive	4	0.84	5.39	0.57	1.02	5.60	0.50
		5	0.99	5.49	0.46	0.85	5.68	0.56
	Like*	4	1.00	5.50	0.46	1.00	5.57	0.78
		5	1.00	5.53	0.49	1.00	5.71	0.53
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)**	Connected	5	1.34	4.36	0.38	1.49	4.55	0.51
		6	1.32	4.52	0.37	1.35	4.51	0.32
	Similar*	5	1.00	4.40	0.71	1.00	4.43	0.86
		6	1.00	4.53	0.71	1.00	4.54	0.56
	Vivid*	5	1.00	4.62	0.02	1.00	4.65	0.33
		6	1.00	4.76	0.23	1.00	4.69	0.30
	Ease	5	0.79	4.69	0.60	0.96	4.75	0.39
		6	1.01	4.80	0.35	1.00	4.81	0.41
	Positive	5	0.95	5.51	0.51	0.93	5.66	0.52
		6	1.02	5.54	0.69	0.92	5.65	0.47
	Like*	5	1.00	5.54	0.46	1.00	5.70	0.57
		6	1.00	5.63	0.50	1.00	5.63	0.39
Compared to Baseline								
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	Connected	1	3.29	4.16	-0.98	2.36	4.27	0.86
		3	3.20	4.42	-0.72	1.88	4.23	0.54
	Similar*	1	1.00	3.96	1.48	1.00	4.16	1.21
		3	1.00	4.28	1.20	1.00	4.34	1.03
	Vivid*	1	1.00	4.72	0.75	1.00	4.60	0.62
		3	1.00	4.58	0.34	1.00	4.53	0.38
	Ease	1	1.12	4.73	0.23	1.03	4.75	0.32
		3	0.98	4.65	0.48	1.01	4.56	0.33
	Positive	1	1.04	5.48	0.45	1.19	5.54	0.60
		3	1.26	5.53	0.53	1.07	5.68	0.50
	Like*	1	1.00	5.85	0.72	1.00	5.91	0.59
		3	1.00	5.71	0.61	1.00	5.72	0.74

Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	Connected	1	2.01	4.16	0.38	2.72	4.25	0.73
		4	1.31	4.43	0.36	1.39	4.44	0.37
	Similar*	1	1.00	3.96	1.26	1.00	4.15	1.25
		4	1.00	4.39	0.54	1.00	4.38	0.74
	Vivid*	1	1.00	4.72	0.69	1.00	4.59	0.59
		4	1.00	4.57	0.44	1.00	4.56	0.46
	Ease	1	1.10	4.73	0.29	1.02	4.74	0.34
		4	1.03	4.54	0.41	1.03	4.56	0.36
	Positive	1	1.04	5.48	0.47	1.17	5.56	0.61
		4	0.94	5.44	0.45	1.05	5.61	0.48
	Like*	1	1.00	5.87	0.71	1.00	5.92	0.58
		4	1.00	5.54	0.58	1.00	5.57	0.80
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	Connected	1	3.82	4.14	-1.49	2.75	4.27	0.71
		5	1.53	4.33	0.21	1.43	4.57	0.58
	Similar*	1	1.00	3.98	1.51	1.00	4.16	1.25
		5	1.00	4.37	0.80	1.00	4.45	0.82
	Vivid*	1	1.00	4.68	0.55	1.00	4.59	0.54
		5	1.00	4.63	0.11	1.00	4.65	0.45
	Ease	1	1.00	4.69	0.44	1.00	4.74	0.38
		5	0.82	4.69	0.55	1.03	4.74	0.27
	Positive	1	1.17	5.45	0.40	1.32	5.55	0.53
		5	0.94	5.52	0.53	0.90	5.69	0.54
	Like*	1	1.00	5.84	0.76	1.00	5.91	0.63
		5	1.00	5.54	0.46	1.00	5.72	0.55
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	Connected	1	2.02	4.14	0.34	2.75	4.27	0.70
		6	1.43	4.59	0.27	1.37	4.50	0.30
	Similar*	1	1.00	3.96	1.26	1.00	4.16	1.26
		6	1.00	4.57	0.76	1.00	4.52	0.57
	Vivid*	1	1.00	4.71	0.66	1.00	4.61	0.50
		6	1.00	4.83	0.27	1.00	4.68	0.34
	Ease	1	1.08	4.72	0.32	0.97	4.75	0.44
		6	1.04	4.87	0.30	1.03	4.80	0.36
	Positive	1	1.01	5.47	0.49	1.16	5.56	0.61
		6	1.15	5.56	0.61	0.96	5.66	0.44
	Like*	1	1.00	5.86	0.69	1.00	5.92	0.58
		6	1.00	5.65	0.54	1.00	5.63	0.41

Note. Items with a * are reference items. Their factor loadings were set to 1. ** indicates that the model ran with a warning in M*plus*. R Variance = Residual Variance.

