Attributional Retraining: Boosting the Academic Persistence and Performance of First-Generation College Students with Low Academic Control

by

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Abstract

First-generation (1st-gen) college students face unique obstacles that threaten to erode their academic motivation and success during the school-to-college transition (Stebleton & Soria, 2012). Attribution-based motivation treatments can improve achievement for failure-prone college students (Perry & Hamm, 2017), yet their efficacy for students with socioeconomic academic risk factors remains unexamined. The present longitudinal, pre-post, randomized treatment field study administered attributional retraining (AR) to 1st-gen and second-generation (2nd-gen) college students in an online two-semester introductory course who differed in academic control beliefs (low, high). 1st-gen, low control AR recipients outperformed their no-AR peers by a full letter grade (B vs. C+), and were 48% less likely to drop out of the course. Conditional process analyses revealed that AR-achievement linkages were mediated by causal attributions and perceived control in a hypothesized causal sequence. Results further the literature by demonstrating that AR can boost the achievement of at-risk 1st-gen students indirectly via motivation-related variables specified within Weiner's (1985, 2014, 2018) attribution theory.

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Introduction

The pursuit of higher education promises tremendous individual growth. Universities provide students with the opportunity to gain new knowledge, develop important life skills such as self-regulation, time management, and critical thinking, and to find out what intellectual disciplines truly ignite their passion for discovery and understanding. In addition, earning a bachelor's degree also comes with the promise of more tangible rewards, such as access to more prestigious jobs, higher incomes, and even living longer (Jasilionis & Shkolnikov, 2016). In this way, success in higher education, one of the three main indicators of socioeconomic status (SES) can be seen as a viable means for enhancing the other major indicators, occupational prestige, and income (Sirin, 2005).

The North American undergraduate student population is characterized by diversity. In contrast to the student body of 100 years ago, university students now come from a broader range of backgrounds (Anderson, 2003). Students often vary on social characteristics such as SES, race or ethnicity, gender, country of birth, and native language, to name a few. These factors contribute to why a student may decide to pursue higher education. Some students may enter university with the goal of *maintaining* their SES, whereas others may have the goal of *improving* their SES, thus achieving upward social mobility (Engle, 2007). Perhaps the most critical determinant of this dichotomy of goals is the education of students' parents.

First-generation (1st-gen) students are those whose parents do not have a bachelor's degree, and unlike their second-generation (2nd-gen) student peers, these students necessarily enter university with the goal of surpassing the educational attainment of their parents.

Regardless of one’s social background, the path to earning a degree is often a harrowing experience, particularly during the first academic year (Perry, Hladkyj, Pekrun, & Pelletier, 2001; Perry, Hladkyj, Pekrun, Clifton, & Chipperfield, 2005). It is not uncommon for students to feel overwhelmed by the pressure and demands of the unfamiliar and competitive college environment; post-secondary students report experiencing anxiety more frequently than any other achievement-related emotion (Pekrun, Goetz, Titz, & Perry, 2002). However, individual studies and federal reports on higher education consistently show that 1^{st}-gen students are at a disadvantage relative to 2^{nd}-gen students in terms of academic performance and degree attainment. Engle & Tinto (2008) refer to this disparity as a widening gap between *access* to higher education, and *success* within it. In order to reduce this achievement gap, there is a pressing need for theory-based motivation interventions which can effectively improve the academic mindset, performance, and persistence of 1^{st}-gen students. Empirical support for such an intervention could lead to widespread implementation in post-secondary institutions, which could in turn improve the lives of 1^{st}-gen students, increase their human capital, and mitigate the systematic inequality that plagues North American education. Thus, this research examined the efficacy of an academic motivation intervention based on Weiner’s (1985, 2014, 2018) acclaimed attribution theory of achievement motivation, for improving the academic outcomes of 1^{st}-gen students.

Review of the Literature

First-generation Students

There is a lack of consensus on how to define 1^{st}-gen students (Auclair et al., 2008). Some researchers use a narrow criterion, such that 1^{st}-gen students are those whose parents only have high school education (Terenzini, Springer, Yaeger, Pascarella, & Nora, 1996). Others use a wider criterion, such that students whose parents have some college education but do not have a bachelor's degree are also considered 1^{st}-gen students (Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012). Frequently, authors do not explicitly delineate how they operationally define student-generation (Peralta & Klonowski, 2017).

In this study, student-generation was operationalized according to the wider definition. That is, students who reported at least one parent with a bachelor's degree were categorized as 2^{nd}-gen, otherwise they were categorized as 1^{st}-gen. The reasons for using this definition are threefold. First, this is the more common definition in the research literature. Second, this is the definition used by TRIO programs in the United States for determining who is eligible for financial support (Engle & Tinto, 2008; Stebleton & Soria, 2012). Third, this definition better captures the concept of being a 1^{st}-generation student. Ultimately, it is a parent's *successful* attainment of a postsecondary degree that matters most, and not simply whether or not a parent has any post-secondary experience. For 1^{st}-gen students struggling to adapt to the competitive and unfamiliar college environment, knowing that your parent(s) went to college and failed may be as demoralizing as knowing they had never gone at all.

Since 1980, the population of 1^{st}-gen students has rapidly expanded in both the United States and Canada (Davis, 2010; Rahilly & Buckley, 2016). Despite being classified as a non-traditional student group, 1^{st}-gen students represent approximately one-third to one-half of the entire undergraduate student population. In the United States, A recent report conducted by the National Center for Education Statistics estimated that 55.6% of all undergraduates are 1^{st}-gen students, and that 46.7% of undergraduates in public 4-year institutions are 1^{st}-gen students (Campbell & Wescott, 2019). In Canada, a recent study estimated that 34.6% of university undergraduates are 1^{st}-gen students (Finnie, Childs, & Wismer, 2010).

The Achievement Gap

Nationally representative US longitudinal achievement surveys reliably indicate that 1st-gen students have lower grades than 2nd-gen students. Warburton, Bugarin, and Nuñez (2001) reviewed data from the 1995-98 beginning postsecondary student study; they found that 1st-gen students had lower GPAs at the end of their first academic year, and this difference remained when controlling for the rigor of high school curriculum and SAT/ACT scores. Pascarella, Pierson, Wolniak, and Terenzini (2004), using data from the 1992-95 national study of student learning survey, found that 1st-gen students had lower GPAs after three years, even when including high school grades and measures of academic motivation as covariates. Chen and Carroll's (2005) analysis of the 1992-2000 national education longitudinal survey found that 1st-gens had lower GPAs in their first academic year, and that this difference persisted across all time periods. These findings parallel those of individual studies, both longitudinal and cross-sectional.

Martinez, Sher, Krull, and Wood (2009) conducted a comprehensive 4-year study with over 3000 participants; their 1st-gen sample had lower GPAs over the four years. Similarly, Vuong, Brown-Welty, & Tracz's (2010) cross-sectional study examining cohorts of sophomore students across five 4-year institutions revealed that 1st-gens had lower GPAs at the end of their freshman and sophomore years. The work of Palbusa & Gauvain (2017) provides recent evidence that 1st-gens have lower first-year GPAs. As one might expect, the consistent performance gap between 1st-gen students and 2nd-gen students corresponds with a gap in persistence and degree attainment.

Reports on nationally representative US surveys indicate that 1st-gen status is a critical risk factor for attrition. Choy's (2001) analysis of three such surveys from the years 1989-94 found that after 5 years 1st-gen students were less likely than 2nd-gen students to have earned a bachelor's degree (13% vs. 33%) and were more likely to have dropped out (45% vs. 29%). These differences remained after including relevant demographic and psychosocial factors such as race/ethnicity, SES, enrollment status, sex, and academic and social integration as control variables. Cataldi, Bennett, and Chen (2018) updated Choy's work using data from the same surveys spanning the years 2003-9. The authors found a similar pattern, such that 1st-gens were more likely to have left postsecondary education after three years (30% vs. 14%) and were less likely to have earned a degree within six years (69% vs. 83%). A recent preliminary report on the beginning postsecondary survey from 2011-17 indicated that for students enrolled at 4-year institutions, 44% of 1st-gen students had earned a bachelor's degree after 6 years compared to 74% of 2nd-gen students, and that 1st-gen students had higher rates of attrition (31% vs. 13%; Chen et al., 2019). This stark and persistent achievement gap begs the question, why are 1st-gen students at such a disadvantage? The answer is complex, but research has identified at least two reliable differences in pre-college characteristics which contribute to the disparity.

The Role of Parents

By definition, 1st-gen students have less-educated parents than 2nd-gen students, and research indicates that this difference manifests itself in a variety of influential ways. Briefly, parents with at least a bachelor's degree spend more time engaged in child care activities, are more involved in their children's transition into postsecondary institutions, and possess knowledge that allows them to instrumentally support their children's achievement, knowledge that parents of 1st-gen students do not have (Choy, 2001; Guryan, Hurst, & Kearney, 2008; Nichols & Islas, 2015; Palbusa & Gauvain, 2017).

Guryan et al. (2008) examined the relationship between parental education and time spent in child care activities, using data from the American Time Use Survey commissioned by the US Bureau of Labor Statistics. This dataset is a nationally representative sample of over 20 000 parents of children under the age of 18, collected over the years 2003-6. Twenty-fourhour time diaries were used to assess different patterns of child-care based on the parents' education.

The authors found a positive association between parental education and hours spent engaged in child care for both men and women. Specifically, mothers with bachelor's degrees spent approximately 4.5 hours more per week on child care activities than those with high school diplomas or less. Moreover, parents with a bachelor's degrees spent more hours per week on educational activities (e.g., reading to children, attending school meetings) than less-educated parents. The authors demonstrated that the relationship between parental education and child-care held across many nations, including Canada. These results suggest that across childhood and adolescence, 1st-gen students receive less academic support from their parents than 2nd-gen students. Evidence indicates that this relative lack of support becomes more pronounced at the onset of the college admissions process.

Choy (2001) reported that parents of 1st-gen students are less involved than parents of 2nd-gen students in discussing SAT/ACT preparation (18% vs. 27%) or various postsecondary programs (45% vs. 61%). Parents of 1st-gen students were also less likely to attend sessions on postsecondary opportunities (34% vs 51%) or to visit the campus of at least one postsecondary institution (66% vs. 82%). This parental involvement is undoubtedly important in determining whether students will enroll in higher education, but for students who do enroll, one's student-generation is a critical determinant of the types of support they receive from their parents.

The support parents provide for university students can be broadly classified into two categories, emotional and instrumental. Emotional support pertains to general encouragement, being receptive to their children's feelings and/or concerns, and expressing care for them. Instrumental support, in contrast, is characterized by specific practical advice regarding what to expect, how to succeed, and how to properly adapt in the face of academic setbacks. Early research indicated that parents of 1st-gen students were not as emotionally supportive as parents of 2nd-gen students (Billson & Terry, 1982; Terenzini et al., 1996). However, more recent studies consistently find no difference in the emotional support provided by parents of 1st-gen students (Bui, 2002; Nichols & Islas, 2015; Palbusa & Gauvain, 2017). It appears that although parents of 1st-gen students wish the best for their children's academic careers, their lack of familiarity with the myriad facets of postsecondary education precludes them from offering instrumental assistance.

Palbusa and Gauvain (2017) conducted a study examining how students' perceptions of their parental support varied between freshman 1st-gen and 2nd-gen students. This study is one of the few to explicitly test hypotheses pertaining to differences in instrumental support provided by parents of 1st- and-2nd-gen students. Students reported how they perceived several aspects of their communication with parents, such as helpfulness, overall quality, emotional support, and both the resourcefulness and usefulness of instrumental support. Other pertinent data such as student-generation, GPA, and high school grades were obtained from institutional records. The authors found that 1st-gen students perceived an equal degree of emotional support from their parents. However, 1st-gen students' communication with parents was perceived as less helpful, of lower quality, and provided less instrumental support in terms of both resourcefulness and usefulness. Critically, a follow-up analysis revealed that perceived quality of parental communication predicted GPA for 2nd-gen students, but not for 1st-gen students. This demonstrates that parents of 2nd-gen students are a valuable asset for their academic success, one which 1st-gen students do not have access to.

Academic Preparation Before College

First-generation students enter university at a disadvantage due to two major factors. The first, as noted above, pertains to the lack of support and relevant knowledge available from their parents. The second concerns a lack of academic preparation during their high school years.

First-generation students decide to pursue higher education later than 2nd-gen students. Choy (2001) reported that among students in the tenth grade, only 55% of students whose parents did not have a university degree aspired to earn degrees themselves, compared to 86% of students whose parents had a degree. This trend applies to Canadian high school students as well. Finnie et al. (2010) found that Canadian 1st-gen students were less likely to report having always known that they would attend university (24% vs. 31%) and were more likely to have decided to attend university in their final year of high school (31% vs. 26%). This may explain, in part, why 1st-gen students are less likely to take courses in high school that better prepares them for success in higher education.

