

Using Social Norms to Promote Actions Beyond the Course

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ABSTRACT

Educators and researchers in online education have grappled with not only how to increase course completion but also how to make a broader impact that goes beyond online courses, such as course participants' real-world applications of the learned knowledge and skills. Research in social psychology and behavioral science suggests that social norms interventions, which convey norms shared in the community that people belong in to promote desirable behaviors, can offer a low-cost and scalable approach to encourage actions beyond the courses (ABCs). We tested three social norm interventions that presented a weekly normative message (descriptive, dynamic, or injunctive norm) with aggregate information about course participants' ABCs in the prior week. Randomized experiments in three online courses found effects on ABCs to be weak and moderated by norm message type and the complexity of the target behavior. Although the interventions did not improve course completion, the dynamic norm message was more effective at promoting ABCs for complex behaviors, such as developing environmental education activities.

Author Keywords

Social norms; Intervention design; Online learning; Behavior change; Field experiments

CCS Concepts

•Applied computing → *E-learning; Distance learning;*

INTRODUCTION

Most educators want their students to see the world in new ways and to go out and use what they have learned. Yet the educational outcomes that receive most of the policy and research attention measure completion of academic programs of study, such as passing a course or graduating, because

the returns to education are typically tied to educational attainment [9, 4]. Ever since online learning became popular, research on online education has grappled with the issue of student attrition and improving completion rates [35, 3, 28]. Much less is known about the broader impacts of online learning outside of online course environments. The COVID-19 pandemic has further strengthened demand for online courses, especially among those looking to upskill or reskill during the economic downturn [18]. For professional learners, it is essential to apply learned knowledge from online courses in their real-world practice. There is evidence that people make use of technical skills they learn in online courses, such as data mining [48] and functional programming [11]. Likewise, participants in practice-oriented online courses have been found to put knowledge into practice throughout the course and engage with learning content by taking actions outside of the course (e.g., teaching practice, medical education) [39]. In online practice-oriented courses, promoting actions beyond the course (ABCs) is central to their educational mission, but relatively little is known about how to promote ABCs in online courses.

Social norms interventions designed to increase or decrease certain behaviors can be a low-cost yet effective way to promote practices outside of the course. The various social norms used in intervention studies all build on people's fundamental desire to be part of the community with which they identify [26, 16]. Prior research has shown that simply telling individuals that a majority of people in their group engage in a target behavior, such as exercising or recycling, increases the target behavior for these individuals [41, 45, 20, 23]. Social norms interventions have not been actively explored in the context of online education. We therefore have a limited understanding of the types of social norms that are effective at increasing course participants' engagement and their real-world application of learned knowledge. Moreover, it is unclear how the effects of social norms may vary based on the target behaviors promoted in the course, such as simple independent actions like recycling or more complex behaviors like teaching a recycling education program in one's community.

We conducted a series of randomized field experiments to examine how different types of social norms (descriptive vs.

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L@S '21, June 22–25, 2021, Virtual Event, Germany.

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<http://dx.doi.org/10.1145/3430895.3460144>

dynamic vs. injunctive norms) motivate online course participants to stay engaged in the course and to apply the learned ideas from the course into practice. We also investigated how the effects of social norms differ depending on the complexity of the ABCs being promoted. This research makes the following two contributions: first, it advances our understanding of how social norms interventions affect learner outcomes beyond course completion in online education; and second, it offers practical implications for course instructors and instructional designers who strive to promote not only engagement in the course but also real-world applications of learned knowledge in practices outside of the course.

RELATED WORK

Interventions Leveraging Social Comparison

In online education, learner engagement can be facilitated by social comparison, that is, comparing oneself with others [19, 42]. In massive open online courses (MOOCs), many intervention studies that aim to increase learner engagement during the course can be viewed in light of social comparison. First, visualizing past learners' data can provide comparative information. For example, a learning analytics dashboard showing the behavior of previous learners who successfully completed the course led to a higher course completion rate and more engagement with learning activities such as taking quizzes [19].

Second, gamification elements can also facilitate social comparison between course participants, such as a badge system that communicates what behavior is encouraged in the course. In fact, introducing badges awarded for reading and voting discussion posts in a course was found to increase participation in the discussion [2]. Similarly, previous research found that a reputation feature, through which course participants could earn a reputation score when their peers up-voted the post they made, increased the number of responses on the discussion board [17]. Both badges and reputation scores are shown to all course participants, which signifies the model behavior and facilitates learner engagement in the course.

Third, directly informing course participants about how their peers in the course are engaging with the course materials (rather than indirectly informing them via rewards like badges) can be a way to draw a comparison between the self and other course participants. Sharing such information can stipulate learner engagement in the course to different effects. For example, prior research found that course participants who received an email saying "there are a number of lively posts on the discussion board" contributed more to the discussion board than those who received emails saying, "we can all use the discussion board to collectively learn more in addition to video lectures and assignments in this course," or "you can use the discussion board to learn more in addition to video lectures and assignments in this course" [31].

Social Norms Interventions

Social norms can change people's behavior in many areas, from public health to environmental activism [16]. Social norms interventions have been used to reduce undesirable behaviors such as smoking and littering [40, 6], but also to

promote desirable behaviors such as pro-environmental behavior [20] and healthy behavior [41]. So far, research in the psychological and behavioral sciences has identified and tested three types of norms: descriptive norms, injunctive norms, and dynamic norms.