Factor Estimates for Base Multi-Group Models: College Generation Status

Waves Compared	Factor	Wave	First-Generation		Continuing-Generation	
			Mean	Variance	Mean	Variance
Consecutive Waves						
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	Relatedness	1	0.00	0.39	0.00	0.27
		2	0.00	0.31	0.00	0.50
	Vividness	1	0.00	1.53	0.00	2.20
		2	0.00	2.02	0.00	2.12
	Positivity	1	0.00	0.50	0.00	0.49
		2	0.00	0.54	0.00	0.58
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	Relatedness	2	0.00	0.20	0.00	0.53
		3	0.00	0.31	0.00	0.53
	Vividness	2	0.00	2.09	0.00	2.35
		3	0.00	1.71	0.00	2.06
	Positivity	2	0.00	0.57	0.00	0.61
		3	0.00	0.54	0.00	0.60
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	Relatedness	3	0.00	0.38	0.00	0.52
		4	0.00	0.79	0.00	0.69
	Vividness	3	0.00	1.71	0.00	2.13
		4	0.00	1.72	0.00	1.76
	Positivity	3	0.00	0.53	0.00	0.60
		4	0.00	1.19	0.00	0.67
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	Relatedness	4	0.00	0.85	0.00	0.63
		5	0.00	0.91	0.00	0.73
	Vividness	4	0.00	1.72	0.00	1.77
		5	0.00	2.12	0.00	1.87
	Positivity	4	0.00	1.28	0.00	0.63
		5	0.00	1.06	0.00	0.68
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)	Relatedness	5	0.00	0.86	0.00	0.65
		6	0.00	0.75	0.00	0.75
	Vividness	5	0.00	1.94	0.00	1.94
		6	0.00	1.51	0.00	1.55
	Positivity	5	0.00	1.04	0.00	0.63
		6	0.00	0.61	0.00	0.77

Compared to Baseline						
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	Relatedness	1	0.00	0.33	0.00	0.27
		3	0.00	0.25	0.00	0.50
	Vividness	1	0.00	1.47	0.00	1.98
		3	0.00	1.78	0.00	2.03
	Positivity	1	0.00	0.49	0.00	0.46
		3	0.00	0.47	0.00	0.58
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	Relatedness	1	0.00	0.54	0.00	0.22
		4	0.00	0.84	0.00	0.66
	Vividness	1	0.00	1.44	0.00	2.02
		4	0.00	1.71	0.00	1.61
	Positivity	1	0.00	0.49	0.00	0.46
		4	0.00	1.13	0.00	0.59
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	Relatedness	1	0.00	0.28	0.00	0.21
		5	0.00	0.73	0.00	0.67
	Vividness	1	0.00	1.60	0.00	2.03
		5	0.00	1.88	0.00	1.79
	Positivity	1	0.00	0.44	0.00	0.41
		5	0.00	1.06	0.00	0.65
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	Relatedness	1	0.00	0.56	0.00	0.21
		6	0.00	0.69	0.00	0.74
	Vividness	1	0.00	1.47	0.00	2.08
		6	0.00	1.47	0.00	1.48
	Positivity	1	0.00	0.52	0.00	0.47
		6	0.00	0.55	0.00	0.71

Note. Mean = Latent Mean of the factor. Following the Mplus User's Guide, the latent means for the factors were fixed at 0 in both groups (V.8; Muthen & Muthen, 2017, p. 547) ** indicates that the model ran with a warning in M*plus*.

Estimates for Covariances between Factors at the Same Wave from Multi-Group Base Models: College Generation Status

Waves Compared	Wave	First-Generation			Continuing-Generation		
		Covariances Between Factors			Covariances Between Factors		
		Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity	Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity
Consecutive Waves							
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	1	0.13	0.24	0.62	0.18	0.36	0.63
	2	0.19	0.37	0.72	0.30	0.54	0.76
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	2	0.15	0.25	0.78	0.33	0.58	0.84
	3	0.22	0.32	0.64	0.30	0.67	0.71
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	3	0.27	0.40	0.65	0.30	0.66	0.75
	4	0.62	0.93	0.95	0.41	0.63	0.68
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	4	0.69	0.96	1.01	0.38	0.57	0.65
	5	0.64	0.89	0.86	0.47	0.73	0.70
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)**	5	0.60	0.83	0.80	0.41	0.69	0.68
	6	0.53	0.73	0.75	0.41	0.65	0.69
Compared to Baseline							
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	1	0.10	0.19	0.59	0.17	0.33	0.57
	3	0.17	0.26	0.62	0.29	0.66	0.69
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	1	0.18	0.29	0.59	0.14	0.30	0.57
	4	0.61	0.96	0.93	0.37	0.58	0.60
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	1	0.08	0.18	0.58	0.13	0.30	0.52
	5	0.55	0.73	0.79	0.44	0.68	0.68
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	1	0.19	0.31	0.62	0.15	0.30	0.58
	6	0.46	0.68	0.70	0.39	0.62	0.64

