

Towards Equal Opportunities in MOOCs: Affirmation Reduces Gender & Social-class Achievement Gaps in China

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ABSTRACT

The presence of achievement gaps in Massive Open Online Courses (MOOCs) implies that not everyone who can gain access to a course shares the same opportunities to succeed. This study advances research on a social psychological barrier to achievement that exists alongside important structural barriers (e.g., Internet access, insufficient prior knowledge). Learners who experience social identity threat (SIT)—a fear of being judged negatively in light of a social group they identify with—are at risk of underperforming. An initial survey identified lower-class men as an at-risk group in an English language learning MOOC for Chinese learners ($N = 1,664$). In a subsequent randomized experiment, an interdependent value relevance affirmation intervention raised grades, persistence, and completion rates exclusively among lower-class men—the lowest performing group in the course ($N = 1,990$). Efforts to establish equal opportunities in online learning should go beyond initiatives that increase access through technology to incorporate strategies that lower psychological barriers to create safe and inclusive learning environments.

ACM Classification Keywords

K.3.1. Computers and Education: E-Learning.

Author Keywords

Social psychology; achievement gaps; randomized experiment; Massive Open Online Course.

INTRODUCTION

Large-scale online learning environments are a technological innovation that can increase access to education by overcoming geographic and financial barriers. In these environments, learning materials such as readings, video lectures, assessments, and interactive simulations can be accessed by many learners simultaneously. Once a set of digital learning materials has been developed, it can in principle serve an unlimited number of interested learners with the appropriate level of prior knowledge. In practice, however, multiple challenges

can limit learners' ability to reap the full benefits of online educational resources. Many of these challenges are a by-product of the dominant one-size-fits-all approach to online courses, where the same environment and content are provided to learners from diverse demographic and sociocultural backgrounds. This leaves online learning environments vulnerable to many of the same shortcomings that give rise to educational inequalities in brick-and-mortar settings. In particular, verbal and visual cues can inadvertently communicate values and norms based on the sociocultural context where the environment was created and the learning materials developed. This can lead some learners to feel less welcome and worry about whether they can be successful.

These concerns are especially likely to arise in learning environments that serve a diverse learner population, such as MOOCs, which have attracted over 35 million learners worldwide in over 4,000 different courses [36]. According to edX CEO Anant Agarwal, "MOOCs make education borderless, gender-blind, race-blind, class-blind and bank account-blind." [1]. Barriers to access free-of-charge MOOCs are indeed low. However, in terms of success rates, there are major disparities between learners from different demographic, geographic, and socioeconomic backgrounds. Research has consistently found that learners from less developed parts of the world [24, 22, 25] and poorer neighborhoods in the United States [16] are less likely to complete MOOCs. Moreover, women and less educated learners are less persistent and receive lower grades in a sample of courses in various disciplines [22]. These achievement gaps may be due to technological and language barriers as well as differences in prior levels of education. However, besides structural barriers that are complex and expensive to overcome, there is evidence for a social psychological barrier, which hinders learners from reaching their potential in online environments [25]. In particular, aspects of the environment and learning materials can raise concerns that undermine learners' sense of belonging and threaten their social identity, and lead them to underperform in the course.

Membership in social groups constitutes an essential part of people's identities [4] and people strive to maintain a positive perception of the various social groups they identify with (e.g., gender, race, social class) [42]. The mere concern of being judged negatively in light of a social group that one identifies with—known as social identity threat (SIT) [40]—can impair working memory, learning, and performance [3, 43]. It has been shown that negative stereotypes about African

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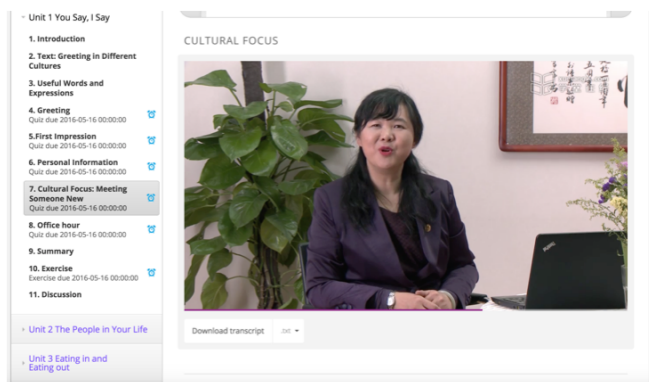


Figure 1. Screenshot of the English language learning MOOC showing a video lecture by one of the main instructors.

Americans' intellectual abilities and women's abilities in technical subjects can raise concerns about confirming these group stereotypes, and inadvertently cause underperformance [39]. Learners who join a U.S.-based MOOC from a country that is less developed report higher levels of SIT and exhibit lower course completion rates [25]. Individuals who contend with SIT experience greater stress and reduced cognitive capacity, as they become vigilant for cues in the environment that may confirm (or disconfirm) their fears of not belonging and being treated unfairly [46, 33, 35].