Descriptive norms emphasize that the majority of people conduct or do not conduct the behavior of interest (i.e., target behavior). Research has shown that providing a descriptive norm is more effective in promoting behavior than merely stating the importance of conducting the behavior. For example, Goldstein and colleagues [23] compared how much hotel guests reused towels when their room had a sign about towel reuse with a descriptive norm message, "almost 75% of guests who are asked to participate in our new resource savings program do help by using their towels more than once," or a message that only called attention to protecting the environment without invoking descriptive norms. Hotel guests exposed to the descriptive norm had an approximately 27% higher towel reuse rate than those in the other group.

Injunctive norms describe what behavior is approved in the community. They have been tested in comparison with descriptive norms. For example, Cialdini and colleagues tested norm messages to prevent wood theft in Arizona's Petrified Forest National Park [13]. Their injunctive norm message, "Please don't remove petrified wood in the park," resulted in a significantly lower theft rate than the descriptive norm message, "Many past visitors have removed the petrified wood from the park, changing the state of the Petrified Forest." In another field experiment conducted in a hospital, Gaube and colleagues show that communicating an injunctive norm via emoticons significantly increased hand hygiene behavior [21]: an alcohol hand-rub dispenser was used significantly more often if it displayed a frowny face when a person entered the room and changes to a smiley face after the dispenser was used, compared to a dispenser showing a neutral image when used.

Dynamic norms highlight an increasing or decreasing trend in conducting a target behavior. Findings from several lab experiments suggest that emphasizing how a growing number of people are conducting a target behavior persuades people to join, even though only a small number of people engage in the target behavior at the moment [38, 45, 37]. However, empirical evidence from field experiments is mixed. One field study compared the use of sustainable cups in a coffee shop before and after displaying this dynamic norm message: "our guests are changing their behavior: More and more are switching from the to-go-cup to a sustainable alternative. Take part in this: Choose a sustainable cup (e.g., coffee-mug or keep-cup) and help to protect the environment" [37]. Yet, the intervention did not significantly increase sustainable cup use. Two other field experiments found that the dynamic norm had a greater positive effect than a descriptive norm [45]. The first experiment showed that students who read a dynamic norm message about students choosing to eat less meat in the school cafeteria were less likely to choose dishes with meat than those who received no message, and those who read that a minority of people (30%) make efforts not to eat meat. The

second experiment found that students used laundry machines for fewer loads when laundry machines showed a dynamic norm message ("Stanford Residents Are Changing: Now Most Use Full Loads! Help Stanford Conserve Water!") instead of a descriptive norm message ("Most Stanford Residents Use Full Loads! Help Stanford Conserve Water!") or no message at all.

Prior research has compared types of norm messages and suggested when one type of social norm message is more effective than others [13, 45]. Previous studies have shown that a descriptive norm can be more effective when the target behavior is already prevalent. If the target behavior is rare, then injunctive norms and dynamic norms could be more useful. When trying to prevent unethical behavior, such as stopping people from stealing petrified wood from the park, injunctive norms are more effective than descriptive norms [13]. When promoting target behaviors for social good, such as eating less meat and doing less laundry during a draught, dynamic norms could be more effective than descriptive norms [45].

Factors To Consider When Designing Interventions

There are multiple factors that could determine the effectiveness of an intervention. One factor is intervention dose. In behavioral science, intervention dose often refers to frequency (how often the contact is made), amount (how long each contact is), and duration (how long the intervention is administered) of an intervention [46, 47]. The dosage of social norms interventions can be important in determining its efficacy. Previous research on social norms interventions typically delivered norm messages either once at the beginning of the experiment [45, 12], or placed them strategically to be visible where target behaviors occur [23, 13, 37, 45]. It, therefore, remains unclear what dose of the social norm message would be most effective.

A second factor playing an important role for social norms interventions is the reference group, as these interventions operate on a group identity under the assumption that people want to behave like others in the group to maintain their group membership [26, 34]. Thus, the effect of social norms interventions may differ depending on the nature or importance of the reference group. In fact, one study found that the effect of a descriptive norm is moderated by how much people identify with the reference group in the descriptive norm message [25].

A third factor affecting intervention efficacy is the complexity of the target behavior. Behavioral science research suggests that we may need different strategies for behavior change depending on how complex the target behavior is. Psychologists found that the amount of effort required to take actions affects people's behavioral choice; people prefer to take less effortful actions [33]. This effort estimation is somewhat subjective, and different theoretical approaches offer different interpretations. According to the theory of planned behavior, perceived behavioral control, which is a belief about how likely a behavior can be achieved, plays an important role in behavior change [1]. Social network scientists, who study behavior change at a societal level and understand behavior change as a contagion process, distinguish between simple and complex contagion. While simple contagion requires only one acti-

ated contact, complex contagion requires multiple sources of exposure [10].

Here we define a complex behavior as one that requires multi-layered efforts that may involve others' participation, while a simple behavior can be achieved through an individual's sole participation. For example, conducting educational activities can be considered complex because it entails multiple actions, including defining target audiences and learning objectives, developing lesson plans, and delivering learning activities to students [36]. Improving educational activities, such as adopting new educational practices or changing existing practices, is complex because it also requires the participation of other stakeholders, such as fellow educators, students, community members, and local facilities [24]. In contrast, voting and taking a flu shot are relatively simple behaviors when compared to conducting educational activities. Previous research has tested the effect of a social norms intervention on one-time behaviors such as choosing a lunch with less meat at the school cafeteria [45] and relatively effortless behaviors such as reusing hotel towels [23], but the effect of social norms interventions could vary depending on the complexity of the target behavior. As of yet, there is little evidence that social norms interventions can promote complex target behaviors, such as modifying or developing new educational activities.