Warburton et al.'s (2001) analysis of the 1995-98 beginning postsecondary student study focused on the relationship between secondary school curriculum and achievement in higher education as a function of student-generation. These researchers found differences between 1st-gen and 2nd-gen students in terms of the rigor of their high school curriculum. 1st-gen students were more likely to have taken basic coursework in high school (40% vs. 28%), and less likely to have taken a rigorous curriculum (9% vs. 22%). Rigorous curriculums included advanced math and science courses, foreign language courses, and at least one advanced placement or honours course. Moreover, 1st-gen students were more likely to score in the lowest quartile on their college entrance examinations (37% vs. 15%), and less likely to score in the highest quartile (13% vs. 33%). Not surprisingly, both rigor of high school curriculum and entrance examination scores were strongly related to university GPA and rates of graduation. More recent national survey data suggest that these patterns persist today (Cataldi et al., 2018)

Critically, Warburton et al. (2001) found that among students who took a rigorous high school curriculum, there were no differences in three-year GPA or attrition rates between 1st-gen and 2nd-gen students. This indicates that sufficient academic preparation prior to college can reduce or even eliminate the achievement differences between 1st-gen and 2nd-gen students. It also alludes to a more substantial conclusion; not all 1st-gen students are at risk of academic failure. And, even for the majority of 1st-gen students who enter university less prepared, positive postsecondary experiences and a strong sense of individual motivation can serve as crucial buffers from the threat of academic failure.

The Impact of Postsecondary Experiences

Although 1st-gen students typically enter university at a disadvantage relative to 2nd-gen students, this disadvantage does not necessarily persist. A growing body of research indicates that 1st-gen students can compensate for their initial deficits through assiduous engagement with academic activities (Aspelmeier, Love, McGill, Elliott, & Pierce, 2012; Pascarella et al., 2004; Terenzini et al., 1996). 2nd-gen students typically develop a foundation of strong academic skills through rigorous high school coursework; for 1st-gen students, this development typically occurs after they begin their postsecondary education (Hahs-Vaughn, 2004).

Terenzini et al., (1996) conducted one of the first comprehensive studies examining the differential effects of college experiences between 1st-gen and 2nd-gen students using data from the first year of the 1992-95 national study of student learning. They found that 1^{st}-gen students, despite having lower pre-college scores on standardized reading, math, and critical thinking exams, had one-year gains on math and critical thinking that matched those of 2^{nd}-gen students. Moreover, the number of hours students spent studying predicted gains in reading ability for 1^{st}-gen students, but not for 2^{nd}-gen students. They also found that number of credit hours completed strongly predicted gains in critical thinking for 1^{st}-gen students, but had no association for 2^{nd}-gen students. This evidence suggests that 1^{st}-gen students can overcome their relative lack of skills at the beginning of college if they are highly engaged with their coursework. Further evidence supporting this argument can be gleaned from the work of Pascarella et al., (2004).

Pascarella et al., (2004) used data from all three years of the 1992-95 national study of student learning to assess differences in 2^{nd}-year and 3^{rd}-year outcomes between 1^{st}-gen and 2^{nd}-gen students. Their results were notable inasmuch that they strongly suggested a *lack* of substantial difference; findings of no difference were more common than not, and differences that did exist were of small magnitude. However, the authors found frequent and substantial differences in the conditional effects, showing that 1^{st}-gen students benefitted more from academic engagement than 2^{nd}-gen students. Salient examples include, for 1^{st}-gen students only, the number of written reports predicting higher writing skills, openness to challenge, and learning for self-understanding, and the degree of academic engagement predicting higher degree plans, openness to challenge, and internal locus of control. The authors summarized their findings by concluding that 1^{st}-gen students derive a larger ‘bang-for-the-buck’ from their college experiences than 2^{nd}-gen students; other authors have reached similar conclusions.

Hahs-Vaughn (2004) examined how pre-college traits and experiences-once-enrolled differed between 1^{st}-gen and 2^{nd}-gen students in predicting their educational outcomes. She used structural equation modeling to analyze data from the nationally representative 1989-94 beginning postsecondary student longitudinal study. The identified model contained three latent factors. The first factor, precollege traits, was a composite of measured variables including mother's and father's education, expected highest degree, and SAT/ACT scores. The second factor, college experiences, was composed of indicator variables assessing academic experiences (e.g., participation in study groups), non-academic experiences (e.g., hours worked, participation in intramural sports), and number of completed credit hours per semester. The third factor, educational outcomes, was composed of measured variables assessing GPA, degree earned, and future degree aspirations. Hahs-Vaughn found that, for 2^{nd}-gen students, pre-college traits was a much stronger predictor of educational outcomes than college experiences (.75 vs .17, respectively). This pattern was reversed for 1^{st}-gen students, such that pre-college traits was a less substantial predictor of educational outcomes than college experiences (.28 vs .42, respectively).

The findings that 1^{st}-gen students' academic outcomes are determined by their university experiences rather than their precollege traits has led some researchers to question the 'risk-factor' paradigm commonly associated with research on 1^{st}-gen students. Aspelmeier et al., (2012) posited that being a 1^{st}-gen student may instead be a 'sensitizing factor' such that these students are harmed more by negative academic experiences and psychosocial factors, but they may also benefit more from positive university experiences. These researchers tested this hypothesis by examining possible interactions between student-generation and two salient psychosocial variables, self-esteem and locus of control. For self-esteem, they found that 1^{st}-gen students with low self-esteem scores had lower personal-emotional adjustment to university than

2^{nd}-gen students with low self-esteem scores, but there was no difference between these groups if they had high self-esteem scores; these findings supported a ‘risk-factor’ model.

However, for locus of control, the authors found evidence which supports the ‘sensitizing-factor’ model. Specifically, relative to 2^{nd}-gen students, 1^{st}-gen students who reported low internal locus of control had poorer academic adjustment, but those who reported high internal locus of control had marginally higher academic adjustment. Similarly, a significant interaction between student-generation and external locus of control in predicting academic adjustment suggested that 1^{st}-gen students are hindered more by high externality but also benefit to a marginally greater extent by having low externality.

Overall, it appears that the academic trajectories of 1^{st}-gen students are more labile than those of 2^{nd}-gen students. 1^{st}-gen students may fail to capitalize on the growth opportunities afforded by post-secondary education, or they may thrive in the face of novel academic challenges in order to achieve their goals. The critical determinant of these two disparate outcomes seems to result from differences in motivation.

The Importance of Motivation and Achievement

Some would argue that success in postsecondary education is ultimately determined by students’ motivation. Over the course of their academic careers, students must spend countless painstaking hours studying for tests, writing term papers, conducting experiments, or otherwise working on academic projects. Moreover, students have to overcome common yet potentially debilitating academic obstacles such as boredom, anxiety about future performance, or profound disappointment after receiving a poor grade; these circumstances would be impossible to overcome without a strong sense of individual motivation. However, several researchers contend that motivational factors may be especially crucial to the success of 1^{st}-gen students (Aspelmeier et al., 2012; Naumann, Bandalos, & Gutkin, 2003.; Pascarella et al., 2004). Their argument, stated simply, is that 2nd-gen students are able to rely on their parents for guidance, but 1st-gen students cannot. 1st-gen students often must rely strictly on themselves in order to overcome academic challenges, and may consequently need to be more highly motivated than 2nd-gen students in order to achieve the same level of success.

An emerging pattern of findings suggests that 1st-gen students' motives for attending university differ from those of 2nd-gen students. 1st-gen students appear to be more focused on learning and achieving good grades, whereas 2nd-gen students tend to also focus on social aspects of their postsecondary experience. For example, Bui (2002) showed that 1st-gen and 2nd-gen students rated their reasons for pursuing higher education differently. 1st-gen students gave lower ratings than 2nd-gen students on two items, the desire to move out of their parent's home, and that their siblings or other relatives had gone to college. Alternatively, 1st-gen students gave higher ratings to the following three items, the desire to gain respect/status, bring honor to their family, and assist their family financially after graduation. This suggests that 1st-gen students may value achievement leading to attainment of a degree more so than 2nd-gen students, with social rewards such as moving out of the family home being comparatively less salient. Evidence from two additional studies supports this interpretation.

Martinez et al. (2009) investigated which pre-college characteristics and/or aspects of the college experience, if any, might moderate the relationship between student-generation and attrition. They had the goal of identifying sub-groups of 1st-gen students which have a high risk of attrition, in order to identify those most in need of academic interventions. For pre-college characteristics, the authors assessed high school grades, ACT scores, and four scales representing different postsecondary aspirations, these were labeled as party, edification, career, and date/mate aspirations. The authors also measured several factors of attrition pertaining to experiences during college, such as job status, cumulative GPA across semesters, alcohol and drug use, academic and social challenges, and psychological distress. This study had a large sample and a four-year longitudinal design. The authors found that GPA was the only variable that significantly moderated the association between student-generation and attrition, such that 1st-gen students with low GPAs were at a higher risk of attrition than 2nd-gen students with low GPAs. Additionally, their results indicated that 1st-gen students had stronger career aspirations, and weaker party and date/mate aspirations relative to 2nd-gen students. This supports the proposition that 1st-gen students are more likely to be focused on their academic success, and having a low GPA may be interpreted as a signal that they are not able to achieve their career goals.

Although they did not include 2nd-gen students as a comparison group, the work of Dika and D'amico (2016) further highlights the importance of academic achievement in determining the persistence of 1st-gen students. The researchers conducted a two-year study examining factors of attrition for 1st-gen students in STEM and non-STEM programs at a large research institution. They found that among the 15 variables assessed, first-semester GPA was the only significant predictor of second-year enrollment across majors. Specifically, they found that a 1-unit increase in GPA corresponded with a 1.41 to 1.80 increase in the odds of persistence.

Based on the literature, it appears that academic interventions most likely to benefit at-risk 1st-gen students are those which can equip these students with the motivational mindset necessary for remaining academically engaged in order to achieve good grades and ultimately earn their degrees. One intervention that meets these criteria is attributional retraining (AR), an attribution-based intervention founded on the principles of Weiner's attribution theory. At-risk

1st-gens may be particularly amenable to this treatment, given that they may be actively seeking strategies to improve their achievement, and are less distracted by social goals in college.

Attribution Theory

The attributional approach to the study of human behavior can be linked to a host of different progenitors, which reflects the broad diversity of domains in which attributional principles can be applied (Weiner, 2008). However, many scholars agree that the origins of attribution theory can be traced to Heider's (1958) seminal work, *The Psychology of Interpersonal Relations*. Heider recognized that virtually every person develops a functional knowledge of social relationships, such that they naturally become able to predict, be aware of, and understand the interpersonal consequences of their actions and the actions of others. In this way, every instance of human interaction is influenced by the naïve, or common-sense, psychology of those involved. Heider had the goal of applying a scientific and systematic scaffolding onto the fundamental truth that is naïve psychology. In doing so, he posited a profound and resonating principle of social psychology; it is one's subjective construal of the causes of an event or outcome, and not the objective reality, that affect future motivated behavior. As Heider (1958, pg. 5) put it, "if a person believes that the lines in his palm foretell his future, this belief must be taken into account in explaining certain of his expectations and actions."

In addition to Heider's contributions, the current incarnation of attribution theory is built upon the conceptual and empirical work of Rotter (1966), the first psychologist to introduce and empirically validate the construct of locus of control. Across several quantitative studies, Rotter observed that people varied in their perceptions of control over reinforcement or reward, such that they could be classified as either internals or externals in their locus of control.

Internals are people who believe that reinforcement is caused by qualities originating from within themselves, such as ability, skill, or effort. Conversely, externals are people who believe that reinforcement is caused by external forces, such as luck, fate, or powerful others. Rotter suggested that, within achievement domains, having an internal locus of control is more adaptive than having an external locus of control, as it is associated with greater achievement striving. Early research on locus of control can be regarded as the first dimensional analysis of causal, or explanatory, thinking. Attribution theory deviates from locus of control research by assuming a more comprehensive taxonomy of causal thinking.

In 1985, Weiner published his attributional theory of achievement motivation and emotion, culminating an impressive literature emerging to that point (e.g., Weiner, 1979; Weiner & Kukla, 1970; Weiner, Heckhausen, & Meyer, 1972). This article led to attributional perspectives advanced in the domains of interpersonal motivation, health motivation, and social justice (Haynes-Stewart, Chipperfield, Perry, & Weiner, 2012; Weiner, 2000, 2006). Recently, within the context of psychology's 'replication crisis', Weiner (2018) reflected on the considerable empirical support for attribution theory across domains, referring to attributional principles as a 'no-crisis zone'. A brief summary of attribution theory as applied to the achievement domain follows.

Attribution theory is guided by the metaphor that humans are intuitive scientists, seeking to identify cause-effect relationships for relevant outcomes in their lives. As such, the attributional process begins with the spontaneous activation of a causal search after an outcome that is unexpected, negative, or otherwise important to the individual. Causal search is engendered by two fundamental motivational needs: *need for mastery* refers to the innate desire to understand one's environment and oneself, and the *need for functional knowledge* refers to the desire people have to prevent negative outcomes from occurring in the future, or to ensure that positive outcomes are subsequently repeated. People use relevant knowledge in their causal searches in order to arrive at specific causal ascriptions. These ascriptions can be systematically categorized into three dimensions of causality, namely, locus, stability, and controllability (Weiner, 1979, 1985).

