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Climate of silence: Pluralistic ignorance as a barrier to climate change discussion

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ABSTRACT

Despite the importance of interpersonal public communication about climate change, most citizens rarely discuss the topic. In two studies, we find that inaccurate perceptions of others' opinions (i.e. *pluralistic ignorance*) contribute to self-silencing among those concerned about climate change. Study 1 illustrates that those who are aware of others' concern about climate change report greater willingness to discuss the issue than those with inaccurate perceptions of others' opinions. Study 2 demonstrates that correcting pluralistic ignorance increases concerned participants' willingness to discuss climate change. In both studies, pluralistic ignorance leads to self-silencing because perceptions that others do not share one's opinion are associated with expecting to be perceived as less competent in a conversation about climate change. In contrast to previous research on confronting prejudice, in the present research expectations about being disliked did not explain self-silencing. We discuss the implications for self-silencing and promoting interpersonal communication about climate change.

1. Introduction

The challenge of climate change requires major economic and social changes, both to transition to a low-carbon economy and to adapt to the changes that are already "locked in" by previous patterns of carbon emissions (IPCC, 2014). A strong limiting factor to the success of these changes is the public's willingness to accept, support, and actively engage in shaping economic, sociocultural, political, and structural changes that help to address climate change (Clayton et al., 2015; Jacobson & Delucchi, 2011). This public response is most likely to occur when social changes coincide with shared meaning and value structures held by a majority of citizens (Dietz, 2013; Habermas, 1971, p 27). Thus, interpersonal communication about topics is crucial to build public acceptance and support for social change: scientifically grounded public discussion can increase public understanding of the problem, community engagement, and development of consensus for locally appropriate mitigation and adaptation solutions (Clayton et al., 2015; Swim, Fraser, & Geiger, 2014). Currently, however, engagement in these conversations are uncommon: only a quarter of the American public report regularly discussing climate change (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2015), and similar levels of silence are found among the British public (Capstick et al., 2015; Rowson, 2013).

We suggest that the social dynamics surrounding climate change are barriers to discussion – *a socially constructed silence* (Marshall, 2014; Norgaard, 2011, p 82). First, we propose that *pluralistic ignorance* – the tendency for a majority to misperceive others' opinions on a topic, falsely believing that fewer people share their opinion than actually do (Prentice & Miller, 1993) – contributes to the lack of discussion about climate change. Despite a solid majority of the public being concerned about climate change, most underestimate the degree to which others are concerned (Leviston, Walker, & Morwinski, 2013). Second, we propose that pluralistic ignorance leads people to avoid discussing climate change because people anticipate being evaluated more negatively by those who disagree with them than those who agree with them in anticipated conversations about the topic. Research on core dimensions of social evaluation suggests that anticipated negative evaluations would be in the form of anticipating being perceived to lack warmth, competence, or both (Fiske, Xu, Cuddy, & Glick, 1999).

2. Pluralistic ignorance and self-silencing

It is perhaps unsurprising that the public has demonstrated pluralistic ignorance about climate change (Leviston et al., 2013).

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Pluralistic ignorance has been demonstrated across many topics: support for racial segregation in the 1970s (most white Americans supported desegregation but believed that most others supported segregation; O'Gorman & Garry, 1976), norms of alcohol consumption (university students believed that norms of alcohol consumption were excessive but perceived that most others supported them; Prentice & Miller, 1993), opinions on foreign policy (most Americans support multilateral foreign policy but perceive that most other Americans support unilateral foreign policy; Todorov & Mandisodza, 2004) and comfort with "hooking up" (students estimated that others felt more comfortable engaging in uncommitted sexual activity than they did; Lambert, Kahn, & Apple, 2003). Pluralistic ignorance could in part be due to the lack of regular conversations about climate change (Leiserowitz et al., 2015), which could lead to individuals having little insight into others' internal beliefs. Interestingly, pluralistic ignorance on climate change has even been found among climate scientists who underestimate concern among other scientific experts (Lewandowsky, Oreskes, Risbey, Newell, & Smithson, 2015).