CURRENT INTERVENTION STUDY

We crafted different types of social norm messages in these studies by following the framing of norm messages in prior work that tested how descriptive norms and injunctive norms affect behavior change [38, 23, 13, 12]. In our study, descriptive norm messages emphasize that the majority of people conduct the target behavior, while injunctive norm messages emphasize that people endorse conducting the target behavior. The dynamic messages were crafted by referring to messages used in prior research that tested dynamic norms [45, 37, 12]. In our study, dynamic norm messages emphasize the increase in conducting the target behavior in the reference group. The norm messages used in our interventions are shown in Figure 1. This study addresses the following research questions:

RQ1. How much can different types of weekly social norms messages about real-world practices influence (a) learners to take actions outside of the course, (b) learners' perceived norms about taking actions outside of the course, and (c) course completion?

RQ2. How does the intervention effect vary based on the complexity of the target behavior?

Intervention Design

The design of the interventions was aligned with three goals: (1) participants receive the social norms message periodically, (2) the messages use course participants as the reference group, and (3) the messages are aligned with the course curriculum.

The first goal serves to reinforce the intervention message by keeping participants aware of social norms throughout the course. This high intervention dosage was deemed necessary as the intervention encourages persistent or recurrent behaviors, unlike one-shot behaviors such as voting or getting a

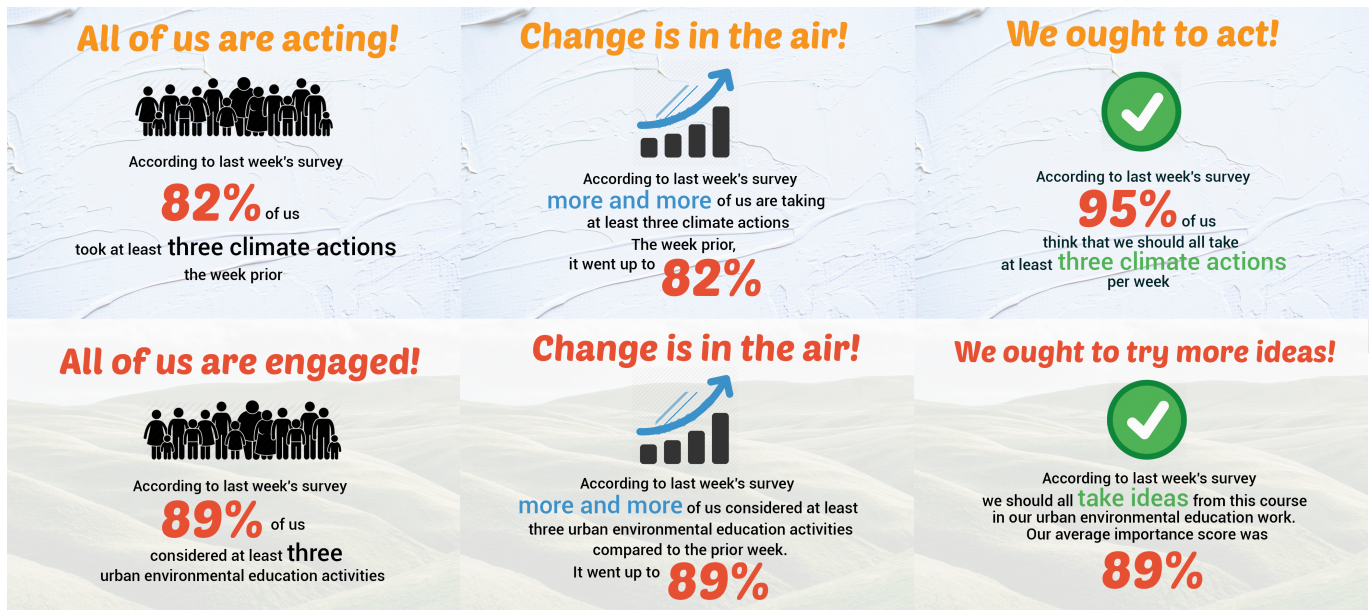


Figure 1. Examples of descriptive (left), dynamic (middle), and injunctive (right) messages to promote simple behavior in the *Climate Change Science, Communication, and Action* course (top) and complex behavior in the *Urban Environmental Education* course (bottom). The background image and the number in the message changed each week, but the wording of the norm messages remained the same. Messages and graphic symbols were adapted from a previous study that used descriptive, dynamic, and injunctive norms for interventions in online education [12].

flu shot, which have been the target of prior intervention research [22, 7]. Repeated exposure to the social norms message may help maintain its salience [14, 15]. This distinguishes the intervention design in this study from others that typically provide interventions only at the beginning of a course [27, 49, 29, 30].

The second goal serves to establish a social comparison with a relevant reference group. Course participants not only share common interests and goals in these courses, they are also in communication with each other. Learning that a classmate does something is more relatable compared to learning that some people in the world do it. Peer course participants are a useful reference group for social comparison, because this group is relatable to all participants who are otherwise very diverse in demographic, geographic, cultural and professional terms.

The third goal serves to seamlessly integrate the intervention with the course content. The intervention messages were created in collaboration with instructors and curriculum designers for each course. As domain experts, they took the course objectives and learning materials into account when developing the messages. In addition to its content, the intervention was nestled among other course materials to blend in, as shown in Figure 2.