The present study tests the role of SIT in contributing to achievement gaps in China in an English language learning MOOC. We hypothesized that male and lower-class learners would be most affected by SIT in this context. First, we conducted a survey to examine how these learners compared with their peers in terms of SIT and subjective social class. Then, we conducted a randomized controlled experiment to test if a social psychological intervention designed to protect against SIT and promote commitment can raise the performance of identity-threatened learners. Our findings show that lower-class men—the most threatened and lowest performing subgroup—exclusively benefited from the intervention, raising their course persistence, grades, and completion rate.

SOURCES OF SOCIAL IDENTITY THREAT

Empirical research on SIT has focused on social issues in the United States and Europe. SIT was found to contribute to the academic underperformance of historically underrepresented minorities (e.g., African American and Latino students) [40], students from low socioeconomic backgrounds [14], and women in STEM (Science, Technology, Engineering, Mathematics) disciplines [8]. However, the implications of SIT are not limited to Western societies. A lab experiment with female students in China found that highlighting negative gender stereotypes reduced subsequent test performance [6]. Nevertheless, SIT has not been investigated in the context of English language learning. We identify two potential sources of SIT for Chinese learners in this context: one based on learners' gender identity, and the other based on their class-based identity in society.

Gender

The first potential source of SIT is gender stereotypes in the context of language learning. Interviews of Chinese students reveal that women are perceived as more talented at language learning [48, 47]. This perception is supported by official records of English achievement in China. A recent study found that while there was no significant gender difference in achievement for the top 10% of students on the English section of the National College Entrance Examination, women outperformed men among students below the 90th percentile [50]. Women also outperformed men in English on the High School Entrance Examination [28]. This gender gap in high school was even greater than the ones observed in elementary and middle school. Learners are likely to be aware of these differences and adopt a stereotype that women are more talented at language learning than men. Situational cues in the MOOC, such as the fact that the main instructors are women, may signal that the stereotype applies in this context (see Fig. 1). We therefore hypothesize that:

Learners are likely to be aware of these differences and internalize a stereotype that women are more talented at language learning than men. Situational cues in the MOOC, such as the fact that the main instructors are women, may signal that the stereotype applies in this context

H1. Men (a) experience higher gender identity threat and (b) perform lower in the course than women.

Social Class

The second potential source of SIT is differences in social class. We identified two aspects of the course that could raise SIT among learners from a lower social class. First, the course was developed at one of China's most prestigious universities and the course materials discuss topics that are clearly more relevant for members of the upper class. For example, one lesson was about meeting foreigners ("Today we're going to talk about...meeting someone from a different country") and another concerned foreign travel ("Do you like to travel? Yes, of course. Last month I visited..."). Yet people outside of provincial capital cities or the four municipalities (Beijing, Chongqing, Shanghai, Tianjin) are much less likely to encounter foreigners, and people of lower socioeconomic status are less likely to travel to foreign countries. Thus, the lesson materials could reduce their sense of belonging, insinuate outsider status, and raise class-based identity threat.

A second aspect of the course that could raise SIT is that the course employed a highly communicative pedagogical approach. Although the number of classroom hours devoted to learning English may be similar across the country, instructional methods vary widely [20, 15, 29]. In particular, English classes in the more developed capital cities (and municipalities) such as Beijing and Shanghai are more likely to focus on building communicative competence, for instance by using English as the medium of instruction. In contrast, English classes in rural schools are more frequently taught using Chinese as the medium of instruction and with minimal English oral communication, partly due to teachers' lower levels of English proficiency and training [20, 49]. Thus, the communicative pedagogical approach in the course can be challenging and

uncomfortable for people from rural areas or smaller cities, raising concerns that they do not belong and that they may be seen as incompetent.

We operationalize social class based on whether a learner is from a capital city or municipality (upper-class) or from a non-capital city (lower-class). This distinction is consistent with the differences in English instruction [20, 29] and expected relevance of course topics noted above. In economic terms, people in capital cities are also better off than those in non-capital cities.¹ We confirm the validity of this operationalization of social status at an individual level using multiple measures. We expect differences in class-based SIT between the two regions to manifest in terms of regional identity threat. Thus, we hypothesize that:

H2. Lower-class learners (a) experience higher regional identity threat and (b) perform lower in the course than upper-class learners.

Gender-Class Intersectionality

Individuals' social identities defined by gender and social class can overlap to give rise to related systems of disadvantage, as an instance of gender-class "intersectionality" [12]. In the present context, lower-class men are expected to carry the greatest psychological burden, due to both negative gender stereotypes and class-based identity threat. Upper-class women, by contrast, are not expected to face psychological barriers in this context, because they are stereotyped as more capable and better equipped to succeed. The remaining two subgroups (upper-class men and lower-class women) are expected to fall in-between the two extremes in terms of their success in the course. Thus, based on gender-class intersectionality, we hypothesize that:

H3. Lower-class men perform at the lowest level while upper-class women perform at the highest level in the course.

