Eight-minute self-regulation intervention raises educational attainment at scale in individualist but not collectivist cultures

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Academic credentials open up a wealth of opportunities. However, many people drop out of educational programs, such as community college and online courses. Prior research found that a brief self-regulation strategy can improve self-discipline and academic outcomes. Could this strategy support learners at large scale? Mental contrasting with implementation intentions (MCII) involves writing about positive outcomes associated with a goal, the obstacles to achieving it, and concrete if–then plans to overcome them. The strategy was developed in Western countries (United States, Germany) and appeals to individualist tendencies, which may reduce its efficacy in collectivist cultures such as India or China. We tested this hypothesis in two randomized controlled experiments in online courses ($n =$ 17,963). Learners in individualist cultures were 32% (first experiment) and 15% (second experiment) more likely to complete the course following the MCII intervention than a control activity. In contrast, learners in collectivist cultures were unaffected by MCII. Natural language processing of written responses revealed that MCII was effective when a learner's primary obstacle was predictable and surmountable, such as everyday work or family obligations but not a practical constraint (e.g., Internet access) or a lack of time. By revealing heterogeneity in MCII's effectiveness, this research advances theory on self-regulation and illuminates how even highly efficacious interventions may be culturally bounded in their effects.

motivation | goal pursuit | culture | education | field experiment

People face many obstacles in the pursuit of their educational goals. In the United States, only 59% of students entering 4-y institutions earn bachelor's degrees within 6 y, and less than a third of those entering 2-y institutions earn a credential within 3 y (1). Compared with brick-and-mortar schools, online education can provide more flexible and affordable opportunities for intellectual and professional development. Between 2011 and 2015, over 35 million people worldwide enrolled in massive open online courses (MOOCs) to gain access to a basic higher education, to advance their career, or to engage in lifelong learning (2, 3). Services that support lifelong learning, such as MOOCs, are increasingly important in the digital economy where employees need to acquire new skills and knowledge to remain competitive. MOOCs have increased access to the opportunities of higher education, including access to course lectures, conceptual and practical assessments, and social capital (4). However, course completion rates typically fall below 10% and still do not exceed 25% for highly committed learners (5, 6). This shortcoming has been attributed to insufficient support and guidance for learners with weak self-regulatory skills (7, 8).

Self-regulation is the process by which people change their beliefs and actions in the pursuit of their goals (9). It is known to support achievement in academic settings (10–13). In contrast to students in traditional school settings whose time is structured around classes in a fixed schedule, online learners are expected to determine when and how to engage with course content. They confront no external pressures to make progress or explicit social norms to facilitate course completion. Learners receive relatively little support and guidance in online learning environments, and as a result, many struggle with self-regulation (14). However, digital learning environments can be used to disseminate not only educational content but also activities that support self-regulation. Guided activities that were found to support academic self-regulation in prior research could be made available to large numbers of online learners and tested at scale. The international audience of learners in MOOCs offers an unprecedented opportunity to explore heterogeneity in the effects of self-regulation strategies and their ecological validity in authentic learning environments (15).

Mental Contrasting with Implementation Intentions

Previous research has developed a self-regulation strategy called mental contrasting with implementation intentions (MCII). The strategy builds on a two-stage process of goal pursuit: goal setting, which involves choosing goals and committing to them, and goal striving, which involves planning and executing goal-relevant behavior (16). MCII promotes goal attainment by combining two complementary self-regulation techniques: first, mental contrasting (MC), which instigates goal commitment and goal striving, and second, forming implementation intentions (II), which promote goal-directed behavior through strategic planning for obstacles (17, 18).