Courses for a Cause

Courses for a cause are practice-oriented courses designed to encourage course participants to apply what they have learned to real-world practice for social good [32], such as changing their daily routines to be more carbon-neutral or updating teaching practices. From the behavior change perspective,

these courses differ in the type of behavior that is targeted, even though all of them urge course participants to take actions outside of the course. Some courses target simple behaviors that require actions at the individual level, such as using public transportation. Other courses target complex behaviors that require multiple actions and collaboration, such as developing educational programs that integrate learning activities taught in the course. In our study design and analysis, we group courses into two categories based on this distinction: courses promoting simple versus complex behavior change (see details below in Methods).

Focus on U.S. Course Participants

Previous studies report that the impact of social norms differ by culture [8, 44]. Moreover, a study that conducted a social norms intervention in a MOOC found that Chinese and U.S. course participants responded differently to normative messages [12]. Unfortunately, the number of participants from other countries was not large enough in the current study to draw statistically robust cross-cultural comparisons. Thus, our primary analysis focuses on course participants from the U.S., the most represented national group in the course.

METHODS

Study Context and Participants

The study was conducted in the context of three online courses offered by Cornell University in all 2019 through the edX Edge platform. The three courses are *Climate Change Science, Communication, and Action* (CC), *Introduction to Environmental Education* (IEE), and *Urban Environmental Education* (UEE). The CC course is intended for anyone who is interested in climate change topics and taking climate actions, while the

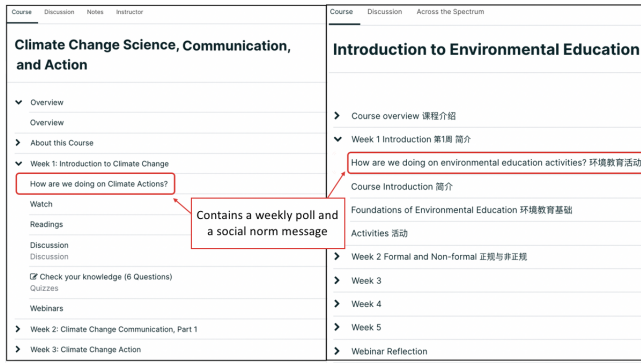


Figure 2. Placement of the social norms intervention. Each week, the intervention was shown in a separate section as a learning activity. The sections were labeled as ‘How are we doing on Climate Actions?’ in the CC course (left) and ‘How are we doing on environmental education activities?’ in the IEE course (right).

IEE and UEE courses are primarily targeted at environmental education professionals who seek to increase environmental literacy and enhance environmental behaviors in their home audiences.

The courses comprised pre-recorded video lectures, readings, discussion assignments and options social media groups. They had already been offered in previous years. All three courses were promoted worldwide through university networks, social media, and previous course participants (over 10,000 people from more than 80 countries). Participants first filled out a registration form provided by the Cornell Civic Ecology lab, and then they were invited to the edX Edge course platform. Some students registered (i.e., filled out the registration form) but did not enroll in the course after receiving an invitation. Course participants could choose to pay a standard fee (\$50), any amount they could afford, or nothing.

The three courses had 1,156 course participants enrolled (85% of registered people) from 67 countries. As explained above, we focus our investigation on U.S. course participants who account for 42% of total participants in the three courses (approximately 42% for CC, 38% for IEE, and 50% for UEE). Information about each course and its U.S.-based participants are provided in Table 1. From here on out, ‘course participants’ refer to U.S. participants only.

Table 1. Course duration and U.S. participant characteristics

Course	Duration	N	Female	Paid	Educators
CC	6 weeks	145	81%	92%	36%
IEE	5 weeks	135	84%	91%	61%
UEE	5 weeks	226	80%	87%	64%

Procedure

At the start of each course, all course participants were assigned to an experimental condition: Control, Descriptive, Dynamic, or Injunctive. We used criteria-based randomization to ensure that the assignment was balanced on prognostic participant characteristics observed on the registration survey [5]. The characteristics we used include age, gender,

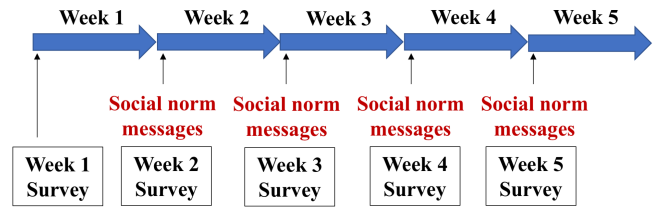


Figure 3. Overview of the weekly social norms intervention. Social norm messages were generated with the previous week’s survey results and displayed at the beginning of each week between weeks 2 and 5. The same survey was immediately followed by the social norm messages. The survey asked about participants’ perceived norms and the number of actions they took (simple behavior, CC) or ideas they explored (complex behavior, IEE and UEE) last week.

nationality, payment for the course, education background, experience level, type of organization working for, occupation, and other domain-specific knowledge and experience. Each week, course participants in the treatment conditions (Descriptive, Dynamic, or Injunctive) were shown their assigned social norm message in the form of an image (see Figure 1). The image was displayed on a designated page of the course materials for that week. The next page showed all participants, including those assigned the Control condition, a weekly survey about their actions and norm perception (Figure 3). We sent the image and the survey link to participants in the treatment conditions via weekly emails, and only the survey links without images to participants in the Control condition. The course instructors also reminded participants on social media to check the edX Edge page and emails. Most participants who stayed engaged in the course materials would go through the page on edX edge. We did not have the means to track if they opened the emails.