SOCIAL-PSYCHOLOGICAL INTERVENTION

In recent years, social-psychological interventions have been developed to support at-risk students in traditional academic environments. These interventions typically consist of brief reading and writing activities. Nonetheless, they are powerful because they target specific problems at critical points in time (e.g., SIT at the start of a course) [45, 10]. We draw on prior work to develop an intervention that is sensitive to the present educational and cultural context. In a recent set of experiments in MOOCs, a "value relevance affirmation" intervention was found to improve the performance of identity-threatened learners from less developed countries [25].

Value relevance affirmation combines elements of two established intervention approaches: values affirmation [10] and utility-value interventions [21]. First, values affirmation is based on self-affirmation theory [38], which offers an account of how people adapt to threatening information given that they are motivated to maintain their self-integrity. Affirming cherished values, such as relationships with friends and family or sports and athletics, expands people's self-concept and protects them from threats to their sense of belonging and social

identity [10]. Numerous field experiments have demonstrated academic improvements among underperforming students in the U.S. following values affirmation (see [10], for a review). In particular, it was found to reduce gender and social-class achievement gaps in traditional classroom settings [32, 17]. Second, the utility-value intervention aims to increase student motivation by helping them discover connections between the course materials and their lives. To this end, students may write an essay on how the topics covered in class inform their future workout plans. This intervention has also been tested in numerous field experiments; for example, it was found to raise course grades among high school students with low expectations of success [21].

The value relevance intervention is an opportunity for individuals to both affirm cherished values and connect them to the course. This should not be challenging because, unlike in traditional school settings, learners enroll in MOOCs at their own discretion to advance a variety of personal, social, or professional aspirations [26]. The intervention prompts learners to consider how their engagement in the course reflects and serves their most important values. For example, a learner may write that he is taking the course to get a better job, which would allow him to spend more time with his family and friends. A classic values affirmation [38], while supporting achievement in a mandatory school settings, could lead to disengagement in a voluntary online course where the easiest response to psychological threat is often to stop participating. Borrowing from utility-value research [21, 21], the value relevance affirmation recasts the course as instrumental to the fulfillment of learners' most important values. This value-based perspective on their engagement in the course can perpetually strengthen learners' commitment each time they return to the course with a value-driven sense of purpose. Negative experiences are less likely to be interpreted as threats to social identity or belonging if learners are truly ardent. These experiences may be perceived as less consequential or not even noticed at all. Accordingly, we hypothesize that:

H4. Interdependent value relevance affirmation increases the performance of identity-threatened learners in the course.

We further adapted the original value relevance affirmation activity [25] for the highly collectivist culture in China. This culture emphasizes connectedness with family and friends and fosters an *interdependent* self-concept, such that a person's relationships become an integral part of their self [31]. Prior work adapted the standard values affirmation activity for Chinese [6] and Asian Canadian [19] students by prompting them to choose and reflect on values that are not only relevant to themselves but also to close others (e.g., family, friends); the small change in the instructions improved the efficacy of the intervention relative to the standard values affirmation in both studies (see [11] for a similar adaptation for Latino students). Based on this insight, we adapted the activity to have participants select cherished values that they also shared with people close to them. Additionally, we leveraged choice architecture [44] to nudge individuals to affirm their relationships with family and friends by presenting this particular value first in the list (the order of the remaining values was randomized).

¹<http://data.stats.gov.cn/english/>

Prior work also found that the utility-value intervention is more effective among East Asians if long-term rather than short-term benefits are emphasized [37]. In line with this, the value relevance affirmation focuses on individuals' cherished values, which are not expected to vary much over time. Nevertheless, as it is unknown how affirming the relevance of different values moderates the efficacy of the intervention, we pose the following research question:

RQ1. How does the treatment effect vary depending on whether close relationships are affirmed as a value?

PRELIMINARY SURVEY

Prior to the intervention experiment, we fielded a survey in an earlier offering of the same English language MOOC featured in our main study. The purpose of the survey was to identify the at-risk group of learners. We evaluated gender differences in SIT and differences in social status between participants from capital versus non-capital cities. The survey was administered in Mandarin. Respondents were 1,664 learners located in (and originally from) China. They were enrolled in an English language learning MOOC offered by Tsinghua University on the Chinese XuetangX platform. In this sample, 50% of respondents were women and 37% were from capital cities. It was not possible to connect survey responses with course outcomes.

Gender identity threat was assessed by rating agreement with a single item: "In the course, I worry that people will draw conclusions about my gender, based on my performance" (adapted from [9]). As predicted, men's ratings of gender-based identity threat were 11% higher than women's ($H1a$; $z = 5.07, p < 0.001, d = 0.25$). Regional identity threat was assessed by rating two items: "In the course, I worry that people will draw conclusions about my hometown, based on my performance," and "In the course, I worry that people will draw conclusions about me, based on what they think about my hometown." Against our prediction, lower-class respondents (i.e. those from non-capital cities) did not report higher regional identity threat ($H2a$; $z = -0.55, p = 0.58$). The statements may have been too specific to capture class-based identity threat. Nevertheless, subjective social status in terms of the MacArthur Scale ("Where do you place yourself on a ladder representing where people stand in your country?") was lower for lower-class than upper-class respondents ($z = 3.78, p < 0.001, d = 0.19$). Moreover, lower-class respondents reported lower levels of parental education: only 10% of parents of lower-class respondents held a bachelor's degree, compared with 18% among upper-class respondents ($z = 4.53, p < 0.001$). Overall, the data tend to support our hypotheses that men experience higher SIT than women and that lower-class learners experience lower social status, though no differences in regional identity threat were detected.