The first causal dimension is locus of causality; causal attributions can be distinguished by whether the cause is internal or external to an individual. The locus dimension is directly linked to affective consequences for pride and self-esteem, such that these feelings are influenced by internal attributions but are unchanged by external attributions. Within the achievement domain, a typical internal attribution pertains to academic aptitude. If a negative outcome (e.g., failing a test) is ascribed to low aptitude, this will decrease the student's self-esteem and pride. Conversely, if a positive outcome (e.g., a grade of A+) is ascribed to high aptitude, the student will experience an increase in self-esteem and pride. A common external attribution for academic performance is the quality of the teacher, so if a student attributes a poor grade to a poor teacher, or a high grade to an easy marker, their pride and self-esteem will be unaffected because the cause is external to the student.

Stability, the second dimension of causality, refers to whether a cause is perceived as being permanent or transient. Stability is directly linked to cognitive changes in expectancy of future success, and changes in hope. Aptitude is typically perceived as a stable cause, such that perceived failures attributed to low aptitude lower expectancy of future success and induce feelings of hopelessness, whereas successes ascribed to high aptitude have the opposite effect on expectancy and hope.

As an example of an unstable cause, students may attribute their poor test performance to being ill on the day of the test. Because their illness is temporary, these students will expect their performance on subsequent tests to improve and experience feelings of hope.

The third dimension, controllability, refers to whether the cause is perceived as being subject to volition. The controllability dimension covaries to a large extent with the locus and stability dimensions, such that external causes are often perceived as uncontrollable, and internal/unstable causes are often perceived as controllable. However, this dimension is unique, and necessary for generating specific hypotheses for the cognitive, affective, and behavioral consequences of causal attributions. The importance of the controllability dimension is exemplified by the disparate effects of two prototypical attributions for a negative achievement outcome, namely, low aptitude and low effort.

Negative outcomes attributed to low aptitude are largely perceived as being internal/stable/uncontrollable. Consequently, a student with this mindset will experience a decrease in their expectations for success, pride, self-esteem, and hope, leading to reduced achievement striving, consistently poor grades, and higher risk of attrition. The pernicious logic of such an attribution is as follows, if nothing can be done to improve, why bother trying? In contrast, an attribution to low effort is typically perceived as being internal/unstable/controllable. In the wake of a perceived failure, students with this mindset will often experience low pride and low self-esteem, but they will also often feel hopeful and expect to improve their performance as they increase their effort. This leads to enhanced achievement striving, achievement gains, and an increase in both persistence and resilience. The controllability dimension is essential within the taxonomy of causal thinking, and is an effective means for broadly classifying causal attributions as they relate to academic achievement. Simply stated, uncontrollable attributions are maladaptive because they reduce motivation, whereas controllable attributions are adaptive because they sustain or increase motivation. Communicating these principles is the focus of attributional retraining, an academic intervention with over three decades of supporting evidence.

Attributional Retraining

Wilson and Linville (1982) conducted the first attributional retraining (AR) intervention study involving young adults, and twice replicated their original results within three years (1985). Freshman college students with low GPAs and high academic anxiety were randomly assigned to either a treatment or a control condition. For those in the treatment condition, an experimenter presented statistical information indicating that GPAs typically improve after the first year of college, and showed videotaped interviews with senior undergraduates who discussed how their grades improved after their first year. In the control condition, participants received filler statistical information, and watched interviews with senior undergraduates who did not discuss their grades. Across all three studies, the researchers found that participants in the treatment condition had significantly increased their GPAs and had higher rates of persistence than those in the control condition. This AR treatment focused on the stability dimension of causal thinking, inasmuch that it induced students to believe that their low GPAs were caused by unstable factors that could change over time. However, an alternative version of AR focused on locus and controllability has demonstrated equal, or even greater, efficacy.

Perry and Penner (1990) examined the moderating role of locus of control on AR treatment effects in a laboratory-based study that afforded well designed experimental controls. Their experimental condition consisted of showing students an eight-minute video of a psychology professor explaining the adaptive value of attributing unsatisfactory academic outcomes to low effort, and attributing successes to a combination of high ability and high effort.

They found a significant AR × Locus of control interaction, whereby externals in the treatment condition, relative to control, had higher performance on a test administered immediately after treatment and on another test administered one week later. They found no treatment effects for internals. These findings underscore the importance of psychosocial moderators when examining AR treatment effects, a paradigm of experimental design which characterized subsequent AR studies.

Over the past 30 years, AR studies consistently show that treatment effects are moderator-based, such that they are strongest for students characterized by social or academic risk factors (Perry & Hamm, 2017). AR has been found to improve cognitive and affective outcomes, performance, and the persistence of students with unrealistic optimism, low cognitive elaboration, low perceived control and high boredom, high stress, and low initial course performance (Hamm, Perry, Chipperfield, Murayama, & Weiner, 2017; Haynes-Stewart, Ruthig, Perry, Stupnisky, & Hall, 2006; Parker, Perry, Hamm, Chipperfield, & Hladkyj, 2016; Parker, Perry, Chipperfield, Hamm, & Pekrun, 2018; Perry, Stupnisky, Hall, Chipperfield, & Weiner, 2010). The critical similarity between these studies is greater efficacy for students who are academically at-risk. Thus, it appears that AR may be a viable means for improving the attributional mindset, performance, and persistence of at-risk 1st-gen students. But how does one clarify if a 1st-gen student is truly at-risk of poor achievement outcomes? To determine this, it is necessary to examine known psychosocial determinants of achievement, such as perceived control beliefs.

Perceived Control Beliefs in Post-secondary Learning Environments

Perceived control reflects beliefs about one's subjective capacity to influence events (Lachman, 2006; Pekrun, 2006; Pekrun & Perry, 2014). Research on perceived control in achievement settings focuses on a domain-specific construct of perceived academic control (PAC). PAC is a reliable predictor of higher college achievement and lower rates of course withdrawal and institutional drop-out (Perry et al., 2001, 2005; Respondek, Seufert, Stupnisky, & Nett, 2017; Respondek, Seufert, Hamm, & Nett, 2019), as well as better emotional and psychological well-being (Ruthig et al., 2008; Ruthig, Haynes-Stewart, Stupnisky, & Perry, 2009). For example, in a three-year field study, Respondek et al. (2019) demonstrated strong relationships between PAC, GPA, and drop-out, as well as evidence that changes in PAC and GPA reciprocally influence one another and institutional withdrawal. Recent meta-analyses are consistent with these findings in showing that a component of PAC (academic self-efficacy) is the strongest psychosocial correlate of college GPA and retention (Richardson, Abraham, & Bond, 2012; Schneider & Preckel, 2017). 1st-gen students report lower academic self-efficacy (Hellman & Harbeck, 1996; Wang & Casteneda-Sound, 2008), as well as lower self-regulation in online learning environments (Williams & Hellman, 2004). Thus, 1st-gen students are likely to have low PAC relative to 2nd-gens, and students with low PAC are at-risk of academic failure, personal distress, and dropping-out of courses. Furthermore, the state of feeling ‘out of control’ is exacerbated by school-to-college transitions in Year-1 and beyond (Perry et al., 2001; Perry et al., 2005).

AR can be described as a control-enhancing motivation treatment because its primary function is to shift students’ causal attributions from the uncontrollable dimension to the controllable dimension. Recent empirical evidence demonstrates that AR is an effective treatment for students reporting low PAC (Parker et al., 2016; Parker et al., 2018). Moreover, AR treatment may be best suited for students exhibiting the following specific combination of risk factors: 1st-gen students with low PAC, undergoing the transition period from high school to university.

Attributional Retraining: Efficacy for Low Control First-generation Students

Newly enrolled 1st-gen students with low PAC are prime candidates for AR intervention. Based on past studies, it can be assumed that these students highly value their academic success. They desire the upward social mobility that accompanies earning a degree, to gain status, honor their family, and assist their family financially (Bui, 2002). They also place academic goals above social goals (Martinez et al., 2009), and their decision to persist or drop-out is based primarily on their GPA (Martinez et al., 2009; Dika & D'amico, 2016). However, despite having greater potential to develop their academic skills through sustained course engagement and effort (Hahs-Vaughn, 2004; Pascarella et al., 2004; Terenzini et al., 1996) these students believe that they lack control over their grades, and cannot rely on their parents for help (Palbusa & Gauvain, 2017). In other words, they desire success, and have the potential to succeed, but do not know *how* to succeed. Moreover, these students may be particularly sensitive to cues within their environment, such as initial successes or failures, as well as messages which either discourage or encourage motivation (Aspelmeier et al., 2012).

This is why AR intervention during the high school-university transition may prevent low PAC 1st-gen students from disengaging from coursework, having low GPAs, and dropping-out. AR lets these students know that they *do* have control over their success, that their effort and strategy are what determine their grade, that anyone with the right mindset can improve in the face of academic setbacks, and provides specific advice for how to change one's mindset from maladaptive to adaptive. This kind of motivational information is precisely what low PAC 1st-gen students need to hear, and they are thus the most likely to adopt its message. For high PAC students, regardless of their student-generation, it can be assumed that the principles of AR are already implicitly known and put into practice. For these students, receiving AR is like taking medicine to treat a disease they do not have; it will not have an effect. For 2nd-gen students with low PAC, although AR content may be relevant to them, they are less likely to attend and adopt its message, as their motivation and success can be supported by their parents instead.

Consider the following scenario. Two introductory psychology students with low PAC receive a grade of D on their first multiple-choice course test. One is a 1st-gen student, the other is a 2nd-gen student. The 2nd-gen student is saddened by their poor grade, but her causal search process eventually leads her to think, “my mother earned a bachelor’s degree, and if she can do it, I can do it.” The 2nd-gen student then contacts their mother for advice, and she tells the student about her own academic setbacks in college, and provides guidance on effective study strategies for multiple-choice tests. The 2nd-gen student uses the advice and improves her subsequent performance to earn a final course grade of a B.

In contrast, the 1st-gen student is saddened by this negative outcome, but her causal search process leads her to think, “my parents never earned a degree, maybe I do not come from a smart enough family to succeed in university”. The 1st-gen student’s low expectations of success and feelings of decreased self-esteem, pride, and hope prevent her from believing that increasing her effort will improve her grades, and after similarly poor performance on subsequent tests she decides to drop the course.

Although this is a hypothetical scenario, it is plausible; a recent qualitative study found evidence to suggest that 2nd-gen students enter university inoculated to the risks of making low aptitude attributions for negative achievement outcomes (Nichols & Islas, 2015). For low PAC

1st-gen students, AR has the potential to disrupt this sequence of maladaptive attributions leading to subjective distress and academic disengagement.

Hypotheses

This study's set of hypotheses pertain to three specific objectives. The first objective is to replicate past findings that 1st-gen students are at a disadvantage relative to 2nd-gen students in terms of SES, academic mindset, performance, and persistence. Specifically, I hypothesized that 1st-gen students will have lower family income, high school grades, pre-treatment PAC, initial test performance, and final grades, as well as higher rates of drop-out, and higher rates of attributing initial course performance to uncontrollable causes (e.g., low ability, poor teaching, task difficulty).

The second objective is to replicate and extend findings demonstrating conditional effects of psychosocial motivation factors according to student-generation. This objective is based on the work of Aspelmeier et al., (2012), and Naumann et al., (2003), who found that internal locus of control or performance expectations, respectively, were stronger predictors of academic outcomes for 1st-gen students than 2nd-gen students. I extended their work by examining if the relationship between students' PAC and relevant psychosocial and performance outcomes would vary according to student-generation. Specifically, I hypothesized a PAC × Student-generation interaction, such that 1st-gen students' initial PAC scores are a stronger predictor of high school grades, initial test performance, final grades, rates of course withdrawal, and endorsement of attributions to uncontrollable causes at a 5-month follow-up than 2nd-gen students' PAC scores. The results of these hypotheses simultaneously allow for a comparison of 1st-gen students who report low (–1 SD) vs. high (+1 SD) initial PAC, to determine if this is a valid measure with which to distinguish between 1st-gens who are academically at-risk and those who are not at-risk.

The third and focal objective is to empirically demonstrate that AR can be an effective treatment for 1st-gen students with low PAC. Specifically, I hypothesized that low PAC 1st-gens who receive AR, compared to their no-AR peers, will have higher post-treatment PAC and final grades, and lower post-treatment rates of attributing course performance to uncontrollable causes, as well as lower rates of course withdrawal. An AR × PAC interaction is implicit in these hypotheses, but the greater focus is placed on tests of simple slopes (i.e., the differences in slopes between AR and no-AR conditions at the specific values of PAC = –1 SD and student-generation = 1st-gen) because it is possible to find evidence of simple slope differences in the absence of a statistically significant interaction (Hayes, 2018). Beyond tests of simple slopes, I hypothesized that the effect of AR on final grades will be mediated by the hypothesized increase in post-treatment PAC and decrease in post-treatment attributions to uncontrollable causes. This represents a test of moderated-mediation, as it provides information regarding for whom the treatment is effective (e.g., low PAC 1st-gen students) and how the treatment worked (e.g., by improving control-oriented academic mindset).