Outcome Measures

Actions outside of the course

Course participants’ actions taken outside of the course were measured using the weekly survey. We asked different questions for CC (for simple behavior) and IEE and UEE (for complex behavior) in the weekly survey. Regarding the real-world actions, we asked the CC participants to choose actions they took last week from a list including plant-rich diet, afforestation, mass transit, recycling, composting, ride-sharing, reducing food waste, LED lighting, water saving and other. On the other hand, in IEE and UEE, we asked participants to report which activities they considered incorporating in their environmental education work, for example, lessons indoors, lessons outdoors, walking tours, using media, visiting environmental facilities, environmental stewardship, recreation, creating artwork, environmental games, camping, using on-line technology, hands-on science activities and other. The questions are shown in Table 2.

Perceived Norms

Course participants’ perceived norms around the promoted action were measured using the weekly survey. Different questions were asked for CC (for simple behavior) and IEE and UEE (for complex behavior). Course participants in CC were asked about how many actions they think their peer course

Table 2. Outcome measures for self-reported actions and attitudes for simple and complex behaviors. A list of actions or ideas was provided as response options for the measure of actions.

Outcome	Behavior	Survey Questions
Action	Simple (CC)	In the last 7 days, which of these climate actions did you take, if any? Check all that apply.
	Complex (IEE, UEE)	In the last 7 days, which of these activities have you been considering using in your environmental education work? Check all that apply.
Attitude	Simple (CC)	How many climate actions do you think each course participant should take in a week? Enter a number: 0 or higher.
	Complex (IEE, UEE)	How important do you think it is for course participants to use ideas from this course in their own environmental education work? Enter a number between 0='Not at all important' to 100='Extremely important.'

participants should take weekly, whereas those in IEE and UEE were asked about how important they think their peer course participants to incorporate learned ideas into educational activities. The questions can be found in Table 2. In the CC course, answers with more than 15 actions were excluded from the analysis considering the distributions of the answers in week 1 (mean=5.3, median=5.0, 1st quartile=4.0, 3rd quartile=6.0) and week 2 (mean=5.8, median=5.0, 1st quartile=3.8, 3rd quartile=5.0).

Course completion

Course completion was a proxy to examine the effect of displaying norm messages weekly. It was measured by whether a course participant received a certificate. The requirements for a certificate varied across courses. For CC, participants had to complete 5 discussion posts, 4 quizzes, and a climate action plan. For IEE, they had to complete 9 discussion posts, 8 comments, and an environmental education activity report. For UEE, they had to complete 6 discussion posts, 5 comments, and an environmental education activity report.

Data Analysis

RQ1a. The effect of a norm message on taking actions was examined by comparing actions taken outside of the course before and after receiving a social norm message for the first time. To control for individual differences in the tendency to take actions, we also included the number of actions taken by the course participants reported in the previous week as a covariate. In other words, we compared actions reported in Week 3 survey in Figure 3 between conditions considering action reported in Week 2 survey Figure 3. We only included participants who participated in both the Week 2 and Week 3 surveys. This yielded a total sample of 263 participants, which is 52% of overall participants (CC: 82 (57%), IEE and UEE: 181 (50%)). We only analyzed Week 3 surveys, not including later surveys, because fewer people completed weekly surveys toward the end of the course, which drastically reduced the sample size.

RQ1b. We examined the effect of a social norm message on norm perception immediately after the first social norm message was shown in Week 2. As illustrated in Figure 3), the immediate impact of the first norm message can be measured

by the responses to the norm perception question in Week 2. Hence, we compared course participants' perceived norms reported in Week 2 between conditions. We added perceived norms reported in the Week 1 survey as a covariate to control for individual differences. For this reason, we only included participants who were in either CC or UEE and took both Week 1 and Week 2 surveys. We excluded IEE course participants because of a data collection issue that prevented us from matching Week 1 survey responses with Week 2 survey responses. This yielded a total sample of 226 participants, which is 61% of the course participants excluding IEE (CC: 89 (61%), UEE: 137 (61%)). We only analyzed Week 2 surveys for the same reason noted in RQ1a.

RQ1c. We compared completion rates between experimental conditions. All participants were included in the analysis regardless of their participation in the weekly surveys (intent-to-treat analysis). Thus, 145 participants and 361 participants were included for the analyses of simple behavior (CC) and complex behavior (IEE and UEE), respectively.

RQ2. We analyzed the CC course (simple behavior) and the other two courses, IEE and UEE (complex behavior), separately, using linear regressions (linear probability models for binary outcomes) with robust standard errors.

As a supplementary analysis, we compared the course completion rates of the three courses with the same courses offered in the past. In particular, we were interested in comparing the completion rates of the Control condition participants with those of the three courses in previous years (CC and UEE were taught a year before and IEE was taught in fall 2017), to see if the weekly survey alone without a social norm message may have some positive impact on course completion. The three courses in previous years were more or less the same in terms of the instructors, course delivery, length, content, and assessments. However, the course offerings that incorporated the weekly social norms intervention emphasized taking actions regularly more than they did in the previous years. For example, in IEE and UEE, course participants were instructed to actually conduct an activity and write a report instead of just a lesson plan in the environmental education courses. Similarly, in CC, course participants were asked to take action during the course rather than simply plan for action after the course was over.

RESULTS

Descriptive Trends

Average completion rates for CC, IEE, and UEE were 44.1%, 65.9%, and 58.8%, respectively. The combined course completion rate for IEE and UEE (i.e., courses promoting complex behavior) was 61.5%. Trends in responses to the weekly surveys are shown in Figure 4. Response rates for the weekly survey in CC and UEE dropped over time but the average number of actions (ideas for complex behavior) hovered around five. The average number of actions the course participants think their peers should take was also around 5 across all weeks. The importance scores reported as the perceived norm in IEE and UEE were above 80% each week.