The MC procedure consists of vividly elaborating on positive outcomes associated with attaining a goal (e.g., learning a new skill) followed by vividly elaborating on central hindrances in the present that might interfere (e.g., a busy work schedule) (19). By juxtaposing the desired future with current obstacles, MC can strengthen goal commitment and striving (18). Insofar as the obstacles to goal attainment are seen as surmountable, MC induces a sense that the desired future is within one's reach, thereby increasing commitment and effortful goal striving. By contrast, for goals perceived as insurmountable, MC may reduce commitment because it highlights the difficulty of achieving one's goals. Intervention studies attest to

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Significance

High attrition from educational programs is a major obstacle to social mobility and a persistent source of economic inefficiency. Over two-thirds of students entering a 2-y institution fail to earn a credential in the United States. In online courses, attrition rates are even higher. In two large field experiments, we tested the conditions under which a writing activity that facilitates goal commitment and goal-directed behavior reduces attrition in online courses. The activity raised completion rates by up to 78% for members of individualist cultures and primarily for those who contended with predictable and surmountable obstacles in the form of everyday obligations, but it was ineffective in collectivist cultures and for people contending with other types of obstacles.

the positive effects of MC on time management and academic performance (20, 21). The effects are mediated by both cognitive and motivational mechanisms. Cognitively, MC strengthens the mental link between future and present, as assessed by the speed with which people associate future-relevant with present-relevant words, and it recasts present barriers as challenges to overcome (22). Motivationally, MC has an energizing effect that manifests in increased systolic blood pressure and behavior change (23).

The II procedure helps people plan how to overcome obstacles and execute goal-directed actions. It encourages people to generate concrete if–then plans (24, 25). Unlike unstructured planning, an II links a specific situation to a goal-directed action. An example of an II is, "If I feel too tired after work to watch the next lecture, then I will make myself coffee to stay awake." Forming an II facilitates goal attainment because it increases the likelihood that people will respond efficiently and even automatically to regular obstacles that threaten the completion of their goals (26). Prior work demonstrates the efficacy of II in supporting goal attainment in various contexts, yielding medium-to-large effect sizes (metaanalysis Cohen's $d = 0.65$) (27).

MC and II are complementary strategies, because MC promotes goal commitment and striving, whereas II promotes goal-directed behavior in the face of obstacles (17). Twelve studies have tested the combined MCII strategy in the education, health, and conflict resolution domain (11, 28–35) (Table S1). Study samples ranged from 51 to 256 participants, all based in the United States or Germany, with mostly medium-to-large positive effects, including long-term effects in the health domain (29, 34, 35). MCII was also found to be more effective than either MC or II alone at reducing unhealthy snacking (28) and at improving joint agreement in bargaining (32), although no prior work has simultaneously evaluated MC, II, and MCII against a control activity, a gap we address in our second experiment.

In summary, empirical evidence has established that MCII works in different domains and for different age groups. However, no prior work has tested MCII outside Western individualist culture. If the intervention produced medium-to-large increases in online course completion, it would help millions of learners worldwide achieve their educational goals. Can MCII support goal pursuit at scale in cultures around the world?

Sources of Cultural Heterogeneity

MCII may prove most effective in Western individualist countries, because it requires personal agency and an ability and a willingness to structure, even integrate, complex and uncertain life situations into controllable routines. These tendencies are characteristic of the independent self and of analytic cognition dominant in individualist cultures (36, 37). The if–then structure of II, for instance, is rooted in the analytic system of formal logic. By contrast, the collectivist cultural tradition is more holistic and relies on dialectic thinking to reconcile logical contradictions (37). In collectivist cultures, personal goals are subordinate to striving for interpersonal harmony, which sometimes means subordinating personal goals to social goals and negotiating competing obligations (36). It may therefore be culturally incongruent and even threatening to ask people in collectivist cultures to single out personal goals, to generate personally favored outcomes associated with achieving these goals, and to predefine paths for overcoming obstacles to their goals, especially if many of these obstacles revolve around social commitments (38). MCII may be consistent with individually oriented achievement motives that focus on personal goal attainment and controllable dilemmas that can be addressed analytically. However, it may be less aligned with the socially oriented achievement motives that prevail in many collectivist cultures, where people desire to meet the expectations of socially significant others and to accommodate to the unpredictable demands of a complex and ritualized social world (36, 38).