Pluralistic ignorance can have significant consequences for effectively addressing social issues. Pluralistic ignorance is associated with attitude change shifting toward the perceived norm (Leviston et al., 2013; Prentice & Miller, 1993); behavioral conformity to the perceived norm (Prentice & Miller, 1993; Schroeder & Prentice, 1998), and relevant to the present study, reduced willingness to share one's opinion on a topic (Miller & McFarland, 1987; Rios & Chen, 2014; Taylor, 1982). Conversely, correcting pluralistic ignorance by providing information about the true beliefs of others can reverse these effects (Schroeder & Prentice, 1998).

The *spiral of silence* theory specifically addresses the impact of pluralistic ignorance on public discourse (Noelle-Neumann, 1993; Taylor, 1982). This theory proposes that individuals scan their social environment for information about others' opinions and that people are less willing to share their opinion when informational cues lead them to believe that they hold a minority view (vs. majority view), especially when the topic is perceived as controversial or morally charged (Noelle-Neumann, 1993). Silencing is proposed to be self-reinforcing: if many who hold a particular view believe that they are in the minority and remain silent, the silence leads others who share this view to believe that their opinion is uncommon and encourages them to also remain silent. Motivation to self-silence is also proposed to increase when individuals believe that their opinion is declining in public popularity (Taylor, 1982).

The premises derived from pluralistic ignorance and spiral of silence theory may explain why people are hesitant to discuss climate change. The principles outlined in spiral of silence theory are purported to apply primarily to morally controversial or value-laden topics, such as abortion, support for addressing racial inequality, and political party preference in national elections (Moy, Domke, & Stamm, 2001; Noelle-Neumann, 1993). Climate change might appear to differ from these more commonly studied topics because climate change is a scientific topic supported by a solid body of evidence and an overwhelming consensus of scientific experts whom agree that human-caused climate change is occurring and presents a significant threat to global civilization (Cook et al., 2013, 2016; Oreskes, 2004). Yet, expression of opinions about climate change has taken on a cultural significance distinct from scientific understanding of the topic due to its politicization. About half of U.S. senators recently voted to publicly deny that "human activity significantly contributes to climate change" (Goldenberg, 2015), despite scientific consensus and only approximately 10% of Americans similarly dismissing the scientific evidence behind anthropogenic climate change (Leiserowitz et al., 2015). Further, many perceive the topic principally as a moral topic because of the potential negative impacts of unchecked climate change (Markowitz, 2012). Another point of view, expressed by a vocal minority who question the scientific consensus, is that climate change is a conspiracy that is immorally being promoted as scientific fact by those who wish to promote a specific political agenda (Lewandowsky, Oberauer, & Gignac, 2013). In sum, it appears that climate change has culturally acquired a controversial, moral connotation in modern society, and thus we propose that the processes described in pluralistic ignorance and spiral of silence will also apply to climate change. Thus, we make the following prediction:

Hypothesis 1. *Participants will be less willing to talk about climate change when they perceive that their opinions are in the minority (vs. the majority).*

3. Impression management and self-silencing

Self-silencing may be a form of impression management. Individuals desire to be viewed in a positive light and sharing an unpopular opinion could result in others perceiving them negatively. Researchers have proposed that people self-silence because of fear of isolation (Noelle-Neumann, 1993), rejection (Bergsieker, Shelton, & Richeson, 2010), social retributions for violating cultural norms prescribing silence (Norgaard, 2011), embarrassment (Miller & McFarland, 1987), being dismissed as a "complainer" (Kaiser & Miller, 2001; Swim & Hyers, 1999), and being seen as ignorant (Salmon & Neuwirth, 1990).