METHODS

Participants and Context

Participants were enrolled in a beginners' English language learning MOOC targeted at Mandarin speakers. The course was offered for free by Tsinghua University for the second time

on the openly accessible XuetangX platform. The course materials encompassed lecture videos, a large number of low-stakes assessments, and a final exam. Participants were recruited with an optional survey at the start of the course.

The survey was started 3,117 times and in 2,864 cases a learner progressed far enough in the survey to be randomly assigned and exposed to the control or treatment activity. We only consider the 2,772 learners who reported that their hometown was located in mainland China (i.e., not Hong Kong, Macau, or a region outside of China) and who were located in China based on their IP address. We excluded duplicate responses by discarding all responses if a learner was exposed to both conditions, and maintaining only the initial response if a learner was repeatedly exposed to the same condition. Of the remaining 2,460 unique responses, we were able to match 2,164 to course outcome records, due to technical problems with passing anonymous user IDs. Finally, we only considered responses that occurred at least one week before the official end of the course, as learners who began after that cutoff date were unlikely to be able to complete the course. The final sample included $N = 1,973$ learners. Importantly, despite these exclusions, random assignment to conditions remained balanced on all available pre-treatment measures ($ps > 0.13$).

Participants were 64% women and 40% were from a capital city. The average age was 23.9 ($SD = 6.95$) and the level of education was varied: 8.2% held a master's or doctoral degree; 69% held a bachelor's, associate, or professional degree, and 23% had only completed high school or less schooling. For 42%, this was their first open online course. Most participants intended to complete all course materials (83%) and reported that it was very or extremely important to them to possess good English skills (89%).

Procedure

The survey was implemented at the start of the course as the first activity in the materials (with reminders also added before each of the first four videos). Most learners in MOOCs complete course materials in the specified order, though some may take the survey at a later time, which we could not verify as this data was unavailable. The intervention activity was embedded at the end of the survey. Following a number of demographic questions and pre-treatment measures (see Measures), participants were randomly assigned to receive either a study skills activity (control) or an interdependent value relevance affirmation (treatment). Both activities, which were translated into Mandarin, asked participants to read prompts and write responses. Participants spent twice as long on the affirmation activity as on the study skills activity (median = 3.4 vs. 1.6 minutes), but they were equally likely to complete each activity (94% proceeded to the following survey page; $\chi^2_1 = 0.18, p = 0.67$).

Study skills control: Participants read four brief testimonials from previous students describing strategies and tips for taking the course. For example, one testimonial stated, "When there's a lot on your mind it helps to make a list. I found writing down a bunch of personal due dates in my planner really helped, even though there were no deadlines in the course." Participants then wrote about their own strategies and insights about how

Table 1. Descriptive statistics (means and SDs) by participant gender and social class across both experimental conditions.

Gender	Social Class	N	Completion Rate	Gender Identity Threat	Regional Identity Threat	Self-Esteem	English Importance	English Anxiety	English Skill	GDP/capita (CNY)
Men	Low	461	30.6%	3.49 (1.41)	3.72 (1.45)	3.30 (0.69)	4.26 (0.78)	3.19 (1.10)	2.66 (0.85)	52,087 (18,542)
Men	High	243	34.6%	3.68 (1.45)	3.91 (1.45)	3.29 (0.69)	4.27 (0.81)	3.16 (1.06)	2.75 (0.78)	74,925 (29,081)
Women	Low	730	47.5%	3.17 (1.22)	3.56 (1.34)	3.18 (0.63)	4.40 (0.70)	3.38 (1.04)	2.82 (0.73)	49,600 (17,844)
Women	High	539	55.8%	3.30 (1.32)	3.57 (1.39)	3.28 (0.61)	4.48 (0.67)	3.32 (1.10)	2.91 (0.75)	83,342 (30,258)

to learn best, and how they compare to the ones they just read. This type of activity showed no effect on learners in another MOOC [23].

Interdependent value relevance affirmation: Participants selected from a list of twelve values and qualities (adapted from [10]) the 2 or 3 most important ones that they shared with people who were close to them, such as friends and family.² Then, participants wrote about why their chosen values were the most important ones to them, and how taking this course might reflect and reinforce their values. To amplify the impact of the affirmation, participants also wrote a message to their future self about how they can gain strength from the fact that taking this course reinforces their most important values.