Note. ** indicates that the model ran with a warning in M*plus*.

Estimates for Correlations between Factors at the Same Wave from Multi-Group Base Models: College Generation Status

Waves Compared	Wave	First-Generation Correlations Between Factors			Continuing-Generation Correlations Between Factors		
		Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity	Relatedness & Positivity	Relatedness & Vividness	Vividness & Positivity
Consecutive Waves							
Semester 1 Week 1 (W1) vs Semester 1 Week 6 (W2)**	1	0.29	0.31	0.70	0.49	0.47	0.61
	2	0.47	0.46	0.69	0.56	0.52	0.69
Semester 1 Week 6 (W2) vs Semester 2 Week 1 (W3)**	2	0.43	0.39	0.71	0.52	0.59	0.70
	3	0.54	0.43	0.67	0.54	0.64	0.63
Semester 2 Week 1 (W3) vs Semester 2 Week 6 (W4)	3	0.60	0.50	0.69	0.55	0.63	0.66
	4	0.64	0.80	0.67	0.60	0.57	0.63
Semester 2 Week 6 (W4) vs Semester 3 Week 1 (W5)**	4	0.66	0.80	0.68	0.60	0.54	0.61
	5	0.65	0.64	0.57	0.68	0.62	0.62
Semester 3 Week 1 (W5) vs Semester 3 Week 6 (W6)**	5	0.64	0.64	0.57	0.65	0.62	0.62
	6	0.79	0.69	0.78	0.54	0.60	0.64
Compared to Baseline							
Semester 1 Week 1 (W1) vs Semester 2 Week 1 (W3)**	1	0.25	0.27	0.70	0.49	0.46	0.59
	3	0.50	0.40	0.67	0.54	0.65	0.63
Semester 1 Week 1 (W1) vs Semester 2 Week 6 (W4)	1	0.35	0.32	0.70	0.46	0.46	0.59
	4	0.63	0.80	0.67	0.59	0.56	0.61
Semester 1 Week 1 (W1) vs Semester 3 Week 1 (W5)	1	0.21	0.27	0.69	0.44	0.46	0.58
	5	0.62	0.62	0.56	0.66	0.62	0.63
Semester 1 Week 1 (W1) vs Semester 3 Week 6 (W6)	1	0.36	0.34	0.71	0.46	0.45	0.59
	6	0.74	0.68	0.78	0.54	0.60	0.62

Note. ** indicates that the model ran with a warning in M*plus*.

APPENDIX E

MPLUS MODEL WARNING

M*plus* Warning in Longitudinal Model (Wave 1 vs Wave 3):

WARNING: THE LATENT VARIABLE COVARIANCE MATRIX (PSI) IS NOT POSITIVE DEFINITE. THIS COULD INDICATE A NEGATIVE VARIANCE/RESIDUAL VARIANCE FOR A LATENT VARIABLE, A CORRELATION GREATER OR EQUAL TO ONE BETWEEN TWO LATENT VARIABLES, OR A LINEAR DEPENDENCY AMONG MORE THAN TWO LATENT VARIABLES.CHECK THE TECH4 OUTPUT FOR MORE INFORMATION. PROBLEM INVOLVING VARIABLE CON3.

Example of M*plus* Warning in Multi-Group Model:

WARNING: THE LATENT VARIABLE COVARIANCE MATRIX (PSI) IN GROUP MALE IS NOT POSITIVE DEFINITE. THIS COULD INDICATE A NEGATIVE VARIANCE/RESIDUAL VARIANCE FOR A LATENT VARIABLE, A CORRELATION GREATER OR EQUAL TO ONE BETWEEN TWO LATENT VARIABLES, OR A LINEAR DEPENDENCY AMONG MORE THAN TWO LATENT VARIABLES.CHECK THE TECH4 OUTPUT FOR MORE INFORMATION. PROBLEM INVOLVING VARIABLE CON2.