The varied explanations for self-silencing listed in the above paragraph can be organized along two core dimensions of impressions: fears about being a) disliked or b) losing respect. Interpersonal evaluation research suggests that up to 90% of initial impressions of others can be organized along these two core dimensions, which directly reflect the core dimensions of social cognition: warmth (those perceived as low in warmth are disliked) and competence (those perceived as low in competence are not respected) (Abele & Wojciszke, 2007; Fiske et al., 1999). These two dimensions have been consistently described across various literature (Fiske, Cuddy, Glick, & Xu, 2002; Heider, 1958; Rosenberg, Nelson, & Vivekanathan, 1968; Singh, Ho, Tan, & Bell, 2007) and align with two basic impression management goals: the desire to have an audience think favorably about oneself and the desire to present one's ideal self to others (Bergsieker et al., 2010; Schlenker, 1975). Thus, warmth reflects being perceived as friendly and cooperative, while competence corresponds with being respected and achieving high social status (Fiske et al., 1999, 2002). Being perceived as either cold (i.e., confrontational and unlikeable) or incompetent (i.e., not respected and low status) are distinct grounds for anticipated social rejection, and thus people may alter their behavior in attempts to manage others' impressions of them on one or both of these dimensions (Holoien & Fiske, 2013).

3.1. Avoiding being disliked

The desire to avoid being disliked has been well established as a motive for self-silencing when one is a target of discrimination and prejudice. (Sechrist, Swim, & Stangor, 2004; Shelton & Stewart, 2004; Stangor et al., 2003; Swim & Hyers, 1999). This desire leads individuals to refrain from confronting discrimination despite their wishes to do so (e.g., Swim, Eyssell, Murdoch, & Ferguson, 2010) or despite what they expect they would do (Shelton & Stewart, 2004; Swim & Hyers, 1999; Woodzicka & LaFrance, 2001), particularly in the presence of others expected to not share one's own point of view (Swim & Hyers, 1999). Individuals faced with discrimination often perceive the possibility of confronting as impolite (Swim & Hyers, 1999) and those who do confront are devalued as difficult

to interact with and "complainers" (Kaiser & Miller, 2001). Consistent with the argument that individuals self-silence to avoid being disliked, women were less likely to assertively respond to sexist comments during a job interview when the desire to be liked was emphasized than when the desire to be respected was valued more highly (Mallett & Melchiori, 2014).

Fear of being disliked may also motivate suppression of opinions about climate change. Individuals may be concerned about being perceived as an "alarmist" or environmental activist if they were to express their concern about the topic, labels which carry potentially negative connotations of being disliked by others. Similar to those who confront discrimination, those who are "alarmed" about climate change are perceived as "whiny", "nagging", and "complainers" (Swim & Geiger, 2016b) and prototypic environmental activists are commonly stereotyped as "eccentric", "self-righteous," and "reactive" (Bashir, Lockwood, Chasteen, Nadolny, & Noyes, 2013), all traits associated with being seen as cold and disliked by others. These negative impressions are associated with reduced willingness to engage in climate change activism and to affiliate with environmental activists. Expectations about being disliked for speaking one's opinions may be accentuated in particular contexts; namely, when individuals anticipate that others do not share their views and thus believe that expressing their opinion would be confrontational within a given context (Noelle-Neumann, 1993). Based upon the above, we make the following prediction.

Hypothesis 2. *Individuals' hesitation to discuss climate change in situations when they perceive their opinions are in the minority (vs. the majority) will be partly explained by expectations of appearing less warm in the conversation.*

3.2. Avoiding losing respect

Another motive for self-silencing is the concern that one would lose others' respect following a conversation about a topic. Expressing an unpopular opinion could result in appearing ignorant to others (Salmon & Neuwirth, 1990), and people may remain silent out of fear of embarrassing themselves when they believe that they are less knowledgeable about a topic than others (Miller & McFarland, 1987). Yet, research suggests that confronting discrimination does not lead to the confronter being perceived as incompetent (i.e. losing respect; Stangor et al., 2003; Swim, Gervais, Pearson, & Stangor, 2009), and women more interested in being respected than liked were more likely to confront sexism during a job interview than other women (Mallett & Melchiori, 2014). This could suggest that concerns about losing respect are less central than concerns about being disliked when individuals consider whether to self-silence unpopular opinions.