Measures

The primary outcome measure was course completion (binary), which required earning an overall course grade above 50%. Two secondary outcome measures were the overall course grade (between 0 and 100) and the number of attempted assessments (between 0 and 47), a measure of persistence with course materials. The secondary outcome measures were highly correlated with course completion (Spearman's $r_s > 0.87$) and featured bimodal distributions with point masses at the extremes.

Multiple self-report measures were included in the survey prior to the experimental activities. There were a small number of missing values (~1% missing for most questions), which were imputed with predictive mean matching using the *R mice* package [5]). The following self-report measures were included as covariates in regression analyses: age (normalized), education level (in three bins as reported above), number of prior open online courses started (normalized), and intent to complete all course materials (binary). Additionally, we determined participants' regional GDP/capita based on their self-reported home province/region to include it as another covariate. These covariates are largely objective measures expected to reduce unexplained variance in outcomes.

Additionally, we assessed regional identity threat ($M = 3.6, SD = 1.4, range = [1, 7], \alpha = 0.86$) as in the preliminary survey. Gender identity threat ($M = 3.3, SD = 1.3, range = [1, 7], \alpha = 0.86$) was assessed with agreement/disagreement on two items mirroring the regional identity threat items (adding a second item to the measure used in the preliminary survey). Self-esteem ($M = 3.7, SD = 0.75, range = [1, 5], \alpha = 0.73$)

²Twelve values and qualities: Relationships with family or friends; Artistic skills/aesthetic appreciation; Sense of humor; Spontaneity/living life in the moment; Learning for the sake of learning; Religious/spiritual values; Sports and athletics; Musical ability/appreciation; Physical attractiveness; Creativity; Business/managerial skills; Romantic values.

was measured with three questions: "How good or bad do you feel about yourself?", "How confident are you in your abilities?", and "How much do you feel that others respect and admire you?" English skill ($M = 2.8, SD = 0.78, range = [1, 5], \alpha = 0.82$) was measured by rating writing, speaking, and understanding, each on a scale from very poor to very good. English anxiety ($M = 3.3, SD = 1.1, range = [1, 5]$) was measured by "How anxious do you feel about speaking English with a native speaker without preparation?"

Open Science and Analytic Approach

The de-identified dataset, analysis script, and intervention materials for this study are available online at osf.io/s5pww. Intervention effects were tested using linear regression with robust standard errors and *z*-tests. The regression models included multiple pre-treatment covariates (specified above) to reduce unexplained variance.

RESULTS

Gender and Social-Class Differences

Descriptive statistics for subgroups defined by gender and social class (pooling across experimental conditions) are provided in Table 1. As hypothesized, men again experienced more gender identity threat than women ($H1a; z = 5.20, p < 0.001, d = 0.25$). Men also reported lower English skills ($z = -4.53, p < 0.001, d = 0.22$), assigned less importance to knowing English ($z = -4.68, p < 0.001, d = 0.23$), and reported lower English speaking anxiety than women ($z = -3.37, p < 0.001, d = 0.16$). This could be a sign of psychological disengagement to cope with identity threat (i.e., "I am not good at it and I don't really care"; [39]). Men performed lower than women in terms of completion rates, as hypothesized ($H1b; 32\% \text{ vs. } 51\%, z = 8.49, p < 0.001$).

We confirmed that participants from capital cities showed clear signs of higher social status compared with those from non-capital cities. Upper-class learners were 56% more likely to hold advanced academic degrees (master/Ph.D.; $z = -2.87, p = 0.004$), reported having better English skills ($z = -2.88, p = 0.004, d = 0.13$), and came from 60% richer regions/provinces ($z = -25.2, p < 0.001$). They also reported higher self-esteem ($t = -1.97, p = 0.049, d = 0.09$). However, we found no difference in regional identity threat between upper- and lower-class participants ($H2a; z = 0.83, p = 0.41$). Yet upper-class participants were significantly more likely to complete the course ($H2b; 49\% \text{ vs. } 41\%, z = 3.61, p < 0.001$).

At the intersection of gender and social class, consistent with our hypothesis, we found that the course completion rate pooling across conditions was lowest for lower-class men and highest for upper-class women, yielding a 25.3 percentage point gap in average completion rates ($H3; z = 8.34, p < 0.001$).

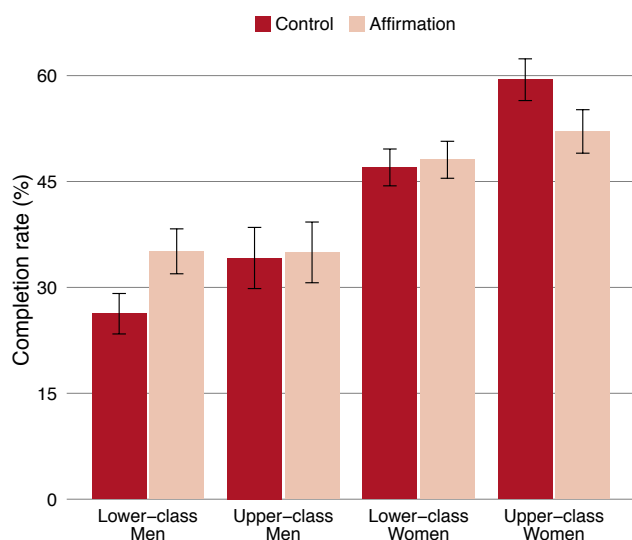


Figure 2. Mean course completion rate in each experimental condition by participant gender and social class. Affirmation raised completion rates exclusively for lower-class men. The drop in completion for upper-class women was not statistically significant. Error bars are $\pm 1SE$.