Methods

Participants and Procedures

Participants (*N* = 782) in this longitudinal, pre-post, randomized treatment field study were enrolled in an online, two-semester introductory course in a research-intensive university. Students who reported neither parent as having a bachelor's degree, or higher degree, were categorized as 1st-gen (*n* = 338; 43.2% of the study sample); the remaining students were 2nd-gen (*n* = 444; 56.7% of the study sample). The majority of 1st-gen students were female (65.5%), between the ages of 17-20 (85%), reported English as their first language (82%), and were in their first year of university (79.6%). Similarly, 2nd-gen students were primarily female (57.2%), between the ages of 17-20 (90%), reported English as their first language (77.5%), and were in their first year of university (74.5%).

The complete AR treatment protocol was administered over five discrete time points spanning the two-semester course. At *Phase 1* (October), students received performance feedback on the first course test. Approximately one week later at *Phase 2* (October), students completed an online questionnaire via a secure website. *Phase 3* immediately followed Phase 2, whereby the website randomly assigned students to either a treatment or control condition using automated software (Shadish, Cook, & Campbell, 2002).

The automated software was programmed to assign 70% of participants to the AR condition (n = 520) and 30% of participants to the control condition (n = 262) at the request of the department head. This procedure of simple random assignment with unequal probabilities (see Alferes, 2012) was employed as part of a departmental initiative to provide AR to as many introductory psychology students as possible.

At *Phase 4* (March), students completed a follow-up questionnaire via the same secure website. At *Phase 5* (May), student performance and withdrawal data were obtained from course instructors. Analyses were conducted on participants with complete data on the main study variables, who provided consent for their questionnaire, performance, and withdrawal data to be used for research.

Independent Variables (see Table 1 for Ms, SDs, αs)

Student-generation (Phase 2, see Appendix A). Students reported the highest degree or level of school completed by their mother and father, based on scales used in the Canadian census (See Appendix A). Students who reported both parents with less than a bachelor's degree were categorized as 1st-gen students (0 = 2nd-gen, 1 = 1st-gen). An additional variable, "are you the first person in your family to attend university" (1 = *yes*, 2 = *no*) was used to categorize students who reported one parent with less than a bachelor's degree and 'don't know' for the other parent, or who reported 'don't know' for both parents. If these students responded "yes" to the additional variable, they were categorized as 1st-gen.

Pre-treatment perceived academic control (PAC; Phase 2, see Appendix B). The domain-specific, eight-item PAC scale assessed students' perceived influence over achievement outcomes in an academic setting (e.g., "The more effort I put into my courses, the better I do in them;" Perry et al., 2001; Perry et al., 2005). The scale had good psychometric reliability (Cronbach's α = .83) and test-retest reliability (r = .57), in keeping with previous research (Hall, Perry, Chipperfield, Clifton, & Haynes-Stewart, 2006; Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010, Perry et al., 2001; Perry et al., 2005, Ruthig et al., 2009; Stupnisky, Renaud, Daniels, Haynes-Stewart, & Perry, 2008).

Online AR treatment protocol (Phase 3). A three-stage AR treatment protocol based on Weiner's (1979, 1985, 2018) attribution theory was administered one week after students received their Test 1 grades. Stage 1, *causal activation*, involved students completing a scale rating the extent to which several common causal attributions represented reasons for their course performance. This procedure is designed to induce students to explicitly consider the causal attributions they use to explain their performance on the test.

Stage 2, *attribution induction*, involved administering an online AR video that focused on the grade-enhancing impact of endorsing controllable attributions rather than uncontrollable attributions for unsatisfactory achievement outcomes. It described how causal attributions for achievement outcomes can be classified based on the dimensions of locus (internal, external) and controllability (controllable, uncontrollable) in a four-cell matrix.

The video noted that students benefit most in terms of motivation and future academic performance from attributing poor academic outcomes to internal and controllable causes. It also described how attributing poor academic performance to uncontrollable causes can reduce students' motivation, leading to a self-fulfilling prophecy of failure. A discussion of the stability dimension of causal attributions was omitted to ensure that the treatment message was as focused and simple as possible.

Stage 3, *attribution consolidation*, involved an exercise in which students were required to summarize the AR video content and explain how they can apply its message to their own lives. See Perry, Chipperfield, Hladkyj, Pekrun, and Hamm (2014) and Perry and Hamm (2017) for reviews of the research literature using this three-stage AR protocol.

In the no-AR control condition, students were shown an online video detailing how psychological principles of illusory visual perception have been employed by famous artists. This video was selected as an adequate control stimulus because it was related to lecture content of the introductory psychology course, but contained no information regarding motivation or achievement. This filler video was approximately equal to the AR video in duration. Students in the control condition completed a similar consolidation exercise; they were required to summarize the content of the video, and write about how it could be applied to their lives. All students completed Stage 1, causal activation.

Dependent Variables

Attributions to uncontrollable causes (Phase 4, see Appendix C). In March, five months post-AR treatment, students rated the extent to which three uncontrollable causes (i.e., low ability, course difficulty, poor teaching; Perry, Stupnisky, Daniels, & Haynes-Stewart, 2008) contributed to their course performance (1 = *not at all*, 10 = *very much so*). This scale had an acceptable level of psychometric reliability (Cronbach's $\alpha = .66$). Baseline levels of these attributions (*Phase* 2) were measured prior to the AR treatment. The baseline scale had an acceptable level of psychometric reliability (Cronbach's $\alpha = .63$). This scale had strong test-retest reliability ($r = .58$).

Post-AR treatment Perceived Academic Control (PAC; Phase 4). Five months post-treatment, students completed a second PAC scale, identical to the first. This scale had good psychometric reliability (Cronbach's $\alpha = .84$).

Final course grade[1] (Phase 5). Final course grade data based on two semesters were provided by the course instructors (with student permission) which represent students' actual course performance on a 100-point percentage metric.

Voluntary course withdrawal (VW; Phase 5). VW data were provided by the instructors (with student permission) that noted whether students withdrew from the online course over two semesters (0 = *did not drop class*, 1 = *dropped class*).

Covariates

Pre-treatment Test 1 (Phase 1). Students wrote their first test on course content four weeks into Semester 1 and received feedback one week prior to the AR treatment.

Family income (Phase 2, see Appendix D). Self-reported family income was assessed with a 7-point item (1 = *<$20 000*, 6 = *>$100 000*; 7 = *'don't know'*). Approximately 33% of students responded 'don't know' to this item, and were thus omitted from any analyses including income as a covariate.

[1] When testing for AR (vs. No-AR) simple slopes, the final grade outcome was modified slightly to omit pre-treatment test performance. These outcomes represent differences in aggregate achievement for all graded tests and assignments that occurred after AR treatment. Initial test performance was included as a covariate in these analyses to control for any differences in pre-treatment achievement.

High school grade (HSG; Phase 2). Self-reported HSG (percentage) was assessed with a 10-point item (1 = *50% or less*, 10 = *91-100%*) and used as a proxy for actual high school achievement based on a strong relation between the two (r = .84, Perry et al., 2005). High school grade was deemed a reasonable measure of baseline academic skills, competencies, and knowledge, as recent evidence indicates that high school grades predict college performance and graduation better than standardized entrance exams (e.g., SAT or ACT; Galla et al., 2019; Schneider & Preckel, 2017). Canadian universities use HSGs rather than standardized entrance exams as their primary admissions criterion.

Age (Phase 2, see Appendix E). Students reported their age using a 10-point item (1 = *17–18*, 10 = *older than 45*).

Gender (Phase 2). Gender was coded categorically (0 = *female*, 1 = *male*).

Results

Rationale for Analyses

Hypotheses for objective 1 focused on examining differences between 1st- and 2nd-gen students. I selected a series of one-way analyses of variance (ANOVAs) as appropriate for testing these hypotheses, because the independent variable, student-generation, was categorical and all outcome variables were continuous data, with the exception of course withdrawal. I conducted Levene's test for homogeneity of variance on all ANOVAs and used Welch's statistic based on an asymptotic F distribution for inferences on all tests displaying evidence of variance heterogeneity. Cohen's d values are reported as measures of effect size for these analyses, which represent the estimated differences between 1st-and 2nd-gen students in a standardized metric. I examined the data to ensure that they reasonably adhered to the major assumptions of general

Table 1.
Descriptive Statistics of Continuous Variables

Study Variables	*M*	*SD*	Actual Range	Cronbach α	*M*	*SD*	Actual Range	Cronbach α
PAC[b] (Time 1)	31.89	5.47	8-40	.83	32.39	5.42	11-40	.83
AUC[b] (Time 1)	13.30	5.93	3-30	.64	13.30	5.58	3-30	.61
PAC[c] (Time 2)	31.75	5.74	17-40	.85	32.26	5.50	17-40	.84
AUC[c] (Time 2)	12.53	6.16	3-25	.69	11.45	5.56	3-27	.62
Final grade[d] (%)	74.04	11.49	41.51-96.35	—	76.65	12.20	40.23-98.30	—
Test 1[a] (%)	64.45	14.23	25-100	—	68.21	15.60	30-100	—
Income[b]	3.99	1.49	1-6	—	4.67	1.46	1-6	—
HSG[b]	7.70	1.67	1-10	—	8.02	1.53	3-10	—
Age[b]	1.79	1.42	1-10	—	1.60	1.08	1-8	—

Note. HSG = high school grade; AUC = attributions to uncontrollable causes. Descriptive statistics for 1st-gen students (*n* = 219-338) presented to the left of the dividing space, descriptive statistics for 2nd-gen students (*n* = 325-444) presented to the right of the dividing space.
[a] Phase 1 measure (October). [b] Phase 2 measure (October). [c] Phase 4 measure (March). [d] Phase 5 measure (May).

linear modeling procedures, namely, linearity, homoscedasticity/homogeneity of variance, and normality, prior to conducting any analyses.

I used logistic regression analyses to examine differences in course withdrawal between 1^{st}-gen and 2^{nd}-gen students. Odds ratios are reported as measures of the relative probability of course withdrawal for 1^{st}-gen students compared to 2^{nd}-gen students. All students with complete data on the main study variables were included in these analyses.

Hypotheses for objective 2 focused on examining conditional effects of pre-treatment PAC between 1^{st}-gen and 2^{nd}-gen students. I used a series of moderated multiple regressions to test these hypotheses, in which student-generation, PAC, and the Student-generation × PAC interaction term were entered into the models simultaneously. I mean-centered all predictor variables prior to conducting these analyses, and probed the interactions to determine the predictive strength of PAC, in both an unstandardized and standardized metric (i.e. b and β coefficients), for 1^{st}-gen students and 2^{nd}-gen students separately. Subsequently, I used the resulting regression equations to generate predicted mean values on all relevant variables for 1^{st}-gen and 2^{nd}-gen students who reported low (-1 SD) vs. high (+1 SD) PAC, to verify my assumption that low PAC 1^{st}-gens would be highly at-risk of poor academic outcomes, whereas high PAC 1^{st}-gens would not be academically at-risk. Only students assigned to the no-AR condition were included in these analyses, because AR treatment effects may have otherwise confounded these results.

Hypotheses for objective 3 focused on examining the simple slopes of AR (vs. no-AR) as moderated by levels of student-generation and PAC. AR × PAC regression models were used to test hypotheses for 1^{st}- and- 2^{nd}-gen students separately. For 1^{st}-gen participants, a priori one-tailed tests assessed the AR × PAC interaction effect based on the directional prediction that AR (vs. no-AR) effects would increase in magnitude as PAC decreased. Follow-up simple slope regression analyses tested the primary hypothesis that AR would benefit 1st-gen students with low (-1 SD) but not high (+1 SD) levels of PAC (Aiken, West, & Reno, 1991; Hayes, 2018). The same analyses were conducted with 2nd-gen students using two-tailed tests, as I did not specify directional hypotheses for these participants[2]. In keeping with previous AR field studies (Hamm et al., 2017; Hamm, Perry, Clifton, Chipperfield, & Boese, 2014), HSG, age, and gender were included in all analyses to control for the extraneous influence of these demographic factors on college achievement (see Richardson et al., 2012). I also examined AR efficacy in regression models with income included as a covariate, in order to separate AR effects from the influence of this additional indicator of SES. All predictor variables were mean-centered prior to analysis, and entered simultaneously into each regression equation.

Tests of moderated-mediation examined whether the AR treatment had an indirect effect on achievement through a sequence of psychosocial mechanisms specified by attribution theory (Weiner, 1985, 2012, 2018). Further details regarding moderated-mediation analyses can be found in the description of results. These analyses were also conducted separately for 1st- and-2nd-gen students.

Because the treatment variable was dichotomous, it was left in its original metric (0 = *no-AR*, 1 = *AR*) to facilitate interpretation. AR treatment effects are reported as both partially standardized (β), and unstandardized (b) regression weights. The former is conceptually analogous to Cohen's d, such that it represents the mean difference, in standard deviation units,

[2] On the basis on prior AR studies it may seem reasonable to assume that AR would also benefit 2nd-gen students with low PAC. However, because evidence suggests that 2nd-gen students' academic skills and abilities are more stable relative to 1st-gens (Hahs-Vaughn, 2004) and that 2nd-gen students have greater access to external academic support (Palbusa & Gauvain, 2017), I reasoned that the effects of AR on these students are too uncertain to make a directional prediction.

between the AR and no-AR conditions. The latter describes the mean difference between AR and no-AR conditions in raw units, which facilitates interpretation when the outcome variable is measured on an inherently meaningful scale (e.g., final course %).