The present work evaluates the efficacy of MCII across cultural contexts. First, we report findings from a cross-cultural survey of online learners that compares views on personal agency, motivation, and handling of complex and uncertain life situations. Then, we report results of two large-scale randomized field experiments with international samples of adult online learners. In the two experiments, we implemented MCII (and MC and II separately) in MOOCs by offering it as a preparatory activity at the beginning of the course. Beyond estimating overall effects, we focus on identifying heterogeneity in treatment effects by cultural context, operationalized based on Hofstede et al.'s (39) national index of collectivism–individualism. Furthermore, leveraging the unprecedented size of our sample for the evaluation of MCII, we applied natural language processing to learners' stated obstacles to examine the types of obstacles that lent themselves to MCII's effectiveness. According to the theory of fantasy realization on which MC is based, the intervention should help people cope with obstacles that leave them with some freedom to act adaptively and flexibly, rather than obstacles that are rigidly defined and leave little room for autonomous action (19).

Cross-Cultural Survey

To investigate cultural differences that may influence the efficacy of MCII, we conducted a survey of people from the United States ($n = 94$) and India ($n = 101$) who had taken at least one online course over the past 12 mo. Respondents were recruited from Amazon Mechanical Turk. The United States is the most represented individualist country among MOOC learners, whereas India is the most represented collectivist country. We first evaluated whether MCII's underlying assumption of a navigable environment and personal agency was more characteristic of individualist than collectivist cultures. Indeed, relative to US respondents, Indian respondents reported that their social environment was more complex and that they shied away from forming if–then plans. Indian respondents listed more obstacles that could interfere with the goal of achieving a good grade in an online course than US respondents (India median = 4, US median = 3; Kruskal–Wallis $X^2 = 9.50, P = 0.002$). They were also more likely to report that if–then plans oversimplify the complexity and ignore the uncertainty of real-life situations [$t_{(192)} = 3.12, P = 0.002, d = 0.45$].

We also examined cultural differences in how people handle their obstacles. Indian respondents were more likely to use their social relationships than US respondents. We asked respondents how they dealt with obstacles by selecting one or more of the following options: (i) I plan future actions by identifying a specific situation and planning my response; (ii) I get social support by asking people close to me to help me find ways to overcome the obstacle; and (iii) I seek social accountability by asking people who are close to me to monitor my progress and make me feel guilty if I do not make progress toward the goal. Respondents in both countries were equally likely to deal with obstacles by planning ahead ($X^2 = 1.59, P = 0.21$) and asking for help ($X^2 = 0.02, P = 0.89$). However, 31% of Indian respondents, compared with only 4% of US respondents, reported seeking social accountability ($X^2 = 21.3, P < 0.001$). Additionally, although Indian respondents were only slightly more motivated "to feel proud of [their] academic achievements" than US respondents ($X^2 = 4.82, P = 0.028$), they were substantially more motivated by a desire not "to disappoint [their] family and friends with academic failures" ($X^2 = 17.3, P < 0.001$).

In summary, members of a more collectivist culture construed their goal-regulation efforts in a more social and complex context. Insofar as MCII requires an agentic self that can act on a predictable environment, it may be less effective in collectivist than individualist cultures.

Self-Regulation Intervention Experiments

We conducted two randomized controlled trials in distinct online courses to evaluate the effects of MCII. The first experiment ran in a graduate-level business course offered over 10 wk. The second ran in an introductory computer science course offered over 6 wk. The intervention activities were implemented at the start of each course (see *Materials and Methods*). Participants were assigned to receive either an MCII or a control activity in the first experiment. In the second experiment, we added two separate conditions to

isolate the effects of MC and II alone. The outcome measure was course completion, that is, whether a participant finished the course and achieved the required final grade to be eligible for a course certificate. We operationalize culture at a national level using the Hofstede collectivism–individualism dimension (39), which assigns a score from 0 (most collectivist) to 100 (most individualist) to 94 nations worldwide. Based on their geographic location, each participant was labeled as belonging in either a collectivist culture ([0, 33]; e.g., Mexico, China, Romania), balanced culture ([34, 66]; e.g., India, Brazil, Russia), or individualist culture ([67, 100]; e.g., United States, Australia, France). For more information on this measure and alternative operationalizations of culture, see *SI Supporting Analyses*.