However, in contrast to confronting discrimination, the degree to which an individual expects to be perceived as competent may affect willingness to engage in discussions about climate change. Since climate change is a scientific topic, expectations of appearing competent may be more salient than expectations of appearing warm since understanding of scientific topics maps onto the competence dimension, but not the warmth dimension, of social cognition (Fiske, Cuddy, & Glick, 2007). This proposition is supported by work examining informal scientific educators' concerns about incorporating climate change into their education curriculum (Swim & Fraser, 2013, 2014). The more concerned educators were about being able to competently communicate about climate change the more likely they were to avoid extensively communicating with visitors about this topic.

Given that even trained scientific educators express concern about being capable of communicating climate change, nonscientists may be even more likely to hold these concerns. Research shows that most nonscientists have limited understanding of the scientific mechanisms of climate change (Leiserowitz, Smith, & Marlon, 2010; Swim et al., 2014), and thus may be concerned about appearing ignorant or incompetent when discussing this topic. Further, the expectation of appearing incompetent may be amplified when considering a discussion with an audience not expected to share one's views, partly because a dissenting audience may challenge the speaker or question their assumptions. Based upon the above analyses we make the following hypothesis:

Hypothesis 3. *Individuals' hesitation to discuss climate change in situations when they perceive their opinions are in the minority (vs. the majority) will be partly explained by expectations of appearing less competent in the conversation.*

4. Present research

In two studies, we examine the effects of pluralistic ignorance on willingness to discuss climate change. We first conducted two pilot studies to verify that the pattern of pluralistic ignorance about climate change observed in Leviston et al. (2013) work would replicate in our target population. Next, in Study 1 we examine whether participants who do not themselves doubt the scientific view on climate change and hold inaccurate perceptions of others' opinions are less willing to discuss the topic than those who endorse similar views about climate change but hold accurate perceptions of others' opinions. In Study 2, we experimentally manipulate perceptions of others' opinions and examine the effects of correcting pluralistic ignorance on facilitating discussion relative to emphasizing the false perceptions of others' opinions. Study 2 participants include a full range of personal opinions about climate change ranging from those who are very concerned about climate change to those who consider themselves nonbelievers. In both studies, we examine whether expectations of being perceived as a) warm and/or b) competent explain the psychological process underlying these effects.

5. Pilot studies

Pilot testing with undergraduate students in introductory psychology courses (reflecting a range of students across the campus) were consistent with previous findings about pluralistic ignorance on climate change (Leviston et al., 2013). One pilot sample completed a screening instrument that has been used to categorize the public into different levels of concern about climate change (i.e., the Six Americas' questionnaire, Maibach, Leiserowitz, Roser-Renouf, & Mertz, 2011) and self-categorized into different levels of concern about climate change as assessed by the same screening instrument. Both methods indicated that a majority of students were on concerned side of the opinion spectrum: survey instrument ($N = 365$): 7% Alarmed, 40% Concerned, 40% Cautious, 3% Disengaged, 8% Doubtful, 3% Dismissive; self-categorization ($N = 368$): 8% Alarmed, 28% Concerned, 39% Cautious, 19% Disengaged, 3% Doubtful, 3% Dismissive. This pattern is similar to this age group in the American public (Leiserowitz et al., 2015) and in subsequent tests in the same participant pool (Geiger & Swim, 2014). Yet, despite this majority concern, in a second pilot test ($N = 89$), only 30% of respondents accurately perceived that a majority of other students were concerned about climate change. The most common misperceptions were that: 1) most undergraduates were disengaged with the topic, 2) most undergraduates were doubtful about climate change, or 3) undergraduates' opinions were polarized.

6. Study 1

In Study 1, we examine whether pluralistic ignorance predicts silence on climate change among undergraduate college students who do not doubt the existence of climate change. In this study, we focus on the three most common misperceptions of other students' opinions identified in the pilot study above. Specifically, Study 1 tests whether those who had accurately perceived that most undergraduates were concerned about climate change in a pre-screening would later be more willing to engage in a discussion about climate change than those who had endorsed one of three other types of inaccurate perceptions of others' opinions in the pre-screening.