Random Assignment Verification

The results of independent sample t-tests suggested that the automated software's random assignment procedure was successful. For both 1^{st}-gen and 2^{nd}-gen students, I found no evidence that the AR and no-AR treatment conditions differed in terms of pre-treatment demographic (gender, age), psychosocial (perceived control, attributions to uncontrollable causes), or performance (HSG, Test 1) variables (all *p*s > .15).

Zero-order correlations (see Table 2)

Correlation coefficients provided an estimate of the unadjusted relationships between the main study variables. In keeping with prior research, 1^{st}-gen students demonstrated an academic risk-profile: 1^{st}-gen status was associated with lower HSGs ($r = –.11$), income ($r = –.22$), pre-treatment test performance ($r = –.13$), final grades ($r = –.12$), and higher Time 1 attributions to uncontrollable causes ($r = .08$) and course withdrawals ($r = .10$). Time 1 PAC was associated with higher HSGs ($r = .16$), Test 1 performance ($r = .28$), final grades ($r = .23$), and lower Time 1 and Time 2 attributions to uncontrollable causes (r = –.52; $r = –.42$, respectively) and rates of course withdrawals ($r = –.19$). These correlations with PAC underscore the risk-profile of students who believe they lack control over academic outcomes. Moreover, both Time 1 and Time 2 attributions to uncontrollable causes were associated with lower Test 1 performance ($r = –.21$, $r = –.29$, respectively), and final grades ($r = –.18$, $r = –.34$, respectively), and higher rates of course withdrawals ($r = .17$, $r = .09$, respectively), pointing to the maladaptive mindset of

Table 2.
Zero-Order Correlations of Main Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Student-generation[b]	–											
2. PAC[b] (Time 1)	–.05	–										
3. AUC[b] (Time 1)	.08*	–.52*	–									
4. PAC[c] (Time 2)	–.05	.57*	–.37*	–								
5. AUC[c] (Time 2)	.10*	–.42*	.58*	–.53*	–							
6. Final grade[d] (%)	–.12*	.22*	–.18*	.32*	–.34*	–						
7. Course Withdrawal[d]	.10*	–.19*	.17*	–.13*	.09*	†	–					
8. Test 1[a] (%)	–.13*	.28*	–.21*	.29*	–.29*	.70*	†	–				
9. Income[b]	–.22*	.09*	–.15*	.16*	–.15*	.16*	–.03	.13*	–			
10. HSG[b]	–.11*	.16*	–.04	.12*	–.11*	.39*	–.12*	.34*	.18*	–		
11. Age[b]	.08*	.04	–.03	.07	–.10*	–.04	.04	.04	–.16*	–.29*	–	
12. Gender[b]	–.09*	.08*	–.12*	.09*	–.09*	.05	.04	.03	.10*	–.15*	.05	–

Note. HSG = high school grade; PAC = perceived academic control; AUC = attributions to uncontrollable causes. 2nd-gen students coded as 0 (n = 432), 1st-gen students coded as 1 (n = 333). Students who did not withdraw from the course coded as 0 (n = 690), students who withdrew coded as 1 (n = 75). Women coded as 0 (n = 465), men coded as 1 (n = 299). Correlations were calculated using pairwise deletion (n range = 441-765).
†Correlations between performance variables and course withdrawal are not provided by the university, which did not retain achievement data for students who dropped the course.
[a] Phase 1 measure (October). [b] Phase 2 measure (October). [c] Phase 4 measure (March). [d] Phase 5 measure (May).
* $p < .05$ (two-tailed tests).

students who attribute their performance to these uncontrollable causes. For final grade, I observed the strongest bivariate relationships with high school grade (r = .40). However, I also observed moderately strong relationships between final grade and Time 2 PAC (r = .32) and Time 2 attributions to uncontrollable causes (r = –.34), further underscoring the importance of a control-oriented mindset for academic achievement.

Objective 1: Differences between first-generation and second-generation students (see Table 3)

A series of one-way ANOVAs provided evidence to support the majority of my hypotheses. 1^{st}-gen students had lower family income [$F(1, 553) = 29.34$, $p < .001$, $d = .46$], high school grades [$F(1, 777) = 7.84$, $p = .005$, $d = .20$], Test 1 performance[3] [Welch's $F(1, 662.15) = 10.93$, $p = .001$, $d = .25$], and final grades [$F(1, 695) = 8.77$, $p = .003$, $d = .23$]. Based on the group means, 1^{st}-gen students had an average high school GPA of 76%-80%, and an average final letter grade of C+ (see Appendix F for the grading distribution of the introductory psychology class). In contrast, 2^{nd}-gen students had an average high school GPA of 81%-85%, and an average final letter grade of B. Both groups of students averaged a letter grade of C+ on the first course test. 1^{st}-gen students also had higher attributions to uncontrollable causes at Time 1 [$F(1, 780) = 5.57$, $p = .019$, $d = .17$]. The hypothesis that 1^{st}-gens would have lower pre-treatment PAC was not supported [$F(1, 772) = 1.63$, $p = .20$, $d = .09$].

Logistic regression analyses indicated a large difference in likelihood of course withdrawal between 1^{st}-and-2^{nd}-gen students. 1^{st}-gen students were more likely to withdraw from the course [OR = 1.91, CIs = 1.18 to 3.08, $\chi^2(1, N = 773) = 6.96$, $p < .001$]. An odds ratio of 1.91

[3] Levene's test for homogeneity of variance yielded a significant result for initial test performance, so Welch's statistic is reported.

Table 3.

Pre-treatment and Final Grade (%) Differences between 1st-gen and 2nd-gen Students

	1st-gens			2nd-gens					
Measure	*M*	*SD*	*n*	*M*	*SD*	*n*	*F*	*Cohen's d*	*p*
Test 1 (%)[a]	64.45	14.23	294	68.21	15.60	406	10.932[w]	.25	.001
Income[b]	3.99	1.49	221	4.67	1.46	334	29.344	.46	<.001
HSG[b]	7.70	1.67	337	8.02	1.53	442	7.84	.20	.005
PAC[b]	31.89	5.47	335	32.39	5.42	439	1.63	.09	.20
AUC[b]	13.30	5.93	338	12.32	5.58	444	5.57	.17	.019
Final Grade (%)[d]	70.03	14.85	292	73.39	14.67	405	8.77	.23	.003

Note. HSG = high school grade; AUC = attributions to uncontrollable causes.

[a] Phase 1 measure (October). [b] Phase 2 measure (October). [d] Phase 5 measure (May).

[w] Welch's statistic based on asymptotic *F* distribution

indicated that 1st-gen students were 91% more likely than 2nd-gen students to withdraw from the course.

Objective 2a: Are PAC relationships moderated by student-generation? (see Table 4 & Table 5)

I ran a series of moderated multiple regressions[4] to assess if PAC interacted with student-generation, with the prediction that PAC would be a stronger predictor of high school grades, Test 1 performance, Time 2 attributions to uncontrollable causes, final grades, and course withdrawal for 1st-gen students relative to 2nd-gen students. Of these five outcome variables, I observed a PAC × Student-generation interaction only for Time 2 attributions to uncontrollable causes [$b = -.29$, $t(194) = -1.78$, $p = .038$, CIs = –.551 to –.021], whereby the relationship between PAC and attributions to uncontrollable causes was stronger for 1st-gen students [$\beta = -.69$, $t(194) = -5.71$, $p < .001$, CIs = –.925 to –.510, $b = -.72$] compared to 2nd-gen students [$\beta = -.41$, $t(194) = -4.33$, $p < .001$, CIs = –.596 to –.267, $b = -.43$]. However, a pattern emerged across the performance outcomes. Despite the interaction effects not reaching statistical significance, PAC appeared to be a stronger predictor of Test 1 performance ($\beta = .41$ vs. $\beta = .27$) and final grades ($\beta = .36$ vs. $\beta = .22$), for 1st-gen students. PAC was a significant predictor of all outcomes for both 1st-and 2nd-gen students.

Objective 2b: Differences between low PAC and high PAC first-generation students (see Table 6)

I calculated estimated mean values on the five outcome variables for 1st-gen students who reported low (–1 SD) and high (+1 SD) PAC, based on the coefficients obtained from the

[4] Moderated logistic regression was used to examine conditional relationships between PAC and the dichotomous course withdrawal variable.

Table 4.
Interactions between PAC and Student-generation

	Test 1[a] (%)		HSG[b]		AUC[c]		Final Grade[d] (%)		Course Withdrawal[d]	
Predictor Variable	*b*	95% CIs	*b*	95% CIs	*b*	95% CIs	*b*	95% CIs	*b*	95% CIs
PAC	1.02*	[.678, 1.370]	.07*	[.041, .107]	-.57*	[-.697, -.435]	.90*	[.547, 1.243]	-.14*	[-.202, -.079]
GEN	-4.64*	[-8.034, -1.256]	-.46*	[-.802, -.118]	1.36*	[.117, 2.603]	-4.35*	[-7.763, -1.243]	.78*	[.002, 1.550]
PAC × GEN	.42	[-.283, 1.118]	-.01	[-.062, .069]	-.29*	[-.551, -.021]	.29	[-.412, .996]	-.01	[-.119, .128]
PAC for 1st-gens	1.25*	[.701, 1.792]	.08*	[.027, .125]	-.72*	[-.925, -.510]	1.05*	[.502, 1.597]	-.14*	[-.219, -.057]
PAC for 2nd-gens	.83*	[.390, 1.269]	.07*	[.028, .116]	-.43*	[-.596, -.267]	.76*	[.315, 1.202]	-.13*	[-.235, -.050]
R^2	.12		.07		.22		.09		.13	
N	227		257		198		226		257	

Note. PAC = perceived academic control; HSG = high school grade; AUC = attributions to uncontrollable causes; VW = voluntary course withdrawal; *b* = unstandardized regression coefficient; CIs = confidence intervals. 2nd-gen students coded as 0, 1st-gen students coded as 1. Sample restricted to students in the no-AR condition. All predictors were mean-centered, and entered simultaneously into OLS regression equations. The regression coefficients for control can be interpreted as the conditional relationship with each dependent variable when student-generation = mean; the regression coefficients for student-generation can be interpreted as the conditional relationship with each dependent variable when PAC = mean.

[a] Phase 1 measure (October). [b] Phase 2 measure (October). [c] Phase 4 measure (March). [d] Phase 5 measure (May).

* $p < .05$

Table 5.

Standardized Relationships (β weights) between PAC and Continuous Outcome Variables by Student-Generation

	Test 1[a] (%)	HSG[b]	AUC[c]	Final Grade[d] (%)
First-generation	.41	.25	–.69	.36
Second-generation	.27	.21	–.41	.22

Note. Sample restricted to students in the no-AR condition. All predictors were mean-centered, and entered simultaneously into OLS regression equations. All estimates are significant that the $p < .05$ level.

[a] Phase 1 measure (October). [b] Phase 2 measure (October). [c] Phase 4 measure (March). [d] Phase 5 measure (May).

moderated multiple regression equations noted above. As expected, the pattern of difference clearly indicated that low PAC 1^{st}-gen students are academically at risk. Compared to 1^{st}-gen students with high PAC, low PAC 1^{st}-gen students had lower pre-treatment test performance, lower high school grades, lower final course grades, higher likelihood of course withdrawal, and attributed test performance to uncontrollable causes to an extent that nearly doubled high PAC 1^{st}-gen students.

To put this in concrete terms, low PAC 1^{st}-gen students received an average grade of C on the first test, had an average high school GPA between 76%-80%, received an average final grade of C, and 1 in 4 were predicted to drop the course. In contrast, high PAC 1^{st}-gen students received an average grade of C+ on the first test, had an average high school GPA between 81%-85%, received an average final grade of B, and 1 in 14 were predicted to drop the course. Additionally, observational comparisons between high PAC 1^{st}-gen students and low PAC 2^{nd}-gen students indicated that they received comparable grades on their pre-treatment test (C+ vs. C+) and that high PAC 1^{st}-gen students had higher final grades (B vs. C+), and had a lower likelihood of course withdrawal (7% vs. 13%). Across all outcome variables, low PAC 1^{st}-gen students displayed the most at-risk academic profile. 1^{st}-gen students with high PAC received an average letter grade of B in the course, as did 2^{nd}-gen students with high PAC.

Objective 3a: AR Simple Slopes (first-generation students; see Table 7)

AR × PAC regression models were used to assess the AR hypotheses. Predictor variables included in the interaction term (AR, PAC) were mean centered, and all variables were simultaneously entered into the regression model. HSG, age, and gender were included as covariates in all models, unless other covariates are specified (e.g., income, baseline measures).

Table 6.

Predicted Conditional Values for Students at combinations of Student-Generation and Low (–1 SD) and High (+1 SD) Perceived Academic Control

Dependent Measures	1st-gens		2nd-gens	
	Low PAC	High PAC	Low PAC	High PAC
Test 1 (%)[a]	58.16	70.50	64.87	73.08
HSG[b]	7.23	8.02	7.71	8.47
AUC[c]	16.43	9.52	13.70	9.54
Final course grade (%)[d]	63.89	74.28	69.69	77.19
Course withdrawal (probability)[d]	24%	7%	13%	3%

Note. PAC = perceived academic control; HSG = high school grade; AUC = attributions to uncontrollable causes. Sample restricted to students in the no-AR condition. All predictors were mean-centered, and entered simultaneously into OLS regression equations.
[a] Phase 1 measure (October). [b] Phase 2 measure (October). [c] Phase 4 measure (March). [d] Phase 5 measure (May).