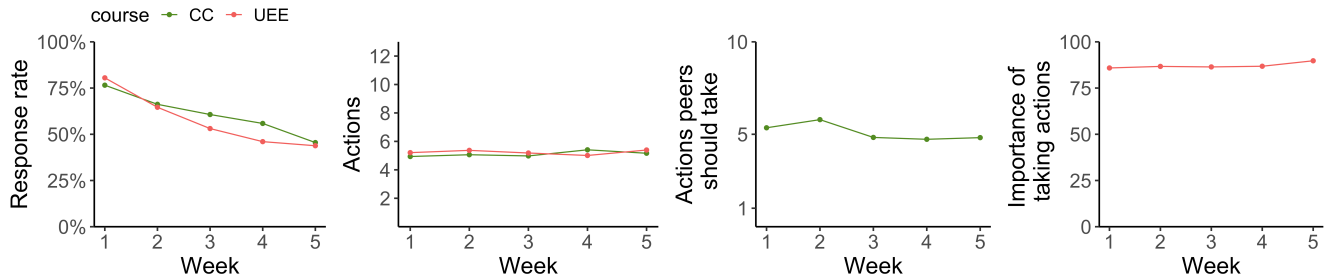


Figure 4. Responses to the weekly surveys in CC and UEE: survey response rates (first from left), the average number of actions taken in the previous week (second), the average number of climate actions course participants should take per week (third), and the importance of using ideas in developing educational activities (last).

Effect on Actions

In the CC course, which encouraged simple behavior change (i.e., taking individual climate actions), participants across all conditions took 0.65 more actions on average in the week following the first social norm message compared to the prior week (95% CI [0.458, 0.847], $t(77)=6.68, p<0.001$). As shown in Figure 5, none of the social norm messages significantly raised the number of additional actions relative to the Control condition (Descriptive: 95% CI [-0.894, 0.347], $t(77)=-0.88, p=0.38$; Dynamic: 95% CI [-0.860, 0.611], $t(77)=-0.34, p=0.74$; Injunctive: 95% CI [-0.975, 0.306], $t(77)=-1.04, p=0.30$). There were no significant differences in the number of actions taken between any of the experimental conditions ($F(3,80)=0.38, p=0.77$).

In the courses encouraging complex behavior change (i.e., developing educational activities), participants in all conditions explored on average 0.67 more ideas for developing educational activities than they did in the week prior to receiving the first social norm message (95% CI [0.555, 0.787], $t(176)=11.41, p<0.001$). As shown in Figure 5, the social norm messages induced more variation for complex behaviors than for simple behaviors. Surprisingly, we found that participants in the Descriptive condition explored significantly fewer ideas (1.15 fewer, on average) than those in Control condition (95% CI [-2.09, -0.21], $t(176)=-2.42, p=0.016$). Likewise, the Injunctive norm message marginally reduced exploration relative to the Control condition (95% CI [-1.497, 0.066], $t(77)=-1.81, p=0.07$). Participants in the Dynamic condition did not explore significantly more ideas than those in the Control condition (95% CI [-0.292, 1.276], $t(77)=1.24, p=0.22$). Comparing between the Descriptive, Dynamic, and Injunctive conditions, we found that participants in the Dynamic condition explored significantly more ideas than those in Descriptive condition (1.6 more ideas on average, 95% CI [0.676, 2.612], $t(176)=3.35, p<0.001$) and those in the Injunctive condition (1.2 more ideas on average, 95% CI [0.385, 2.030], $t(176)=2.90, p=0.004$).

Effect on Perceived Norm

In the course that encouraged simple behaviors (CC), participants across conditions indicated that 0.7 more actions should be taken on average than in the past week (95% CI [0.492, 0.924], $t(81)=6.53, p<0.001$). Thus, participants became generally more aware of the importance of taking climate

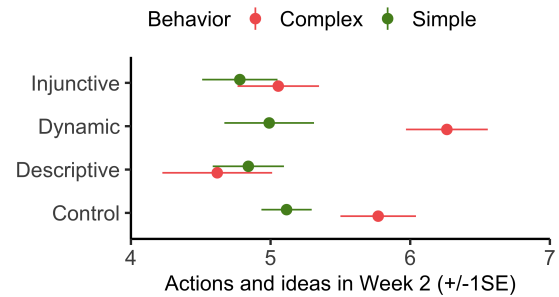


Figure 5. The number of climate actions (simple behavior) taken in Week 2 (top) and the number of ideas explored (complex behavior) in Week 2 (bottom). Both were reported on the Week 3 survey. Point estimates and standard errors are derived from covariate-adjusted regression models.

actions as a collective effort. The social norms intervention did not increase perceived norms for simple behaviors relative to the Control condition, as shown in Figure 6 (top). In fact, participants in the Injunctive condition indicated that significantly fewer actions should be taken relative to the Control condition (95% CI [-1.854, -0.240], $t(81)=-2.58, p=0.01$). The Descriptive and Dynamic conditions did not significantly differ from the Control condition (Descriptive: 95% CI [-1.646, 0.136], $t(81)=-1.69, p=0.10$; Dynamic: 95% CI [-1.249, 0.417], $t(81)=-0.99, p=0.32$).

In the course that encouraged complex behaviors (UEE), participants across conditions rated the importance of using ideas learned from the course about 5 points higher compared to the past week (95% CI [0.235, 0.883], $t(132)=3.41, p<0.001$). The social norms intervention did not significantly increase the perceived norms (Descriptive: 95% CI [-9.756, 6.527], $t(81)=-0.39, p=0.70$; Dynamic: 95% CI [-6.222, 9.678], $t(81)=0.43, p=0.67$; Injunctive: 95% CI [-1.361, 13.343], $t(81)=1.62, p=0.11$). However, there may have been a ceiling effect for the measure of importance given that the scores range between 80% and 90% in the Week 1 and Week 2 surveys, as shown in Figure 6.