Intervention Effects: Completion, Grades, & Persistence

The affirmation intervention significantly increased the completion rate among the lowest performing group, lower-class men, from 24.6% to 34.6% ($H4$; $z = 2.47$, $p = 0.013$), adjusting for covariates ($p = 0.039$ unadjusted; Fig. 2). Women in capital cities saw a small and not statistically significant decrease in completion from the affirmation intervention ($z = -1.66$, $p = 0.098$). The achievement gap (unadjusted) between lower-class men and upper-class women was cut in half, from 33 to 17 percentage points. No change in the completion rate was detected for the remaining two groups: lower-class women and upper-class men ($|zs| < 0.85$, $ps > 0.39$).

An identical pattern of intervention effects was observed for course grades (Fig. 3). Among lower-class men there was a visible shift in density from grades below 25 to grades above 60. Indeed, the affirmation intervention significantly raised average course grades for this group ($H4$; $z = 2.86$, $p = 0.004$, adjusting for covariates; $p = 0.017$ unadjusted). A slight negative shift in grades occurred for upper-class women, but this shift was not significant ($z = -1.78$, $p = 0.075$). As with completion rates, no major changes in the grade distribution occurred in the remaining two groups ($|zs| < 1.1$, $ps > 0.30$).

We conducted a survival analysis to test effects on persistence, measured by the number of assessments attempted throughout the course (data on video watching and other behaviors were unavailable). Kaplan-Maier survival curves show that the affirmation intervention improved the trajectory of persistence for lower-class men early in the course (Fig. 4). The intervention reduced the drop-out risk by 24% ($H4$; $e^{\text{coef}} = 0.76$, $z = -2.88$, $p = 0.004$), according to a covariate-adjusted Cox regression ($p = 0.048$ unadjusted; proportional hazards assumption not violated, all $p > 0.12$). Consistent with the results for completion rates and grades, the survival

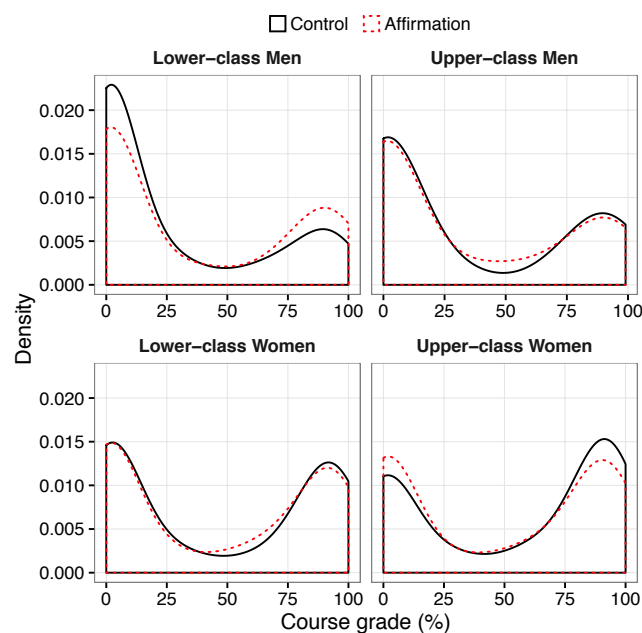


Figure 3. Grade distribution in each experimental condition by participant gender and social class.

analysis yielded no significant effect on the other subgroups ($|zs| < 1.8$, $ps > 0.087$).

Heterogeneity in Affirmed Values

In the value relevance affirmation activity, 88% of participants selected three values to affirm, while others selected one or two. The most frequently selected values were relationships with family/friends (69%), physical attractiveness (56%), creativity (39%), sense of humor (34%), and spontaneity/living life in the moment (30%). To test if affirming certain values was associated with stronger or weaker intervention effects, we compared the average completion rate in the control condition (c) with the average rate in the affirmation condition when a specific value was affirmed (a_1) and when it was not affirmed (a_0). Group differences in completion rates were tested using z -tests with robust standard errors (c , a_1 , a_0 represent means).