Previous research on pluralistic ignorance (Goode, Balzarini, & Smith, 2014; Larimer, 2010) and willingness to engage in discussion (Oshagan, 1996; Salmon & Kline, 1985) suggests that perceptions of others' behaviors and opinions can influence conformity only to the extent that the particular "others" referenced are perceived to be relevant to the individual in a given situation. Specifically, people are likely to modify their behavior or discussion based on the perceived opinions of those with whom they identify (Larimer, 2010; Neighbors et al., 2010) or the perceived opinions of those with whom they are speaking (Ajzen & Fishbein, 1977), while those with whom they do not identify or a more distant reference group may be unlikely to induce conformity. To verify this proposition, we also assess perceptions of the American public's (a more abstract and distant reference group) opinion in the pre-screening. We anticipated that these perceptions would not be associated with later willingness to discuss climate change.

6.1. Methods

6.1.1. Participants

Respondents were recruited based on their answers in pre-screening as part of a battery of measures submitted by several psychology labs in the university department distributed during the first two weeks of classes. A subset of the initial 1148 participants from the pre-screening were recruited based upon their opinions about climate change and their perception of other students' opinions about climate change (measures are described in sections 5.1.3.1 and 5.1.3.2) We did not recruit those who indicated that they were "Doubtful" or a "Nonbeliever" in order to study self-silencing among those who hold the majority opinion. Perceptions of other students' opinions were used to select an adequate representation of the four categories of opinion perceptions which made up the primary predictor variable in the present study.

Respondents were 305 undergraduate students (124 males, 180 females, and one student who did not indicate gender) enrolled in introductory psychology classes at Pennsylvania State University. The average age was 20 (range 18–48), and most students (76%) identified as White, with the largest three ethnic minority groups being Asian (8%), Hispanic (6%), and Black (5%). Politically, more students were liberal (34%) than conservative (19%), with 36% describing themselves as moderate and 7% as libertarian.

6.1.2. Procedure

Approximately six weeks after completing pre-screening measures, participants were directed to an online survey. Participants were instructed to imagine the following scenario:

> You are assigned a group class project in your Intro to English class at Penn State. You are in a group with 4 other people, and you decide to meet together in the library to work on this project. After a few productive hours of work, your group begins to get distracted. The topic of the weather comes up. You are thinking about bringing up how climate change may be affecting the current weather.

Participants then indicated their expectations about how they would be perceived if they initiated a discussion about climate change and their willingness to discuss climate change in this setting by answering the survey measures described below.

6.1.3. Pre-screening measures

6.1.3.1. Personal opinion about climate change. Respondents self-categorized into one of six groups arranged in a continuum from most to least concerned about climate change (Very Concerned, Concerned, Cautious, Disengaged, Doubtful, and Nonbeliever). We used the terms "Very Concerned" and "Nonbeliever" instead of the original "Six Americas" category labels "Alarmed" and "Dismissive" (Leiserowitz et al., 2015) because of the potential pejorative nature of these labels. We provided descriptions of each group to participants based on prototypical descriptions given in the "Six Americas" report (Maibach, Leiserowitz, & Roser-Renouf, 2009, also see Geiger & Swim, 2014 for validity of self-categorization).

Similar to pilot data, most students who had completed the pre-screening were more concerned than unconcerned (Very Concerned 11%, Concerned 27%, Cautious 27%, Disengaged 26%, Doubtful 6%, Nonbeliever 3%.).