Before random assignment and exposure to different conditions, participants indicated their likelihood of watching most lectures in the course (from "extremely unlikely," 1, to "extremely likely," 7) and the importance they attached to this goal (from "not at all important," 1, to "extremely important," 5). Across both experiments, 65% of participants rated the goal as at least "very important" and "very likely" to be attained. Their ratings did not differ significantly between experimental conditions either overall or within each cultural context (Ps > 0.093; Table 1). Participants spent more time completing the MCII activity and were more likely to leave it unfinished than the other activities (Ps < 0.001; see intervention compliance in Table 1). However, this variation does not bias our inferences, because we analyze data from all exposed participants regardless of their compliance with the activities. This intent-to-treat analysis yields conservative estimates of average treatment effects that are relevant to evaluating the overall impact of the intervention. We analyzed participant-level data using linear probability models with robust standard errors and pretreatment self-report measures as covariates (results are robust to using logistic mixed-effects models and to modeling individualism as a continuous variable; *SI Supporting Analyses*).

Results

Across all cultural contexts, MCII did not significantly increase course completion relative to the control condition in either experiment, although there was a positive trend (experiment 1: $b = 0.008$, $z = 1.66$, $P = 0.097$; experiment 2: $b = 0.021$, $z = 1.54$, $P = 0.122$). MC and II alone did not significantly increase course completion in the second experiment ($bs < 0.005$, $zs < 0.37$, Ps > 0.71).

However, once we evaluated the effect of MCII separately by cultural context, we found large effects in individualist countries only (Fig. 1). MCII increased course completion by 32% (experiment 1: $b = 0.018$, $z = 2.35$, $P = 0.019$) and 15% (experiment 2: $b = 0.039$, $z = 2.41$, $P = 0.016$) for participants in individualist countries, relative to the control condition. In contrast, MCII did not raise course completion in collectivist and culturally balanced countries (experiment 1: $|bs| < 0.004$, $|zs| < 0.38$, Ps > 0.70; experiment 2: $|bs| < 0.023$, $|zs| < 0.67$, Ps > 0.51). Despite the

positive impact of MCII in individualist countries, MC and II alone caused no statistically significant improvement in course completion for participants in any cultural context in the second experiment relative to the control condition (MC: $|bs| < 0.07$, $|zs| < 1.83$, Ps > 0.067; II: $|bs| < 0.01$, $|zs| < 0.38$, Ps > 0.71). However, we unexpectedly found a trend for MC to increase course completion in collectivist countries ($b = 0.07$, $z = 1.83$, $P = 0.068$), discussed below. The key finding is that, in both experiments, MCII was highly effective for learners in individualist cultures, but not for those in collectivist and balanced cultures.

Given the earlier finding that Indian respondents viewed if–then plans as oversimplifications, we tested whether participants in collectivist and balanced cultures were less likely than participants in individualist cultures to adhere to the if–then structure when forming II. The following results focus on participants' written responses to the intervention activity. In the first experiment, 41% of participants in individualist countries but only 32% in nonindividualist countries wrote "if" and "then" when instructed to do so ($X^2 = 54$, $P < 0.001$). In the second experiment, where "If …, then …" was provided as an explicit prompt, 24% of participants from individualist countries deleted the prompt, whereas 28% of participants from nonindividualist countries did ($X^2 = 6.8$, $P = 0.009$). These differences did not seem to reflect less engagement with the activity in nonindividualist cultures: Participants in nonindividualist countries wrote almost as much as participants in individualist countries in response to the II prompt; whatever difference existed could be accounted for by the deletion of the words "if" and "then" (median word count: 10 vs. 12 in experiment 1, 14 vs. 15 in experiment 2).

Finally, we examined heterogeneous effects of MCII by what kind of obstacle participants faced. We identified each participant's primary obstacle using topic modeling—a natural language-processing technique—of the 17,963 written descriptions of obstacles that we collected in both experiments. Three thematic clusters of obstacles emerged from the data (most frequent topical terms in parentheses): everyday obligations (work, job, life, family, busy, schedule), lack of time (time, lack, constraint, enough, find, available), and practical barriers (Internet, computer, language, video, understand). Participants were categorized into one of three groups based on the classification of their primary obstacle. Although all three obstacles were commonly indicated in each cultural context, everyday obligations and a lack of time were somewhat more frequent in individualist cultures, whereas practical barriers were somewhat more frequent in collectivist cultures in both experiments (Table S2; X^2s > 88, df = 2, Ps < 0.001).