As predicted, I found an AR × PAC interaction for post-treatment PAC [b = –.27, t(251) = –2.03, p = .025, CIs = –.485 to –.050]. I probed the interaction by testing the simple slopes of AR (vs. no-AR) at low (–1 SD) and high (+1 SD) levels of PAC using the PROCESS macro for SPSS (Hayes, 2018). Simple slope analyses revealed that low PAC 1st-gen students who received AR reported higher PAC than their peers in the no-AR condition 5 months post-treatment [β = .28, t(251) = 1.76 p = .038, CIs = .116 to 3.154, b = 1.64]. Because Time 1 PAC was included in the interaction term, the reported increase in Time 2 PAC controlled for autoregressive effects. Accordingly, the regression model accounted for a large proportion of variance in post-treatment PAC (R^2 = .36). This effect did not hold when income was included as a covariate, although the point estimate was in the expected direction [β = .14, t(166) = .73, p = .233, CIs = –.992 to 2.601, b = .81]. AR (vs. no-AR) had no effect for high PAC 1st-gen students.

I did not find a significant AR × PAC interaction in the regression model predicting attributions to uncontrollable causes, although the point estimate was in the expected direction [b = .23, t(254) = 1.49, p = .069, CIs = –.024 to .477]. Despite the lack of a significant interaction term, simple slope analyses showed that AR (vs. no-AR) reduced attributions to uncontrollable causes for low PAC 1st-gen students [β = –.43, t(254) = –2.29, p = .011, CIs = –4.277 to –.697, b = –2.49]. This effect held when baseline attributions were included as a covariate [β = –.28, t(256) = –1.72, p = .043, CIs = –3.141 to –.069, b = –1.61], and the regression model accounted for a large proportion of variance in post-treatment attributions (R^2 = .43). I found a significant AR × PAC interaction when income was included as a covariate [b = .35, t(168) = 1.88, p = .031, CIs = .042 to .477], as well as the strongest estimated reduction in attributions to uncontrollable causes [β = –.49, t(168) = –2.43, p = .008, CIs = –5.086 to –.962, b = –3.02]. No AR treatment effect was found for high PAC 1st-gen students.

I observed the predicted AR × PAC interaction for final course grade [b = –.66, t(258) = –2.34, p = .010, CIs = –1.120 to –.193]. Simple slope analyses indicated that AR (vs. no-AR) boosted the actual course performance of low PAC 1st-gen students by over 5% [β = .46, t(258) = 2.67, p = .004, CIs = 2.006 to 8.475, b = 5.24]. This performance boost translates into an average letter grade of B (i.e., >72%) for those who received AR and an average grade of C+ for those in the control condition. This effect held when controlling for pre-treatment test performance [β = .29, t(260) = 2.13 p = .017, CIs = .759 to 5.975, b = 3.37], and the regression model accounted for a large proportion of variance in final grade (R^2 = .47). I observed the strongest increase in performance when income was included as a covariate [β = .68, t(167) = 3.09, p = .001, CIs = 3.629 to 12.013, b = 7.82]. AR (vs. no-AR) had no effect for high PAC 1st-gen students.

Contrary to my prediction, I did not find an AR × PAC interaction for course withdrawal, although the point estimate was in the expected direction [b = .07, χ^2(1, N = 331) =1.18, p = .119, CIs = –.028 to .173]. A simple slope logistic regression analysis was used to examine the effects of AR for low PAC 1st-gen students. As predicted, AR (vs. no-AR) reduced the likelihood of course withdrawal for 1^{st}-gen students with low PAC [OR = 0.45, CIs = –1.474 to –.129, χ^2(1, N = 331) = –1.96, p = .025, b = –.80]. An odds ratio of .45 indicated that low PAC 1st-gen students who received AR were 55% less likely than their no-AR peers to withdraw from the course (13.4% vs. 25.7%; see Figure 1). This effect did not hold when income was included as a covariate, but the direction of the point estimate remained consistent [OR = 0.64, CIs = –1.269

Table 7.

Predicted Conditional Values for First-generation Students at Combinations of AR and Low (-1 SD) and High (+1 SD) PAC

Dependent Measures	Low PAC		High PAC	
	No-AR	AR	No-AR	AR
*PAC[c]	27.31[a]	28.94[a]	35.76	34.70
AUC[c]	17.17[a]	14.68[a]	9.77	9.59
*Final course grade (%)[d]	68.46[a]	73.70[a]	76.95	75.59
Course withdrawal (probability)[d]	26%[a]	13%[a]	7%	7%

Note. PAC = perceived academic control; AUC = attributions to uncontrollable causes; AR = attributional retraining (*n* sizes: AR= 207; no-AR= 126). All reported conditional values obtained from OLS regression models including high school grade, age, and gender as covariates. All predictors were mean-centered, and entered simultaneously into OLS regression equations.

[c] Phase 4 measure (March). [d] Phase 5 measure (May).

[a] Predicted values are significantly different from each other ($p < .05$; 1-tailed).

*AR × PAC interaction is significant ($p < .05$; 1-tailed)

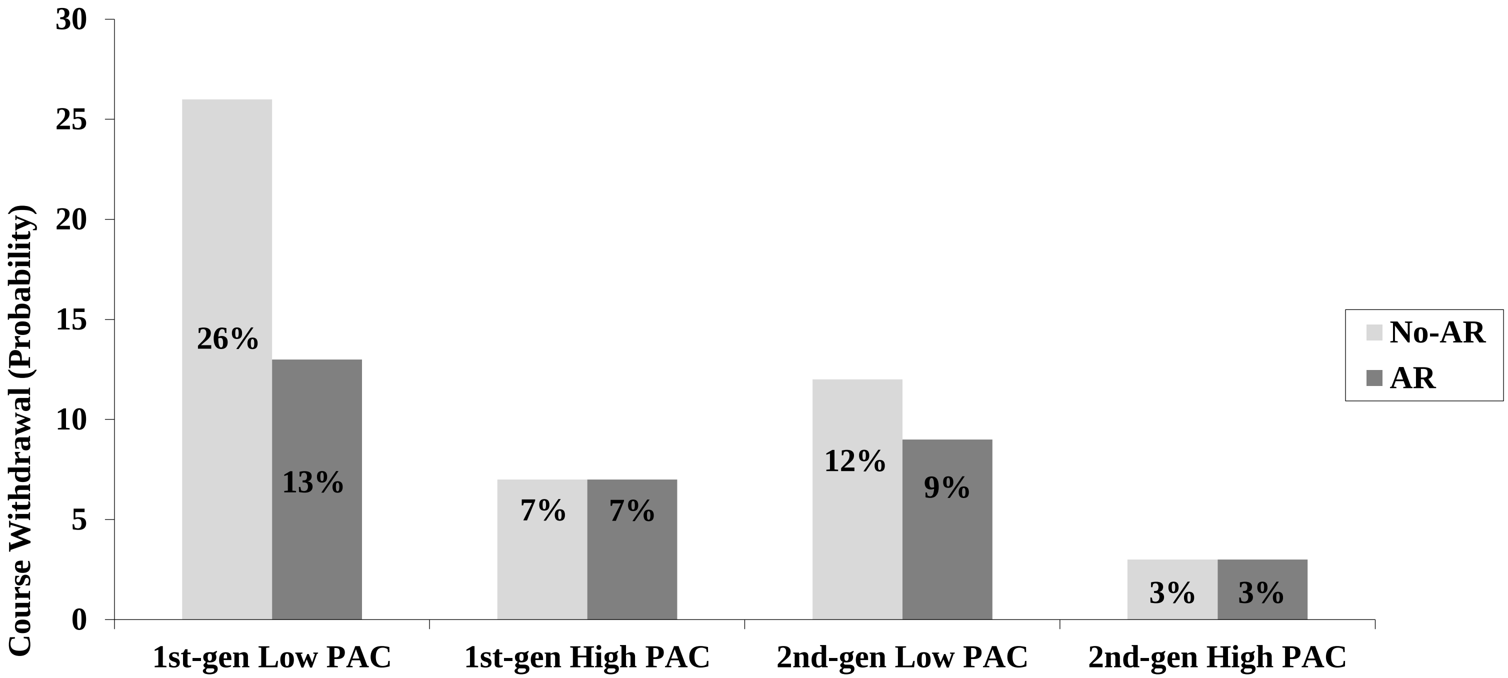

Figure 1. PAC = perceived academic control; AR = attributional retraining. Effects of AR (vs. no-AR) on probability of course withdrawal for first-generation (1^{st}-gen) and second-generation (2^{nd}-gen) students at low (– 1 *SD*) and high (+ 1 *SD*) levels of perceived academic control (PAC).

to .379, χ^2(1, *N* = 219) = –.89, p = .19, b = –.80]. I did not observe an AR treatment (vs. no-treatment) effect for high PAC 1st-gen students.

Objective 3b: AR Simple Slopes (second-generation students & all participants; see Table 8)

I found no AR × PAC interactions for 2nd-gen students (all *p*s > .25), and simple slope analyses indicated no difference between 2nd-gen students in the AR and control conditions, irrespective of PAC (all *p*s > .15).

To increase statistical power, and to explore potential 3-way interactions, I assessed the conditional effects of AR using the full sample of 1st- and-2nd-gen students via AR × Student-Generation × PAC regression models. These results corroborated prior analyses, such that low PAC 1st-gen students who received AR reported higher post-treatment PAC [β = .29, *p* = .037, CIs = .130 to 3.080, *b* = 1.61], achieved higher grades [β = .52, *p* = .002, CIs = 2.705 to 9.712, *b* = 6.21], showed a reduction in attributions to uncontrollable causes [β = –.39, *p* = .016, CIs = –3.910 to –.514, *b* = –2.21], and were less likely to withdraw from the course [OR = 0.48, CIs = –1.396 to –.087, χ2(1, *N* = 765) = –1.72, *p* = .043, *b* = –.74]. These effects held when controlling for baseline measures. We did not observe treatment effects for high PAC 1st-gen students, or for 2nd-gen students.

When income was included a covariate, I found significant AR × Student-Generation × PAC interactions in the models predicting attributions [*b* = .42, *t*(441) = 1.90, *p* = .029, CIs = .056 to .780], and final grade [*b* = –1.07, *t*(448) = –2.16, *p* = .016, CIs = –1.882 to –.252]. The regression model predicting attributions was characterized by a reversal of the AR × PAC interaction, such that the effects of AR changed from reducing attributions to raising attributions as 1st-gen students' PAC increased, but the effects of AR changed from raising attributions to

Table 8.
Predicted Conditional Values for Second-generation Students at Combinations of AR and Low (-1 SD) and High (+1 SD) PAC

Dependent Measures	Low PAC		High PAC	
	No-AR	AR	No-AR	AR
PAC[c]	29.31	29.18	35.32	35.43
AUC[c]	14.01	13.17	9.58	9.45
Final course grade (%)[d]	74.74	74.84	80.17	78.04
Course withdrawal (probability)[d]	12%	9%	3%	3%

Note. PAC = perceived academic control; AUC = attributions to uncontrollable causes; AR = attributional retraining (*n* sizes: AR= 301; no-AR= 126). All reported conditional values obtained from OLS regression models including high school grade, age, and gender as covariates. All predictors were mean-centered, and entered simultaneously into OLS regression equations.

lowering attributions as 2nd-gen students PAC increased (see Figure 2) The regression model predicting final grade was characterized by a nullification of the AR × PAC interaction, such that the effects of AR changed from improving final grade to lowering final grade as 1st-gen students' PAC increased, but the effects of AR did not change as 2nd-gen students PAC increased (see Figure 3). Despite these patterns of findings, simple slopes were only significant for low PAC 1st-gen students.

Objective 3c: Path analysis for first-generation students (see Table 9, Figure 4)

My path model was based on Weiner's attribution theory (1985, 2018) and tested the directional hypothesis that effects of AR (vs. no-AR) for low PAC 1st-gen students on course performance would be mediated by an increase in post-treatment PAC and a decrease of attributions to uncontrollable causes. I tested this hypothesis using OLS regression analyses with 90% bias corrected confidence intervals that were based on 10,000 bootstrap samples. As expected, I found evidence of moderated mediation, such that I observed indirect effects of the AR × PAC interaction through both post-treatment PAC (b = –.169, CIs = –.343 to –.048) and attributions to uncontrollable causes (b = –.068, CIs = –.193 to –.001).