6.1.3.2. Perceptions of others' opinions (proposed predictor). Respondents chose one of five graphs that they believed best represented the distribution of: a) fellow university undergraduates' and b) the American public's opinions about climate change (Fig. 1). The categories of concern depicted in the graphs were derived from the descriptions which respondents had previously read in order to describe their own opinions (section 5.1.3.1). The five graphs were designed to represent the following five options: 1) most are concerned (*concerned model* that most accurately represents the university student population; Option C); 2) most doubt climate change is occurring (*doubtful model*; Option D), 3) most are in the middle of the distribution (*disengaged model*; Option B), 4) a bimodal distribution (*polarized model*; Option E) and 5) people are equally distributed across all six possibilities (*rectangular model*, Option A). Pilot testing indicated that respondents understood the meanings of the different graphs and suggested that Option A indicates uncertainty or lack of an ability to decide.

As noted above, we recruited participants to adequately represent participants who endorsed each of the four distributions assessed in the study. We did not recruit the respondents who chose the rectangular distribution because few endorsed this distribution in pilot testing and our predictions were about comparison among respondents who chose the other four distributions. We did not use responses on perceptions of the American public's opinions to guide participant recruitment. This resulted in the inclusion of a few participants who had selected the rectangular distribution for perceptions of the American public's opinions ($n = 7$). These seven participants were removed from all analyses which involved this variable.

6.1.4. Survey measures

The survey measures were assessed six weeks after the pre-screening measures detailed above.

6.1.4.1. Anticipated evaluations by others (proposed mediators). Participants rated their expectations of being perceived as warm (friendly, fun, good-natured, likeable, nice; $\alpha = 0.89$) and competent (competent, responsible, intelligent, level-headed, successful; $\alpha = 0.76$) (each on a −2 "Very Unlikely" to 2 "Very Likely" scale) if