We evaluated the effect of MCII in each cultural context for each type of obstacle in the first experiment (experiment 2 yielded similar trends but was limited by its smaller sample size due to its two additional experimental conditions). We found that MCII was effective in individualist countries only if the obstacle concerned an everyday obligation (Fig. 2). In this case, MCII increased course completion by 78% relative to the control condition ($b = 0.039$,

Table 1. Descriptive statistics for two randomized field experiments by condition

Condition	First experiment		Second experiment			
	Control	MCII	Control	MC	II	MCII
N (countries)	3,112 (85)	6,507 (86)	2,123 (81)	2,082 (79)	1,972 (78)	2,167 (78)
Intervention compliance rate, %	94.7	77.5	95.9	94.1	97.9	83.8
Median time spent on intervention, min	5.0	8.0	4.3	4.3	4.2	6.6
Self-report measures, quartiles						
Goal importance	[4, 4, 5]	[4, 4, 5]	[4, 4, 5]	[4, 4, 5]	[4, 4, 5]	[4, 4, 5]
Likelihood of attainment	[5, 6, 6]	[5, 6, 6]	[5, 6, 7]	[5, 6, 7]	[5, 6, 7]	[5, 6, 7]
Course completion rate						
Overall, %	5.42	6.32	25.4	25.7	25.9	27.5
Individualist countries, %	5.52	7.28	25.7	24.8	26.2	29.5
Balanced countries, %	5.64	5.93	25.8	25.7	25.9	24.2
Collectivist countries, %	5.03	4.80	23.5	29.9	24.5	21.1

First experiment (*N* = 9,619)

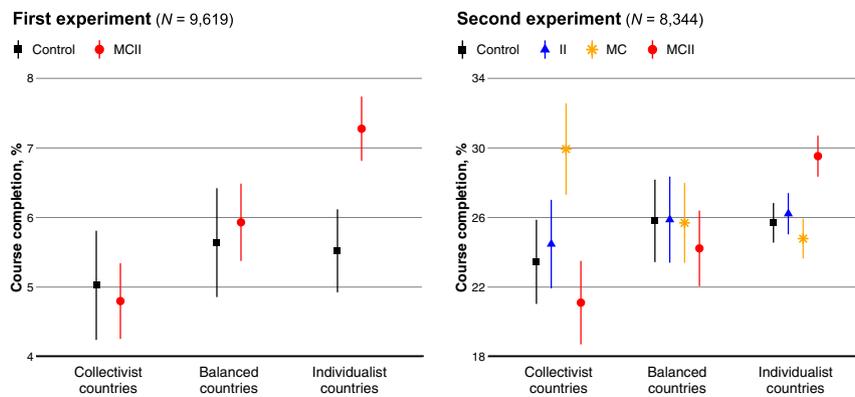**Second experiment** (*N* = 8,344)

Fig. 1. MCII raises course completion only among learners in individualist countries. Course completion outcomes of two randomized field experiments evaluating the effect of mental contrasting (MC), implementation intentions (II), and mental contrasting with implementation intentions (MCII) relative to a control activity in three cultural contexts defined by the Hofstede collectivism–individualism index: collectivist countries [0, 33], balanced countries [34, 66], and individualist countries [67, 100]. Error bars represent ±1 SE.

$z = 2.93$, $P = 0.003$). By contrast, MCII did not raise course completion in individualist countries for any other obstacle type (Ps > 0.44). We detected no statistically significant effects of MCII in other cultural contexts for any obstacle type (Ps > 0.094). There was only an unexpected negative trend in completion due to MCII among participants in collectivist countries who faced obstacles concerning everyday obligations ($b = -0.035$, $z = -1.67$, $P = 0.094$), discussed below. The key finding is that the primary beneficiaries of MCII were members of individualist cultures whose primary obstacle seemed to reflect an obligation that was controllable as it could be predicted and surmounted by an agentic self.