Sources of Mplus Warnings

Model	Problem Group(s)	Problem Variable	Source of Warning	Specific Issue
Longitudinal				
Wave 1 vs Wave 3	*NA*	Connected Item Wave 3	Linear dependency among more than two latent variables	High Correlation between the Relatedness Latent Variable and the Connected item (r = 0.931). High Correlation between the Vividness Latent Variable and the Vivid (r = 0.914) and Ease Items (r = 0.919).
Multi-Group: Sex				
Wave 1 vs Wave 2	Male	Connected Item Wave 2	Negative residual variance	Connected Wave 2: Residual Variance = -0.177
Wave 1 vs Wave 3	Male & Female	Connected Item Wave 3	Linear dependency among more than two latent variables	High Correlation between the Relatedness Latent Variable and the Connected item (Female Group: r = 0.927; Male Group: r = 0.922). High Correlation between the Vividness Latent Variable and the Vivid (Female Group: r = 0.920; Male Group: r = 0.898) and Ease Items (Female Group: r = 0.921; Male Group: r = 0.921).
Wave 2 vs Wave 3	Male	Connected Item Wave 2	Negative residual variance	Connected Wave 2: Residual Variance = -0.024
Wave 4 vs Wave 5	Male	Positivity Latent Variable Wave 5	Linear dependency among more than two latent variables	High Correlation between the Positivity Latent Variable at Wave 5 and the Positivity Latent Variable at Wave 4 (r = 0.799). High Correlation between the Positivity Latent Variable at Wave 5 and the Relatedness Latent Variable at Wave 5 (r = 0.721).
Multi-Group: College Generation Status				
Wave 1 vs Wave 2	First-Generation	Positivity Latent Variable Wave 2	Negative residual variance	Connected Wave 2: Residual Variance = -0.378
Wave 1 vs Wave 3	First-Generation	Connected Item Wave 3	Negative residual variance	Connected Wave 1: Residual Variance = -0.978; Connected Wave 3: Residual Variance = -0.715
Wave 2 vs Wave 3	First-Generation	Connected Item Wave 2	Negative residual variance	Connected Wave 2: Residual Variance = -0.675; Connected Wave 3: Residual Variance = -0.387
Wave 4 vs Wave 5	First-Generation	Vivid Item Wave 5	Negative residual variance	Vivid Wave 5: Residual Variance = -0.059
Wave 5 vs Wave 6	First-Generation	Positivity Latent Variable Wave 6	Linear dependency among more than two latent variables	High Correlation between the Positivity Latent Variable at Wave 6 and the Relatedness Latent Variable at Wave 6 (r = 0.785). High Correlation between the Positivity Latent Variable at Wave 6 and the Vividness Latent Variable at Wave 6 (r = 0.782).

Note. Problem Group = Group with the latent covariance matrix that was not positive definite as identiifed by Mplus. Problem Variable = Mplus identified variable involved in the problem.

APPENDIX F

IRB APPROVAL

APPROVAL: EXPEDITED REVIEW

Sau Kwan
Psychology
Virginia.Kwan@asu.edu

Dear Sau Kwan:

On 3/28/2016 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Strengthening Present-Future Self-Continuity Mitigates Temporal Discounting and Improves College Persistence
Investigator:	Sau Kwan
IRB ID:	STUDY00004110
Category of review:	(7)(b) Social science methods, (5) Data, documents, records, or specimens, (7)(a) Behavioral research
Funding:	Name: ^DUPLICATE: DOEd - Institute of Education Sciences (IES)
Grant Title:	
Grant ID:	
Documents Reviewed:	• Grant Draft, Category: Grant application; • COMPENSATED Consent Form copy.pdf, Category: Consent Form; • Funding.pdf, Category: Other (to reflect anything not captured above); • Grant IRB Spring 2016_draft3172016_vk.docx, Category: IRB Protocol; • PILOT Recruitment.pdf, Category: Recruitment Materials; • Response to requested modifications.pdf, Category: Other (to reflect anything not captured above); • research design and FSC measure, Category: Technical materials/diagrams; • COMPENSATED Recruitment .pdf, Category: Recruitment Materials; • measures, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • PILOT Consent Form.pdf, Category: Consent Form;

The IRB approved the protocol from 3/28/2016 to 3/27/2017 inclusive. Three weeks before 3/27/2017 you are to submit a completed Continuing Review application and required attachments to request continuing approval or closure.

If continuing review approval is not granted before the expiration date of 3/27/2017 approval of this protocol expires on that date. When consent is appropriate, you must use final, watermarked versions available under the “Documents” tab in ERA-IRB.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

APPENDIX G

INSTITUTE OF EDUCATION SCIENCES GRANT SUPPORT

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