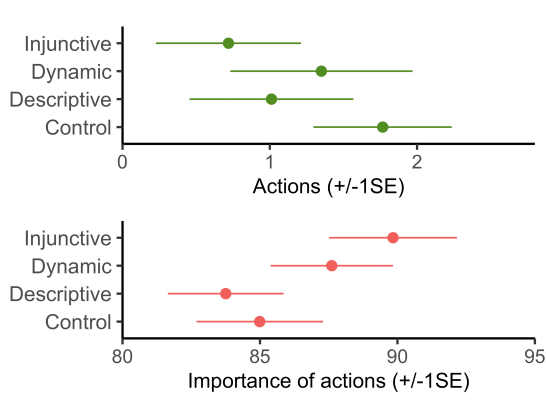


Figure 6. Results of the questions about perceived norms in CC (top) and IEE and UEE (bottom) in Week 2 survey. The number of climate change actions course participant *should* take (top) and the importance of using ideas in educational activity development (bottom). Point estimates and standard errors are derived from covariate-adjusted regression models.

Effect on Course Completion

The social norms interventions did not significantly increase the course completion rate overall (95% CI [-0.077, 0.119], $t(509)=0.42, p=0.7$), and we did not find significant differences between the social norms conditions, even when analyzing the CC course (simple behavior) and the IEE and UEE courses (complex behavior) separately.

In a supplementary analysis, we compared the completion rates of the three courses in this study with past completion rates. Overall, as shown in Figure 7, the average completion rate in the Control condition was significantly higher than in the same courses offered in prior years (with course fixed effects, 95% CI [0.137, 0.327], $t(1077)=4.79, p<0.001$). While participant characteristics may shift over time, this analysis offers suggestive evidence that the weekly survey itself might have a positive impact on course participants' completion rate, as this was the only major difference between the offerings in the Control condition.

DISCUSSION

In the context of courses that aim to encourage action beyond the course, the current study examined how highlighting different types of social norms affects three major outcomes: (a) course participants' actions taken outside of the course, (b) their perceived norms around the importance of taking actions, and (c) course completion. In examining these intervention effects, we distinguish between courses that promote simple behaviors (i.e., taking individual climate change actions) versus complex behaviors (i.e., developing educational activities). Overall, the weekly social norms intervention did not improve any of the outcomes significantly more than the Control condition. However, we found some differences in the effect of different norms on promoting simple behavior and complex behavior. Below, we provide explanations for the findings and reflect on the design of the intervention.

First, the IEE and UEE course participants in the Descriptive norm condition showed a significantly lower number of ideas

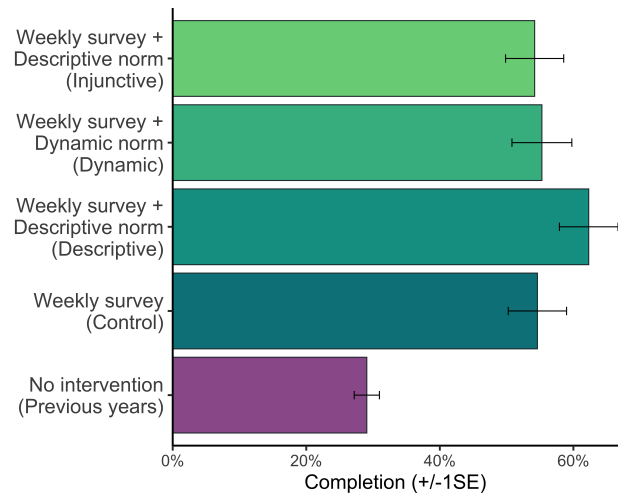


Figure 7. Completion rates of the three courses in previous years combined and the courses in the present study per condition.

explored for developing educational activities (complex behavior) than those in the Control condition. Potentially, the negative effect of the Descriptive condition was due to the specific number of ideas used in the descriptive norm message. The message mentioned, "according to last week's survey X% of us considered at least **three** educational activities." Considering the average number of ideas explored overall was 5 in the previous week, course participants in the Descriptive norm message may have lowered the number of ideas in the following week. Similar to prior research that found people used more energy when they discovered that their neighbors were using more [43], our course participants might be influenced by the number of ideas their peers were considering.

Second, no difference between the Dynamic and Control conditions was detected in IEE and UEE, but the Dynamic condition was significantly more effective than the Descriptive and Injunctive conditions. As suggested by prior studies that demonstrate the superiority of dynamic norms over other types of norms when promoting a behavior that a minority of people conduct [45, 38], the Dynamic condition might outperform the other two norms conditions in IEE and UEE (complex behavior), because the promoted behavior is something only a specific group of people (e.g., educators) would do on special occasions (e.g., developing a curriculum for a new course). In IEE and UEE, course participants were guided to develop and implement their lesson plans with a newly learned pedagogy. It is a daunting task, even for seasoned educators, to develop new educational activities from scratch over a relatively short period of time, especially when the activities need to be developed taking new pedagogical approaches into account. A norm message describing *more and more* fellow participants engage in developing educational activities (i.e., a dynamic message) could motivate course participants to start considering possible options (i.e., what we call 'ideas' in the weekly surveys) for their lesson plans.