We found significant heterogeneity in the effect of the affirmation for lower-class men (RQ1). The increase in completion rates was exclusively observed for the 65% of participants who affirmed their relationships with family/friends ($c = 26\%$; $a_0 = 24\%$; $a_1 = 41\%$; $z = 2.93$, $p = 0.003$). Repeating the analysis for upper-class women, we again found heterogeneity. While the 70% of upper-class women who affirmed their relationships with family/friends exhibited no change from control levels, those who did not affirm this value performed significantly worse ($c = 59\%$; $a_0 = 36\%$; $a_1 = 59\%$; $z = -3.80$, $p < 0.001$). These correlational findings suggest that affirming close relationships is important for the intervention to support identity-threatened individuals in China. For non-threatened individuals, however, the intervention may lead them to invest their efforts outside of the course, unless they connect the course to their close relationships (e.g., learning English to make their parents proud). This raises questions

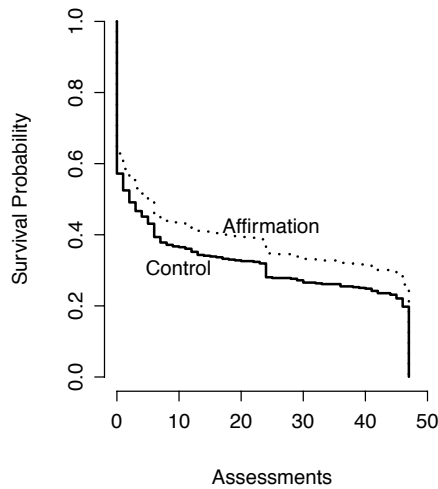


Figure 4. Course persistence for lower-class men in each experimental condition. Kaplan-Meier survival curves are based on the number of attempted course assessments.

for future research on strategies to encourage individuals to affirm values that may be culturally most relevant.

For completeness, we report additional associations between treatment effects and commonly affirmed values (chosen by at least 10%). For lower-class men, intervention effects were detected only when sports/athletics and learning for the sake of learning were not affirmed (e.g., sports: $c = 26\%$; $a_0 = 37\%$; $a_1 = 26\%$; $z = 2.38, p = 0.017$). Upper-class women exhibited lower completion rates relative to the control condition ($c = 59\%$) if they affirmed physical attractiveness ($a_0 = 56\%$; $a_1 = 48\%$; $z = -2.17, p = 0.030$) and if they did not affirm spontaneity/living life in moment ($a_0 = 49\%$; $a_1 = 57\%$; $z = -2.06, p = 0.039$). These exploratory findings are tentative and invite future research into which values are most conducive to achievement.

DISCUSSION

This research advances the social-psychological account of achievement gaps in online learning [25]. We provide new evidence that psychological barriers can undermine academic learning and achievement not only in brick-and-mortar settings but also in online learning environments. An intervention in the form of a brief writing activity, which did not remove any structural barriers, reduced gender and social-class achievement gaps. This suggests that social and cultural cues in the environment, such as the instructor's gender and references in the learning materials, raised SIT by conveying that group stereotypes apply in this setting or by insinuating outsider status [33].

We found that men experienced higher gender SIT and performed lower than women in an English language learning MOOC (H1), and lower-class learners reported lower self-esteem and subjective social status and performed lower than upper-class learners (H2b), even though no difference in regional SIT was found (H2a). Consistent with research on

intersectionality [12], lower-class men performed the lowest, while upper-class women performed the highest (H3). To test the psychological basis of this achievement gap, we used an intervention designed to support identity-threatened online learners from a collectivist culture. The interdependent value relevance affirmation substantially improved persistence, grades, and completion rates for the most disadvantaged group in this context, lower-class men (H4). Other groups of learners remained unaffected, except for a negative trend ($p = 0.098$) for upper-class women, the highest performing group. A slight reduction in completion rates in the highest performing group due to a value relevance affirmation was also observed in prior work [25]. We shed new light on this phenomenon by revealing that this tendency to disengage depends on which values high-achievers affirm. The intervention may lead non-threatened individuals in a collectivist context to disengage from the course unless they affirm the relevance of the course to their close relationships.

Limitations

The current research demonstrates both pre-treatment differences in SIT and social status, and the behavioral and performance impact of a value relevance affirmation on identity-threatened individuals; however, it leaves a closer investigation into the psychological mechanisms for future research. Building on psychological theory and prior empirical work, the value relevance affirmation was designed to foster motivation and buffer against SIT, but without follow-up self-report data we cannot examine the mechanism by which the intervention improved outcomes among lower-class men. An attempt to collect relevant data in a follow-up survey was unsuccessful due to very low response rates. While open learning environments lend themselves to collecting longitudinal behavioral data, the same cannot be said for self-report data, as surveys are optional and attrition rates are high and often differential across conditions.

We found converging evidence that learners from capital cities and municipalities are on average from a higher social class than learners from non-capital cities. However, this geographic operationalization of social class is relatively coarse—clearly not everyone from a capital city is in the upper-class of society and vice versa. It is also unclear whether learners from non-capital cities experienced class-based identity threat, because we only assessed regional identity threat and found no difference. The communicative pedagogical approach in the course in combination with gender cues may have raised SIT specifically among men who were aware of gender stereotypes in language learning and who additionally felt unprepared—even intimidated—by the course format because they attended schools in lower-class regions with less emphasis on English communication. Further research should disentangle potential sources of SIT and evaluate how they relate to social class identity using individual-level data.