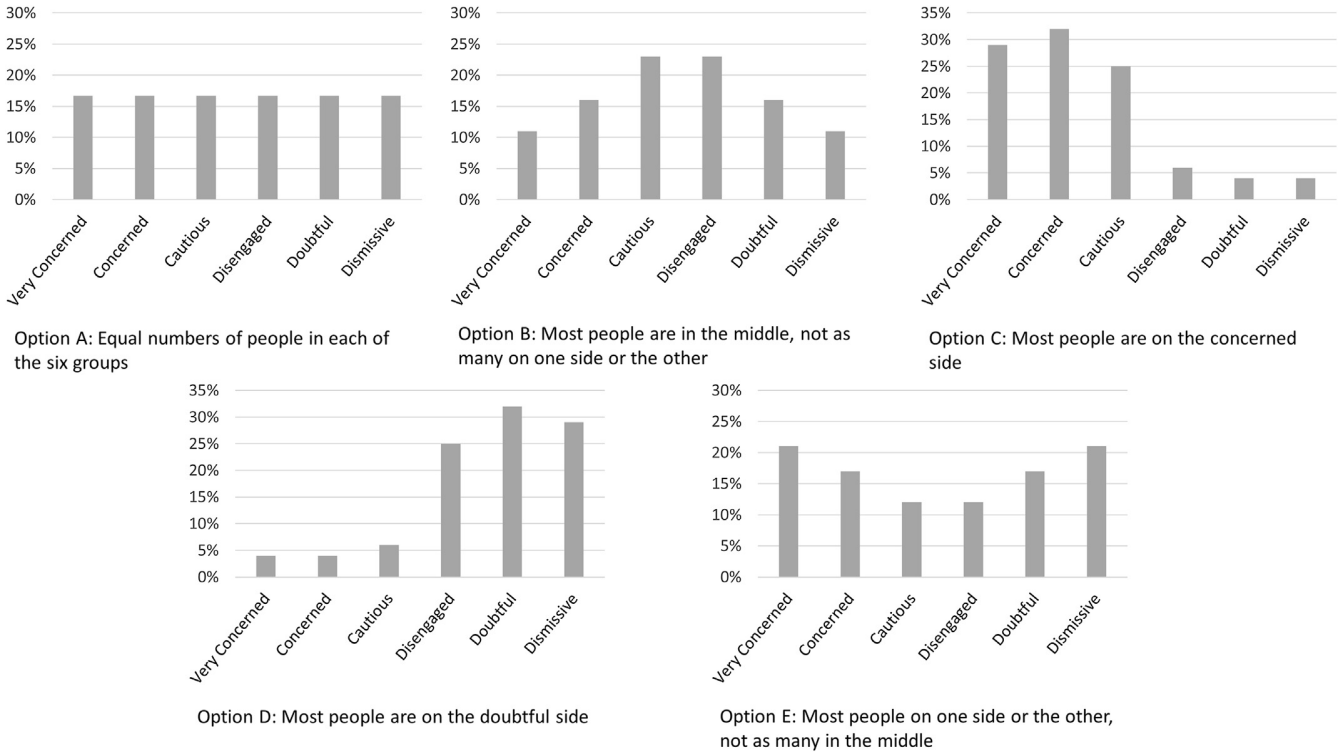

Fig. 1. Opinion distribution answer choices in Study 1. Those who chose Option A were not recruited to participate in the study.

they were to talk about climate change. We also assessed expectations of appearing as a complainer, an alarmist, and an environmentalist to analyze since expectations about being disliked (i.e., perceived as cold) might be grounded in expectations about being categorized in one or more of these groups. Similar to expectations of being perceived as warm (as presented below), results show null results for relationships between these variables and perceptions of others' opinions. Thus, to simplify presentation of results, we do not present analyses related to these variables.

6.1.4.2. Willingness to discuss climate change (proposed outcome). Following other research measuring willingness to discuss controversial topics (e.g. Noelle-Neumann, 1993; Scheufele, Shanahan, & Lee, 2001), respondents answered the question, "How likely would you be to discuss climate change in the above situation?" (−2 "Very Unlikely" to 2 "Very Likely"). Responses were normally distributed (skewness = −0.23, kurtosis = −1.00), suggesting that ordinary least squares (OLS) regression techniques would be appropriate for data analysis.

6.2. Results

6.2.1. Overview

We used one-way ANOVAs to test whether perceptions of a) other undergraduates' and b) the American public's opinions are related to i) willingness to discuss climate change and ii) anticipated evaluations by others. The independent variable corresponded to the four opinion distributions the respondent chose for the relevant target group. We next conducted mediation analyses to test whether anticipated evaluations mediated the relation between opinion perceptions and willingness to discuss climate change.

6.2.2. Pluralistic ignorance and discussions

Perceptions about undergraduates' opinions were associated with willingness to discuss climate change, $F(3, 301) = 2.96$, $p = 0.03$, $\eta^2 = .03$.[1] Contrast tests compared those who accurately perceived that most undergraduates were concerned about climate change versus each of the other three possible inaccurate perceptions. As hypothesized, those who inaccurately perceived that most undergraduates were doubtful about climate change were significantly less willing to discuss climate change ($M = -0.85$, $S.d. = 1.00$) than those who accurately perceived that most undergraduates were concerned ($M = -0.23$, $S.d. = 1.15$), $p = 0.004$, $\eta_p^2 = 0.03$. In contrast, those who inaccurately perceived that most undergraduates were disengaged ($M = -0.40$, $S.d = 1.11$), or polarized in their opinions ($M = -0.44$, $S.d = 1.24$), were not statistically less willing to discuss the topic than those with accurate opinions ($ps > 0.25$), although the difference was in the expected direction.

We conducted a separate ANOVA to examine whether perceptions of the American public's opinions were related to willingness to discuss climate change. In contrast to the above findings with perceptions of undergraduates' opinions, perceptions of the American public's opinions were not related to willingness to talk about climate change, $F(3, 294) = 0.37$, $p = 0.77$, $\eta^2 = 0.004$.