Third, we are hesitant to conclude that social norms interventions are ineffective at promoting simple behaviors, based on the null results we observed in the CC course, which encouraged course participants to take more climate actions. We cannot rule out the possibility that participants may stick with the same actions over weeks due to accessibility or other barriers. In addition, participants would not begin composting, for example, if they do not have space for it. Future research could ask about the frequency of conducting each climate action to arrive at more precise interpretations. Finally, the fact that the course was pedagogically designed to inspire action and required participants to take them and then reflect on action in weekly discussion posts may have overshadowed any effects from the social norms intervention.

Fourth, we surprisingly found that the injunctive norm message negatively affected the perceived norm, with course participants indicating that significantly fewer climate actions should be taken relative to the Control condition. In contrast, none of the other norm messages affected norm perceptions. We speculate that the negative effect of the injunctive norm message could be because of its wording: "according to last week's survey, X% of us think that we should all take at least **three** climate actions per week." As previously noted with regard to the descriptive norm message, a message stating that the majority of course participants think people should take at least 3 actions may lower the number of actions they indicate, given that the average was around 5. For the perceived norm for the complex behavior, we found no difference between conditions in the reported importance that course participants explore ideas in developing educational activities. However, we potentially encountered a ceiling effect, as course participants from all conditions rated the importance at 80% or higher on average.

Finally, completion rates were not significantly different between conditions, which is not too surprising given that the intervention targeted actions outside of the course rather than course completion, which has been the target of prior successful interventions [27, 19, 49]. In a supplementary analysis, we compared the completion rates of the three courses with those of the same courses previously offered where no intervention was employed. We found the completion rates of the courses in the present study were significantly higher, including for course participants in the Control condition compared to those in previous courses. This leads us to speculate that the weekly surveys alone might have had a positive impact on course participants throughout the courses. Surveying the state of taking actions on a regular basis may reinforce the course expectation that participants apply learned skills in practice. It may also motivate them to continue or to take more actions outside of the course. However, in the absence of a credible causal identification strategy, these results should be interpreted with caution. Further research is needed in more controlled settings to clarify the role of the weekly survey in the weekly social norms intervention.

The courses we studied have relatively high completion rates, which may be due to the characteristics of the course participants: the courses primarily attracted educators committed

to conducting educational practices and environmentally concerned citizens who are motivated to take climate actions. However, the courses also included other types of participants, including university students and volunteers who have general interests in the topics, just as regular MOOC participants (about 60% in the *climate change* course and about 40% in the *environmental education* courses were not educators). Many of the U.S. course participants worked in environmental education or similar, tangential fields, and so found common ground in their professional identities, their outside work, and their climate action plans, which often included education components.

Practical Implications and Future Directions

This research and its findings have implications for intervention design and future research on social norms in online learning. First, combining social norm messages with an activity, such as the weekly survey in the current study, can be a well-embedded way to measure actions beyond the course and perhaps even boost the effectiveness of an intervention. As we saw, the Control condition with weekly surveys compared favorably to the other social norms conditions in our study as well as to previous course offerings. Further studies using randomized controlled trials are needed to explore the effect of social norm messages and weekly surveys individually in this context. Second, different ways of measuring behavioral and normative outcomes offer different opportunities for crafting norm messages. For measuring climate actions, instead of the number of actions, we may consider asking for the frequency of engaging in the actions because some participants may not be able to expand the number of actions but can increase how often they take it. For measuring environmental education activities, we may assess the long-term impact of social norm interventions on conducting activities rather than just considering ideas. Last but not least, the wording of norm messages may cue and influence message recipients substantially. For example, adding the number of actions in the message could have a negative or positive effect on participants' choices. Future research can investigate how to use numbers in these messages and whether there are differences between indicating the minimum, average, or model number of actions/ideas.

We also have recommendations for instructors to design practice-oriented courses that foster actions during and beyond the course. First, in addition to learning materials, incorporating activities such as weekly surveys to report actions or ideas learned into weekly assignments can help participants stay engaged. Second, instructors can use weekly discussions to guide participants and reflect in more depth about actions or ideas they plan to take. Third, instructors should be aware of the complexity of different behaviors and consider different strategies to support participants accordingly.

Limitations

This study focused on U.S. participants, who account for only half of the total course participants. Further research is needed to examine the impact of social norm interventions on participants with different cultural backgrounds (e.g. [12]). Moreover, the decision to focus on U.S. participants reduced our final sample size considerably, and the interventions should be

tested with a larger sample size in future studies. Furthermore, the fact that we asked participants to report their actions one week after they saw the norm messages might delay or diminish the impact of the norm messages on our outcome measures. Finally, we considered individual climate actions as relatively simple behaviors compared to conducting environmental education activities as more complex behaviors. However, some climate actions, such as composting and installing solar panels, could be more complex than other climate actions, such as eating plant-rich meals and reducing food waste. Future studies should consider separating climate actions depending on their level of complexity.

CONCLUSION

This study explored novel designs of social norms interventions in online learning settings that are designed to promote actions beyond the course itself. Although we did not find a significant impact of weekly social norm messages on participants' learning outcomes, we found that dynamic norms were more effective than descriptive and injunctive norms in promoting ideas in environmental education. We encourage more research into how much online courses encourage learners to apply learned knowledge and skills in real-world settings, and how behavioral and pedagogical interventions can promote such transfer at scale.

ACKNOWLEDGEMENT

We thank course administrators, Yueyang Yu and Kimberly Snyder, teaching assistants in the three courses, all of the course participants for enabling us to explore the social norms intervention, and anonymous reviewers for their constructive comments. This work was partly supported by a grant from the Cornell China Center.

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