Theoretical Contributions

How psychological processes tied to identity, belonging, and threat unfold in computer-mediated learning environments is a largely unexplored theoretical frontier. The present findings demonstrate the influence of social-psychological processes on

academic achievement in a novel context—large-scale online learning environments—and in a novel population—Chinese English language learners. This extends prior work focusing on social inequalities that arise in in-person settings, but it remained unclear how threats to social belonging and identity arise in online environments that afford low levels of social presence and interaction. These environments present numerous social and cultural cues through the design of the environment and the content and format of learning materials. Learners who are conscious of a stigma associated with their group identity (e.g., women being more talented at language learning than men) tend to respond more strongly to identity-relevant cues (e.g., both course instructors being women) [34], especially in novel situations that bear greater uncertainty about one's ability to be successful [13]. Thus, online learning environments can serve as a research site to investigate the impact of different cues and the psychological mechanisms that give rise to achievement gaps.

Another theoretical contribution of this work arises from the study sample, which was collected in a highly interdependent cultural context [31]. We expected that relationships with family and friends would be an important value to affirm in China [19, 6], though prior work has not tested how the choice of affirmed values relates to the efficacy of the value relevance affirmation. Affirming close relationships turned out to be vital for supporting lower-class men and preventing affirmation-induced disengagement among upper-class women (RQ1). This initial correlational evidence suggests that it matters which values people affirm, though it is unclear how the choice of affirmed values moderates the intervention effects in other cultural contexts, such as the U.S., where people tend to have highly independent self-concepts [31]. Perhaps affirming certain values requires less effort and is more effective at protecting people's sense of self-integrity depending on the cultural context. Another interpretation of the finding is that people who affirm close relationships are more likely to benefit from the intervention. Further research could examine heterogeneity in affirmed values across demographic and sociocultural contexts, and test the effects of strategically presenting different sets of values to affirm.

From a disciplinary education perspective, there is a large body of literature on foreign language classroom anxiety [18], but this phenomenon has not been examined in online classrooms. We therefore included a question to assess this type of anxiety and found that, consistent with prior work in in-person environments [2, 27], women reported higher anxiety than men ($p < 0.001$). While we cannot evaluate the effect of affirmation on anxiety because this variable was assessed before treatment, we also found no evidence that anxiety moderated the intervention effect. This suggests that men's underperformance is not due to foreign language classroom anxiety. The pattern that men underperform despite reporting lower levels of anxiety may be interpreted as a symptom of psychological disengagement from the English course, a context in which they feel stigmatized [30]; future research could investigate the relationship between SIT and foreign language classroom anxiety.

Practical Implications

Despite increasing access to higher education content, MOOCs have fallen short of providing equal opportunities to success, especially for members of social groups that underperform in traditional academic settings, as evidenced by systematic differences in course outcomes [16, 22, 25]. We demonstrate the role of a social-psychological barrier to achievement and introduce a theory-based intervention approach to reduce educational disparities. This intervention can be scaled to any number of learners; it takes them just minutes to complete; and the implementation of the activities is fast and does not incur any costs. Additionally, the intervention can be targeted to just those (identity-threatened) learners expected to benefit from the activity. More research is needed to understand when and for whom the intervention is most effective. Points of transition (e.g., entering a new course) and before a threatening interaction (e.g., taking a test, receiving critical feedback) are critical times when an affirmation can support at-risk learners [10]. Moreover, it may be important to tailor the intervention activity and its framing to fit the cultural context, as was done here for Chinese learners.

Another practical implication of this work concerns the importance of social and cultural cues in learning environments. Prior work identifies multiple cues that can raise SIT, including numeric underrepresentation and stereotypical classroom decorations (e.g., gaming posters in a computer science classroom) [7, 33]. However, instructional designers can also plant cues in an environment to forestall experiences of SIT and fears of non-belonging, for example, by designing the virtual classroom with warm colors and by explicitly communicating that diversity is valued in the community [7, 35]. In a "neutral" environment, the absence of cues may not be sufficient to alleviate stress and vigilance, which depletes valuable cognitive resources that could be otherwise invested in learning [46, 33, 35]. It may therefore be necessary to embed affirming experiences in the learning environment to lift the threat that at-risk learners experience by default in such settings. It may also be necessary to adapt learning materials to different cultural contexts to avoid perceptions of cultural mismatch [41].

CONCLUSION

Social-psychological factors can limit academic achievement in online learning environments, especially among learners who are already disadvantaged in brick-and-mortar settings. To move beyond providing equal access and fulfill the promise of providing equal learning opportunities, MOOCs and other learning environments need to provide a psychologically safe climate for all learners. In no way does this lessen the critical need to address persistent structural sources of educational inequality. Instead, it is a reminder that even if structural barriers were overcome and universal access to education were available, there would still be a need to address social-psychological barriers to achievement.

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