Discussion

This research establishes that MCII can be implemented at scale for practically zero cost and still be effective for thousands of learners. The intervention was delivered as an online activity that took fewer than 8 min to complete, but its effects were substantial. Course completion increased by 32% (experiment 1) and 15% (experiment 2) for members of individualist nations in general and by 78% for those whose obstacles took the form of everyday obligations (experiment 1). This work demonstrates the potential of MCII to support goal pursuit at scale in educational settings. It may also be effective in other settings that call for self-discipline and sustained engagement, such as in organizational and health contexts. This research also shows that

psychological interventions, although powerful, can be conditional in their effects. Their impact is moderated by cultural and situational forces. Benefits of MCII depended on a cultural context of individualism and emerged primarily for everyday obligations amenable to if–then planning.

As values and beliefs vary by culture, it is no simple matter to translate an intervention developed in one culture for another. Prior work shows that the benefits of II depend on a commitment to form and enact if–then plans (40). We expected that this element of MCII would appeal primarily to the analytic and agentic cognitive style prevalent in individualist cultures, where people rely more heavily on rules of formal logic to guide their thinking and behavior (37). If–then plans presuppose a degree of personal choice to act and react, an assumption that resonates more in individualist cultures than collectivist ones (36). If–then plans may also be more difficult to enact in cultures where many obstacles involve spontaneous and uncontrollable opportunities and obligations. Our results were consistent with many of these cultural differences: Compared with members of individualist nations, members of collectivist nations reported fewer obstacles that involved everyday (i.e., controllable) obligations (Table S2); they perceived if–then plans to oversimplify the complexity and uncertainty of life; and they were more likely to refuse to form if–then plans in both experiments. These culturally rooted reservations to forming if–then plans are likely to have undermined the efficacy of
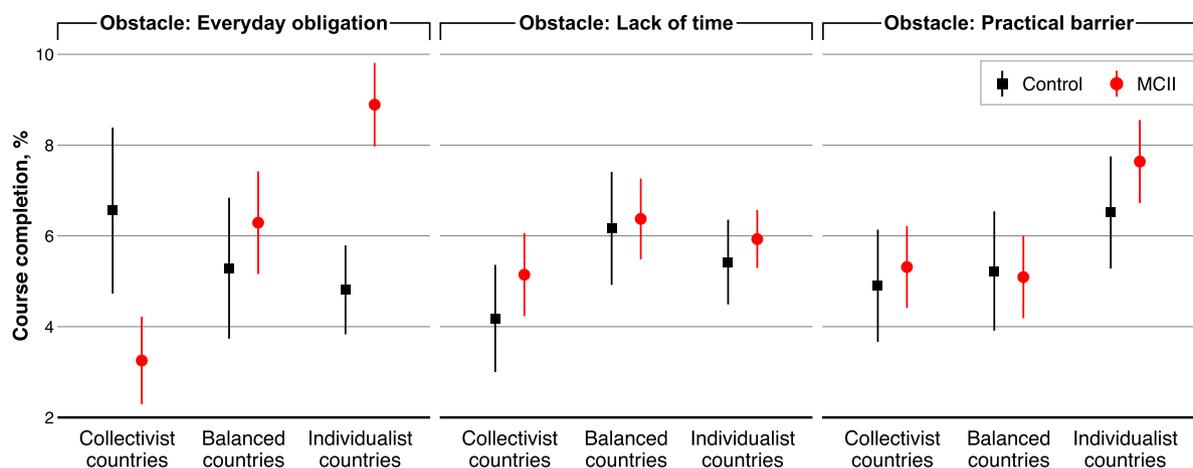

Fig. 2. MCII's effect is conditional on the type of learners' stated obstacle. Course completion outcomes in the first experiment examined by obstacle type and cultural context (*n* = 9,619). Three obstacle types were identified using natural language processing (latent Dirichlet allocation topic modeling) of learners' stated obstacles. Error bars represent ±1 SE.

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MCII, rendering it not only ineffective but even counterproductive. MCII yielded a negative trend for members of collectivist nations who reported obstacles related to everyday obligations, the very opposite of the pattern observed in individualist nations. It is possible that an adapted II activity, in which if–then plans are more fluid and tied to social accountability, might prove more resonant and effective in collectivist cultures.