I probed the significant interactions using the PROCESS macro for SPSS to determine the direct and indirect effects of AR at low (–1 SD) and high (+1 SD) levels of PAC (Hayes, 2018). As expected, simple slope regression analyses revealed, for only low PAC 1st-gen students, a direct effect of AR on final course grade [β = .29, t(240) = 1.63, p = .052, CIs = –.037 to 6.624, b = 3.29], and indirect effects of AR through post-treatment PAC [β = .10, CIs = .136 to 2.420, b = 1.08] and attributions to uncontrollable causes [β = .08, CIs = .260 to 1.997, b = .87]. The indirect effects through attributions to uncontrollable causes remained when controlling for baseline attributions and HSG [β = .05, CIs = .062 to 1.454, b = .52]. When I included income as

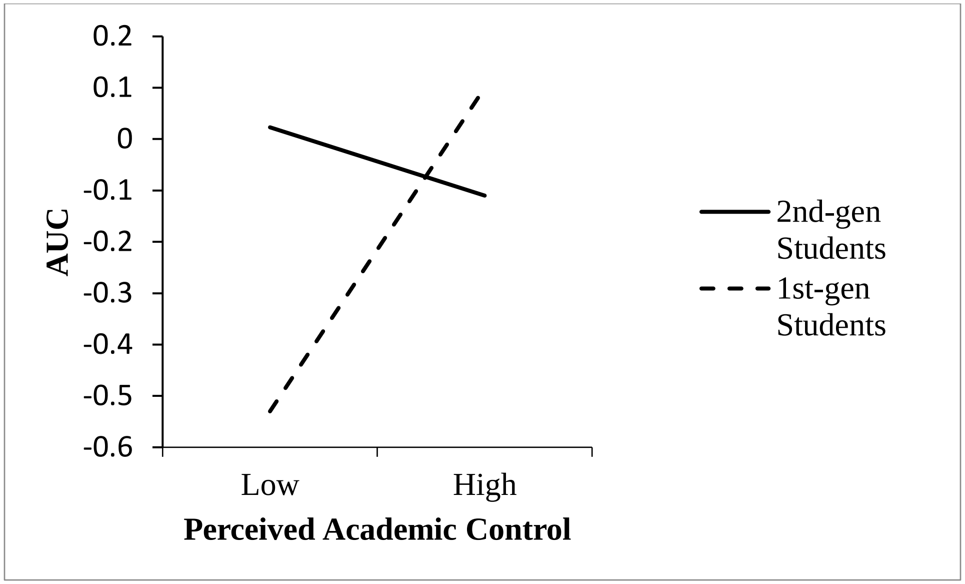

Figure 2. AUC = attributions to uncontrollable causes. Effects of attributional retraining on AUC according to student-generation and PAC, with income is included as a covariate. AR × Student-generation × PAC interaction is significant at p < .05. Effect sizes are reported in a partially standardized metric.

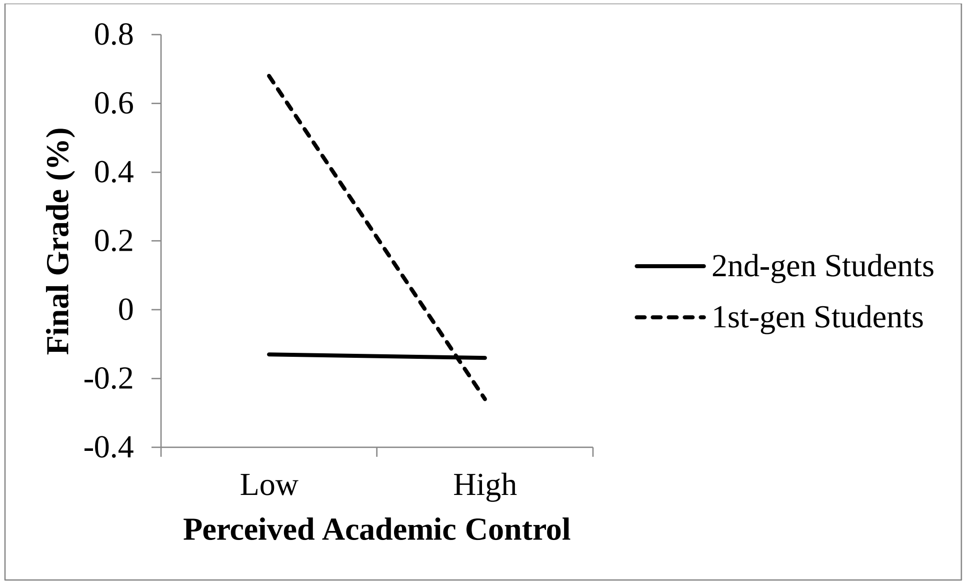

Figure 3. Effects of attributional retraining on final grade (%) according to student-generation and PAC, with income is included as a covariate. AR × Student-generation × PAC interaction is significant at $p < .05$. Effect sizes are reported in a partially standardized metric.

a covariate, the direct effect of AR increased [$\beta = .56$, $t(157) = 2.65$, $p = .004$, CIs = .136 to 2.420, $b = 6.38$], and the indirect effect through attributions remained stable. I found no evidence that AR had direct or indirect effects on final grades for high PAC 1st-gen students.

Objective 3d: Path analysis for second-generation students & all participants

There were no statistically significant indirect effects of AR × PAC interactions for 2nd-gen students, and simple slope analyses indicated no direct or indirect effects of AR (vs. no-AR) across the observed range of PAC (0 was within the bounds of all bootstrap confidence intervals).

To increase statistical power, I assessed the conditional direct and indirect effects of AR on course performance using the full sample of 1st- and-2nd-gen students with complete data. Simple slope analyses indicated, for only low PAC 1st-gen students, a direct effect of AR on final course grade [$\beta = .30$, $t(576) = 1.66$, $p = .049$, CIs = .029 to 6.966, $b = 3.50$], and indirect effects of AR through post-treatment PAC [$\beta = .06$, CIs = .094 to 1.554, $b = .69$] and attributions to uncontrollable causes [$\beta = .09$, CIs = .334 to 2.077, $b = 1.07$]. The indirect effects through PAC and attributions to uncontrollable causes remained when controlling for baseline attributions and HSGs [$\beta = .06$, CIs = .022 to 1.502, $b = .64$; $\beta = .06$, CIs = .063 to 1.454, $b = .65$, respectively]. The direct effect of AR and the indirect effect through attributions to uncontrollable causes remained when I included income as a covariate. I found no evidence that AR had an effect on high PAC 1st-gen students, or for 2nd-gen students.

Table 9.

Conditional indirect effects model of Attributional Retraining predicting final grade (%) for first-generation students

Moderator value	Conditional indirect effect through PAC			
	Boot indirect effect	Boot SE	$BootLLCI_{90}$	$BootULCI_{90}$
AR × PAC	–.169	.088	–.338	–.047
AR at Low PAC (– 1 SD)	1.081	.685	.138	2.412
AR at High PAC (+ 1 SD)	–.579	.496	–1.468	.149
	Conditional indirect effect through AUC			
AR × PAC	–.068	.057	–.191	.003
AR at Low PAC (– 1 SD)	.866	.496	.256	1.977
AR at High PAC (+ 1 SD)	.201	.365	–.274	.938
	Conditional direct effect			
AR × PAC	-.427	.294	–.913	.060
AR at Low PAC (– 1 SD)	3.294	2.017	–.037	6.624
AR at High PAC (+ 1 SD)	–.893	1.9360	–4.090	2.304

Note. PAC = perceived academic control; AUC = attributions to uncontrollable causes; AR = attributional retraining; $BootLLCI_{90}$ = 90% confidence interval lower limit; $BootULCI_{90}$ = 90% confidence interval upper limit (n = 244). Bootstrap N = 10 000. Conditional effects reported in an unstandardized metric.

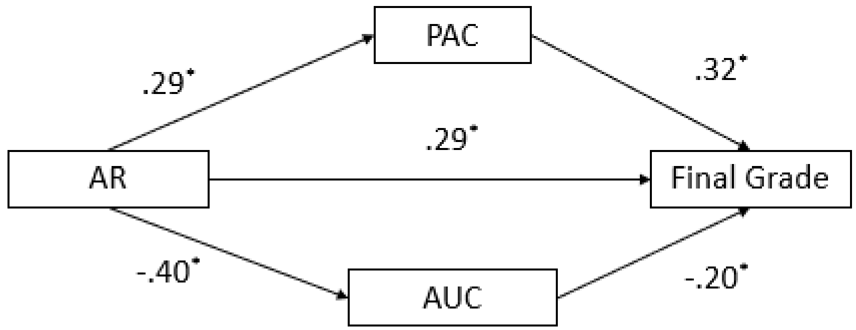

Figure 4. PAC = perceived academic control; AUC = attributions to uncontrollable causes. Direct and indirect effects of attributional retraining for low Time 1 PAC first-generation students on final course grade (%) through Time 2 PAC and AUC. Bootstrap N = 10 000. Simple-slopes are presented in a partially standardized and standardized metric. The indirect effect of the AR × PAC interaction is significant for both PAC and AUC.

$^{*}p < .05$ 1-tailed

Discussion

1st-gen students face many unique obstacles during school-to-college transitions which threaten their motivation and academic development (Engle, 2007; Stebleton & Soria, 2012; Stephens et al., 2012). Despite successfully competing to enter college, a substantial proportion of 1st-gen students falter under the weight of such obstacles, resulting in a persistent social class achievement gap between 1st-gen students and their 2nd-gen peers (Fiske & Markus, 2012). The objectives of this study were threefold: to replicate past findings of a social class achievement gap, to examine conditional effects of PAC between 1st-and-2nd-gen students, and, because perceived control beliefs are known to be a critical determinant of causal attributions and post-secondary success (Perry et al., 2005; Perry & Hamm, 2017; Respondek et al., 2019; Schneider & Preckel, 2017), to examine whether an online attributional retraining treatment could improve the performance, persistence, and motivational mindset of 1st-gen students who have low PAC.

Are First-generation Students at a Disadvantage?

Based on the ANOVA analyses, 1st-gen students are at a disadvantage relative to 2nd-gen students. The largest difference was observed for family income (d = .46), which provides further evidence for the strong relationship between major indicators of SES, namely income and parental education. In keeping with prior studies, the results for final grade indicated an average difference of a C+ for 1st-gen students and a B for 2nd-gen students, and 1st-gen students were virtually twice as likely to withdraw from the course.

Contrary to my hypothesis, pre-treatment PAC was the only outcome that did not yield a significant difference. The few studies that have examined differences in control beliefs across student-generations provide mixed results. For example, Hellman and Harbeck (1996) reported that 1st-gen students had lower academic self-efficacy, but a more recent study by Vuong et al.,

(2010) reported no difference. Assuming that there is, in fact, no meaningful average difference in control beliefs between 1st-gen and 2nd-gen students, this may be due to all students having met a certain minimum level of perceived control that is required before deciding to enroll in post-secondary education. Alternatively, the majority of students in this study were in their first year of university, and PAC tends to decrease over time (Respondek et al., 2019). Thus, it is possible that 1st-gen and 2nd-gen students, on average, enter university with similar levels of perceived control, but these beliefs decrease at a faster rate and/or to a greater extent for 1st-gen students. A third hypothesis is that despite having comparable PAC scores, PAC beliefs function differently for 1st-gen students. Because 1st-gen students are often less prepared to face the novel challenges of post-secondary education (Choy, 2001) and cannot rely on their parents for assistance, psychosocial motivation factors, including PAC, may have a stronger positive influence compared to 2nd-gen students (Aspelmeier et al., 2012; Naumann et al., 2003), who are likely to be somewhat familiarized to the university environment prior to enrolment, and can gain valuable insight from their parents on how to succeed (Palbusa & Gauvain, 2017). I tested this hypothesis as a second objective of the study, which was partially supported.

Are the Effects of Control Moderated by Student-Generation?

Based on moderated multiple (and logistic) regressions using only those students randomly assigned to the no-AR condition, it appears that PAC may be a stronger predictor of certain outcomes for 1st-gen students. Despite the PAC × Student-generation interactions not reaching statistical significance, a trend emerged whereby PAC had a stronger relationship between performance variables for 1st-gen students. Specifically, every additional point on the PAC scale predicted a 1.25% increase in pre-treatment test performance for 1st-gen students, and a .83% increase for 2nd-gen students. Similarly, each point on the PAC scale predicted a 1.05%

increase in final grade for 1st-gens and a .76% increase for 2nd-gens. The only significant PAC × Student-generation interaction pertained to Time 2 attributions to uncontrollable causes, which suggests that longitudinal relationships between PAC and attributions are stronger for 1st-gen students. This finding, coupled with the substantial differences between low and high PAC 1st-gen students, add empirical support to the logic underpinning why AR was an effective treatment for low PAC 1st-gen students.

Comparisons between low and high PAC 1st-gen students in the no-AR condition supported my hypothesis that low PAC 1st-gen students are academically at-risk, whereas high PAC 1st-gen students are not. Compared to those with high PAC, Low PAC 1st-gen students had lower Test 1 (%) grades (58.16 vs. 70.50), substantially higher attributions to uncontrollable causes (16.43 vs. 9.52), lower final grades (63.89 vs. 74.28), and higher likelihood of course withdrawal (24% vs. 7%). Notably the difference in final grades represents that of two full letter grades (C vs. B), and high PAC 1st-gen and 2nd-gen students both received an average final letter grade of B, high PAC 1st-gen students also outperformed low PAC 2nd-gen students (B vs. C+). This underscores the importance of examining critical motivation variables such as PAC when studying 1st-gen students. One cannot accurately predict students' post-secondary success from their student-generation alone. Moreover, given that AR effects are most pronounced for at-risk student populations, these findings clarify why AR improved the academic mindset, performance, and persistence of only low PAC 1st-gen students.