Another contribution of this research is that it disentangles the two components of MCII relative to a control condition. In individualist cultures, MC and II alone did not increase course completion relative to the control condition. In combination, however, these two components catalyzed one another's influence to yield a large benefit. There was also a trend in collectivist nations for MC alone to increase course completion relative to the control condition. Although speculative, one possibility is that the open-ended format of the MC activity allowed members of collectivist cultures to integrate the individualistic goal of completing all lectures with collective values, for instance, by articulating ways in which completing the course would help their family. In fact, MC has been shown to help people find integrative solutions in interpersonal bargaining (41). MC may therefore help members in collectivist cultures by energizing goal pursuit while at the same time providing sufficient latitude to think holistically about their goals. This latitude may be constricted with the addition of the II component.

Beyond culture, the type of obstacle that people anticipated moderated the effect of MCII. Natural language processing of an abundance of textual data revealed three types of obstacles reported by participants: everyday obligations, a lack of time, and practical constraints such as Internet connectivity. MCII should raise goal attainment most for surmountable and predictable obstacles (19). Consistent with this notion, MCII had no effect when learners cited a shortage of time and practical constraints as their primary obstacles. These leave relatively less freedom for adaptive solutions under the individual's control. However, MCII had a strong effect when learners cited everyday obligations as the primary obstacle. Everyday obligations can be anticipated, planned for, and creatively adapted to. Moreover, the very regularity of such obstacles would contribute to the effectiveness of II, as they would repeatedly cue the adaptive actions that learners generate in their if–then plans (26).

This research establishes that MCII can be implemented at scale to support goal pursuit in a population of adult learners in online global learning environments. It also establishes two sources of heterogeneity in its effectiveness that are consistent with the literatures in self-regulation and cultural psychology. Although a culture's level of collectivism–individualism is associated with other variables, such as economic prosperity, English proficiency, and other cultural differences, we evaluated several potential confounding variables and found that none of them consistently moderated the effect of MCII, save one. The exception was Inglehart's distinction between cultures that value self-expression versus survival (42). However, this distinction is both conceptually similar to collectivism–individualism and highly correlated with it. Moreover, a stepwise regression analysis indicated that the collectivism–individualism dimension best explained the heterogeneity in our data (*SI Supporting Analyses*).

Our findings highlight the need to adapt self-regulation strategies to the cultural context. Members of different cultures responded divergently to seemingly minor differences in the intervention activity. The results not only suggest that the intervention taps into powerful motivational processes, but that culture can imbue even small details with important meanings. Self-regulation activities may need to be changed in light of the different cultural frameworks in which they are interpreted. In collectivist cultures, it may be important to avoid if–then contingency plans that oversimplify the complexity of socially interdependent situations. Moreover, it may be important to elicit goals congruent with the cultural context: Members of collectivist cultures might benefit from MCII if the goal is tied to collectivist values (e.g., helping their family), whereas members of individualist cultures might benefit if the goal is tied to individualist values, as in the present studies. One way to accomplish this may be to use the recently refined instructions for MCII

(see refs. 18 and 43), which permit participants to flexibly define their own goals. The new Wish Outcome Obstacle Plan instructions prompt participants to generate a wish or goal of their own choosing that they deem attainable before proceeding to the MC and II steps.

Throughout the world, millions of people enroll in affordable education programs, eager to expand their horizon. Educational opportunity is growing rapidly as more people can gain access to high-quality course content online from even remote regions of the world. In a dynamic and technology-driven economy, the flexible educational opportunities provided through online learning will prove increasingly important for people to acquire new skills throughout their life. However, too many people fail to achieve their educational goals. This research shows that brief but culturally attuned practices can help people throughout the world take advantage of new educational opportunities. Not only can educational content be made to reach vast numbers of learners, but so can the self-regulatory support needed for them to succeed.