Attributional Retraining: Boosting Performance and Persistence

This study demonstrates that AR treatments can improve performance for 1st-gen students who believe they lack control over achievement outcomes. Low PAC 1st-gen students who received AR outperformed their peers in the no-treatment (control) condition by over 5% on their final grades in a two-semester, online introductory course (*M*s = 68.46 vs. 73.70). The effect size of this difference (β = .46) is moderate according to Cohen's (1988) conventions and ecologically meaningful inasmuch that it equates to a full letter grade advantage (B vs. C+) based on the actual grading distribution used by the course instructors. This effect corroborates a recent meta-analysis by Lazowski and Hulleman (2016), who reported that AR (vs. no-AR) effects are, on average, moderate in size (*d* = .54).

Moreover, low PAC 1st-gens in the AR condition were 55% less likely to withdraw from the online course (13.4% vs. 25.7%). Given that AR had a meaningful performance boost for this academically at-risk group, and that low GPA is the strongest risk factor of attrition for 1st-gens (Dika & D'amico, 2015; Martinez et al., 2009), it is not surprising that AR enhanced persistence as well as performance. 1st-gen students appear to use course performance as the primary signal for whether they can succeed in university. As such, any intervention strategies designed to enhance rates of persistence for 1st-gen students should necessarily focus on also enhancing GPA. This finding is also consistent with prior research indicating that an online AR intervention can reduce the odds of course withdrawal for low PAC students (Parker et al., 2018)

Beyond objective measures of performance and persistence, we found evidence that AR benefited low PAC 1st-gens in terms of cognitive motivation factors specified by Weiner's attribution theory (1985, 2000, 2014). Specifically, low PAC 1st-gen students who received AR reported higher post-treatment PAC, and rated the uncontrollable causes of task difficulty, poor teaching, and low ability as contributing less to their performance than their no-AR peers. The reduced emphasis on low ability attributions is particularly salient. Academic ability is commonly perceived to have a significant genetic component (Shostak, Freese, Link, & Phelan, 2009), hence 2nd-gen students have a natural buffer against these maladaptive attributions because of their highly educated parents; 1st-gen students have no such defense (Nichols & Islas, 2015).

This study extends motivation treatment research by providing additional evidence of AR efficacy in online learning environments. Moreover, this study provides a novel, contemporary, and societally relevant contribution by examining AR effects on 1st-gen students, a rapidly growing and hitherto overlooked student-population in the AR literature. More generally, this is the first AR study focused on a socioeconomic academic risk factor. The results also align with recent evidence indicating that AR-performance linkages are mediated by changes in theoretically derived psychosocial factors (Hamm et al., 2017; Parker et al., 2018).

Attributional Retraining Efficacy Through Conditional Processes

Inspired by a call to identify the conditional processes through which AR improves achievement (Perry et al., 2014; Perry & Hamm, 2017), I conducted path analyses for 1st-gen students by testing AR effects as moderated by pre-treatment PAC and mediated by post-treatment PAC and attributions to uncontrollable causes. Consistent with hypotheses, I found evidence that, for only low PAC 1st-gen students: (a) AR reduced the endorsement of uncontrollable causes as contributing to poor performance and enhanced perceptions of control over academic outcomes, (b) changes in maladaptive causal attributions and perceived control predicted actual course performance, and (c) AR effects on achievement were mediated by changes in attributions and PAC. These findings refine the AR literature by supporting its classification as a control-enhancing motivation intervention; low control 1st-gen students who received AR saw meaningful gains in achievement as a result of increases in their perceptions of control and adaptive reframing of their maladaptive causal thinking.

The indirect effects of AR are noteworthy for both theoretical and practical reasons. First, we found that AR (vs. no-AR) mitigated 1st-gen students' maladaptive causal thinking. Theoretically, this is consistent with Weiner's (1985, 2000, 2014) attribution theory, as it suggests that the AR treatment was effective in conveying its content to recipients to help sustain their achievement motivation. Practically, these results advance prior research (e.g., Hamm et al., 2017; Perry et al., 2010) by demonstrating that AR can improve students' attributional mindset in unfamiliar and competitive achievement settings over an extended time period, even when statistically adjusting for pre-existing differences.

Similarly, the fact that AR led to a meaningful increase in low PAC 1st-gen students' perceived control five months post-treatment ($\beta = .28$) has important theoretical and practical implications. Perceived control is not explicitly defined as a construct in Weiner's attribution theory. However, controllability is explicitly defined as a unique dimension of causal thinking, and there is significant merit in finding evidence of convergence between theories of motivation and academic achievement (Pekrun & Marsh, 2018). Furthermore, the strong correlation between attributions to uncontrollable causes and PAC ($r = –.54$) clearly indicates that attributional thinking and perceived control beliefs are related in a theoretically consistent manner. From a practical standpoint, this study provides evidence that AR can bolster perceived control, a major psychosocial determinant of college achievement, for 1st-gen students who believe that they lack control over their academic outcomes.

The finding that AR boosted low PAC 1st-gen students' beliefs in their control over academic outcomes supports prior evidence that 1st-gen students have greater potential than 2nd-gen students to develop as scholars after enrollment in post-secondary education. PAC is commonly treated by researchers as a relatively stable, trait-like characteristic (Perry et al., 2001;

2005). This is likely the case for 2nd-gen students, and students who otherwise prepared for higher education in secondary school through rigorous curricula. However, for 1st-gen students who enter university less prepared for the challenges to come, positive initial experiences, such as receiving AR, are critical, as they have the potential to induce adaptive change in psychosocial beliefs such as perceptions of control. These changes, when initiated early in students' post-secondary careers, may even make the difference between graduating within 6 years or dropping out entirely (Hamm et al., 2014).

The significant AR × Student-generation × PAC interactions should be interpreted with caution. Based on the observed pattern of difference in AR effects, high PAC 1st-gen students in the no-AR (vs. AR) condition had slightly lower attributions to uncontrollable causes and slightly higher final grades. Similarly, high PAC 2nd-gen students who did not receive AR were estimated to have lower attributions to uncontrollable causes. However, these simple slope differences did not approach the threshold for statistical significance. Additionally, the three-way interaction terms only reached statistical significance when including income as a covariate. This raises methodological concerns, as the interpretability of results becomes clouded when a covariate has a strong association with an independent variable (e.g., income and student-generation; Miller & Chapman, 2001). Until these findings are further replicated, the three-way interactions should be interpreted simply as a corroboration of the AR findings pertaining to 1st-gen and 2nd-gen students separately; Low PAC 1st-gen students in the AR (vs. no-AR) condition had a superior academic profile, 2nd-gen students in the AR (vs. no-AR) condition did not display any meaningful differences.

Strengths, Limitations, and Future Directions

Several strengths underscore the contributions of this study. First, the dependent measures comprised two objective and ecologically-valid academic outcomes, course performance and course withdrawal (see Lazowski and Hulleman 2016; Richardson et al. 2012; Shadish et al. 2002; Tunnell 1977). Such performance and persistence measures represent genuine 'real-world' outcomes, which serve as proxies for the two primary criteria defining the social class achievement gap between 1st-gen and 2nd-gen students (i.e., GPA & graduation rates). Second, this study was based on a well-established theory of achievement motivation, namely Weiner's (1979, 1985a, 2012, 2014 2018) attribution theory. The key propositions of Weiner's theory are clear, testable, and supported by over four decades of replicated laboratory and field studies (e.g., Fiske & Taylor, 1991).

Third, I employed a longitudinal, pre-post, randomized treatment design, as well as rigorous statistical controls (e.g., high school grade, baseline measures). These procedures enhance the viability of causal inferences compared to methodological designs that do not manipulate independent variables or include baseline measures as covariates (Shadish et al., 2002). Finally, conditional process analyses clarified both for whom AR was effective (low PAC 1st-gen students) and how AR led to meaningful gains in performance (decreases in maladaptive attributions, increases in perceived control).

One limitation of this study concerns the student-generation variable. Student-generation (e.g., 1st-gen, 2nd-gen) was derived from self-report, rather than institutional records, and did not allow me to control for or examine if students had siblings or other close relatives with post-secondary degrees, or if they came from single- or dual-parent households. Students who regularly reside with and receive support from only one parent, who does not have a bachelor's degree, are often classified as 1st-generation (Vuong et al., 2010). Additionally, student-generation was treated as a dichotomous variable, which precluded an examination of potential differences in AR efficacy for 2^{nd}-gen students with moderate (i.e., bachelor's) versus high (i.e., master's or PhD) parental education. However, the findings obtained from ANOVA and ANCOVA analyses examining family income, achievement, and persistence differences between 1^{st}-gen students and 2^{nd}-gen students replicated past studies, which provides some empirical validation for how student-generation was operationalized in the current study.

Another limitation pertains to the scale measuring students' attributions of course performance to uncontrollable causes, which had somewhat poor psychometric reliability (Cronbach's $\alpha < .70$). This may have been the result of a lack of face validity between causal attributions. For students with no prior knowledge of attribution theory, attributing course difficulty, low ability, and/or quality of teaching as the causes of poor performance may be interpreted as being unrelated to one another. However, the strong negative relationships between attributions and PAC at both Time 1 (r = -.54) and Time 2 (r = -.57), as well as the negative relationships between attributions and final grade and course withdrawal indicated that this measure had good construct validity.

The family income variable represents a third limitation of the study. The majority of students responded 'don't know', either because of a genuine lack of knowledge or reluctance to provide this information, which substantially reduced the sample size of analyses that included family income as a dependent variable or covariate. Moreover, this scale lacked precision, as each point in the scale represented a range of $20 000. This study would be strengthened by having accurate income data for all students.

The literature would benefit from future research aimed at replicating these findings across different institutions and cultures, to determine if AR efficacy is not moderated by environmental and student factors idiosyncratic to the host institution. Extending the longitudinal time-span of the study to allow for tests of differences in graduation rates within six years would provide valuable evidence as to whether AR effects persist after a single academic year, and if they translate into a greater number of 1st-gen students earning degrees. Replicating this study with additional measurement points in a single academic year would also help clarify the temporal sequence of changes in psychosocial factors which mediate the AR-performance relationship. Finally, future research would be improved by including GPA obtained from institutional records as a global performance outcome with high ecological validity, to determine if AR boosts performance across all courses, or only the introductory psychology course in which it was administered.

Considerable progress has been made in recent years regarding research on the efficacy and viability of brief motivation treatment interventions (Walton, 2014). This study provides preliminary evidence that an online, scalable, AR intervention that can be mass administered at relatively low cost may be an effective means for improving the performance, persistence, and motivational mindsets of 1st-gen students who perceive a lack of control over their achievement outcomes.

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Appendix A

Student-Generation (Phase 2)

What is the highest degree or level of school your *<u>mother (father)</u>* *completed?*

1. Did not complete high school
2. High school diploma or equivalent
3. Registered apprenticeship or trades certificate or diploma (e.g., hairstyling, cooking, electrician)
4. Community college certificate or diploma (e.g., legal assistant, accounting technology)
5. Bachelor’s degree (e.g., B.A., B.Sc., B.Ed.)
6. Professional degree in medicine, dentistry, veterinary medicine, optometry, or law
7. Master’s degree (e.g., M.A., M.Sc., M.B.A.)
8. Doctorate (i.e., Ph.D.)
9. Don’t know

Appendix B

Perceived Academic Control (Phases 2 & 4)

1	2	3	4	5
Strongly Disagree				**Strongly Agree**

R = Item is reverse coded

1. I have a great deal of control over my academic performance in my psychology course.
2. The more effort I put into my courses, the better I do in them.
3. No matter what I do, I can't seem to do well in my courses. **R**
4. I see myself as largely responsible for my performance throughout my college career.
5. How well I do in my courses is often "luck of the draw." **R**
6. There is little I can do about my performance in university. **R**
7. When I do poorly in a course, it's usually because I haven't given my best effort.
8. My grades are basically determined by things beyond my control and there is little I can do to change that. **R**

Appendix C

Attributions to Uncontrollable Causes (Phase 4)

	1	2	3	4	5	6	7	8	9	
Not at all										**Very much so**

If you do POORLY in your introductory psychology course, to what extent would the following statements represent the reasons for your performance? Record your answers using the following scale.

1. I'm not cut out for university.
2. The course demands are too difficult for must students at this level.
3. My professor goes through the course material too quickly.

Appendix D

Family Income (Phase 2)

What was the total income of your family in 2016? This is the total amount of money your mother and/or father received in 2016. (If you don't know exactly, please provide your best estimate.)

1. <$20,000
2. $20,000-$40,000
3. $41,000-$60,000
4. $61,000-$80,000
5. $81,000-$100,000
6. >$100,000
7. Don't know

Appendix E

Age (Phase 2)

What is your age?

1. 17-18
2. 19-20
3. 21-22
4. 23-24
5. 25-26
6. 27-30
7. 31-35
8. 36-40
9. 41-45
10. Older than 45

Appendix F

Introductory psychology grading distribution

Letter Grade	Percentage	Final Grade Point
A+	90-100	4.5
A	85-89.9	4.0
B+	80-84.9	3.5
B	72-79.9	3.0
C+	64-71.9	2.5
C	56-63.9	2.0
D	50-55.9	1.0
F	<50	0