Materials and Methods

Cross-Cultural Survey. The survey was administered through Amazon Mechanical Turk. We recruited 367 respondents located in either the United States or India. We excluded 49 respondents who did not pass basic attention checks, two who reported growing up outside of the United States or India, and 121 who had not taken an online course in the last 12 mo. The final sample included 195 respondents: 69% male; 12% aged 18–24, 63% aged 25–34, 17% aged 35–44, and 8% aged over 44. Respondents did not differ between the two countries in terms of gender, age, and the number of online courses they had taken (Ps > 0.50). Complete survey questions are available in *SI Survey Questions*. Statistical comparisons were conducted using t tests for normally distributed variables and Kruskal–Wallis χ^2 tests for skewed variables. Respondents provided informed consent at the start of the survey. The study protocol was approved by Stanford University's institutional review board (IRB).

Field Experiments. We conducted two randomized controlled experiments in distinct courses offered through the two leading MOOC platforms, Coursera and Open edX. Participants were enrolled in a free online course on topics in business (experiment 1) or computer science (experiment 2). They were recruited via email to participate in the experiment, which was presented as an optional preparatory activity. Recruitment occurred either in the weeks before the start of the course (experiment 1) or right after the course began (experiment 2). The final sample encompassed 9,619 learners from 86 countries in experiment 1 and 8,344 learners from 87 countries in experiment 2 (see *SI Materials and Methods*, for details on pretreatment exclusion criteria). Demographic information beyond geographic location was not collected, but the sample is expected to contain a majority of educated adults in full-time employment, based on prior work in similar courses (3, 7). The study protocol was approved by Stanford University's IRB. Participants were informed at the time of enrollment that the course was used for educational research; informed consent was not required as the IRB determined that this study was exempt.

All participants reported their likelihood (7-point scale) and the importance (5-point scale) of achieving the goal of "watching most of the lectures in this course." We chose this goal because it accommodated the variety of motivations to take the course (3). Before being assigned to conditions, participants stated two positive outcomes that they associated with watching most of the lectures in the course and two obstacles that could interfere with doing so. These pretreatment responses were used as a basis for excluding participants who stated invalid outcomes or obstacles (*SI Materials and Methods*) as well as for adapting the intervention content. Next, participants were randomly assigned to condition (experiment 1: MCII vs. control; experiment 2: MCII, MC, II, vs. control). The MCII materials were adapted from a prior successful MCII intervention (11). For MC, participants elaborated, first, on their stated positive outcomes associated with the goal of watching most of the lectures and, second, on how their stated obstacles could interfere with this goal; they were asked to imagine both the positive outcomes and the obstacles as vividly as possible. For II, participants wrote three if–then plans, one for each specified obstacle and one related to when and where they intended to watch lectures. In experiment 2 only, "If …, then …" was prefilled in each textbox. In the control condition, participants wrote about their personal experiences that day (experiment 1), or about prior experiences with the course topic, their expectations for the course, and how much time they intended to spend on the course each week (experiment 2). For MCII, participants received the MC

activity followed by the II activity. Complete instructions are provided in *SI Materials and Methods*.

We assessed participants' achievement in terms of course completion, a standard binary performance metric available in both studies. To complete the course, participants had to achieve a course grade above the instructor-defined threshold (70% in experiment 1; 80% in experiment 2). The course grade summarized their performance on regular course assessments and a final examination. We analyzed the intervention effects on course completion using linear probability models with robust SEs. Logistic mixed-effects models with a random effect to account for clustering by country yielded equivalent results (*SI Supporting Analyses*). The percentage of lectures watched in the course was also available, and although this measure showed patterns consistent with course completion, it was not amenable to analysis due to its severely skewed and multimodal distribution (*SI Measures* and Fig. S1). Two

pretreatment covariates were included in all models to increase precision: self-reported goal importance and likelihood of attainment (mean-centered). Geographic location was determined from participants' IP addresses using Maxmind's GeoIP database (https://www.maxmind.com/). Cultural context was operationalized using Hofstede et al.'s individualism index (39). Thematic clusters of participants' written descriptions of obstacles were created using topic modeling by latent Dirichlet allocation with a Gibbs sampler (six random starts of 5,000 Gibbs iterations with 4,000 burn-in and 100 thinning) (44).

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