6.2.3. Impression management

Perceptions of other undergraduates' opinions were associated with expectations about appearing competent, $F(3, 300) = 4.31$, $p = 0.005$, $\eta^2 = 0.04$, but not with expectations about appearing

[1] For this and all other analyses presented below, we examined whether results were moderated by participants' personal opinion about climate change. We found no significant interaction effects in any analyses, $ps > 0.17$, perhaps partly due to the restricted range of opinions among participants recruited to be in this sample.

warm, $F(3, 300) = 1.65$, $p = 0.18$, $\eta^2 = 0.02$. Contrast tests again compared those who accurately perceived that most undergraduates were concerned about climate change versus each of the other three possible inaccurate perceptions. As hypothesized, participants who believed that most undergraduates were doubtful about climate change expected to appear less competent ($M = 0.46$, $S.d. = 0.65$) than undergraduates who held more accurate perceptions ($M = 0.81$, $S.d. = 0.52$), $p = 0.001$, $\eta_p^2 = 0.04$. Undergraduates who held the more accurate perception also perceived that others would perceive them as more competent than those who believed others were disengaged ($M = 0.60$, $S.d = 0.54$), $p = 0.01$, $\eta_p^2 = 0.02$, but not more than undergraduates who believed others were mostly polarized, (M = 0.69, S.d. = 0.53), $p = 0.16$.

We conducted separate ANOVAs to examine whether perceptions of the American public's opinions were related to expectations of appearing warm or competent. In contrast to perceptions of other undergraduates' opinions, perceptions of the American public's opinions were not related to expectations of appearing competent, $F(3, 294) = 2.02$, $p = 0.11$, $\eta^2 = 0.02$, or expectations of appearing warm, $F(3, 294) = 0.09$, $p = 0.97$, $\eta^2 = .001$.

6.2.4. Mediation analyses

We used PROCESS with 5000 bootstraps to conduct a regression-based parallel mediation analysis (Hayes, 2013, Model 4) testing whether the observed difference between those who believed other students were concerned and those who believed other students were doubtful was explained by perceptions of appearing warm or competent. We created the following dummy code based on participants' perceptions of other students to test this relationship: concerned = 0, disinterested = 0, polarized = 0, doubtful = −1 (entered as the independent variable) and included the following two other dummy coded variables as covariates in the mediation model to control for other possibilities examined in the ANOVA: a) concerned = 0, disinterested = −1, polarized = 0, doubtful = 0 and b) concerned = 0, disinterested = 0, polarized = −1, doubtful = 0 (see Cohen, Cohen, West, & Aiken, 2003). We entered a) perceptions of appearing warm and b) perceptions of appearing competent as parallel mediators and willingness to discuss climate change as the dependent variable. We omitted the variable corresponding to perceptions of the American public's opinions from these analyses because the prior analyses showed that this variable was unrelated to the other variables in the mediation analysis.

As shown in Fig. 2, those who believed most other students doubted climate change were less willing to discuss the topic than those who believed most other students were concerned because the former expected to be perceived as less competent in a discussion than did the latter, indirect effect = 0.09, SE = 0.06, 95% CI [0.01, 0.25], while expectations of appearing warm did not play a role in this process, indirect effect = 0.01, SE = 0.03, 95% CI [−0.02, 0.11].

6.3. Discussion

Among students who do not doubt climate change, those who endorse the misperception that most others doubt climate change were less likely to engage in discussions about climate change than those who held accurate perceptions of others' opinions. In contrast, those who held other types of inaccurate perceptions—-that others are disengaged or polarized—were not significantly less willing to discuss climate change than those who held the accurate perception. The lack of statistical significance in differences between these two groups and those who believed others were concerned prevented us from making any conclusions about differences among these three groups. However, examining the mean values for each of the four groups leads to the speculation that the effect on perceptions of others' opinions on self-silencing is a matter of degree: the more an individual's perception diverges from the reality that others share their concern about climate change, the more hesitant they may be to speak up. Future research could consider assessing perceptions of others' opinions as a continuous variable to examine whether the relationship between perceptions of others' opinions and self-silencing best fits a linear pattern or if there is a certain tipping point upon which individuals become more likely to self-silence.

Results also show that the reason that those who believe that most others doubt climate change are less willing to discuss the topic than those who accurately perceive others' opinions is

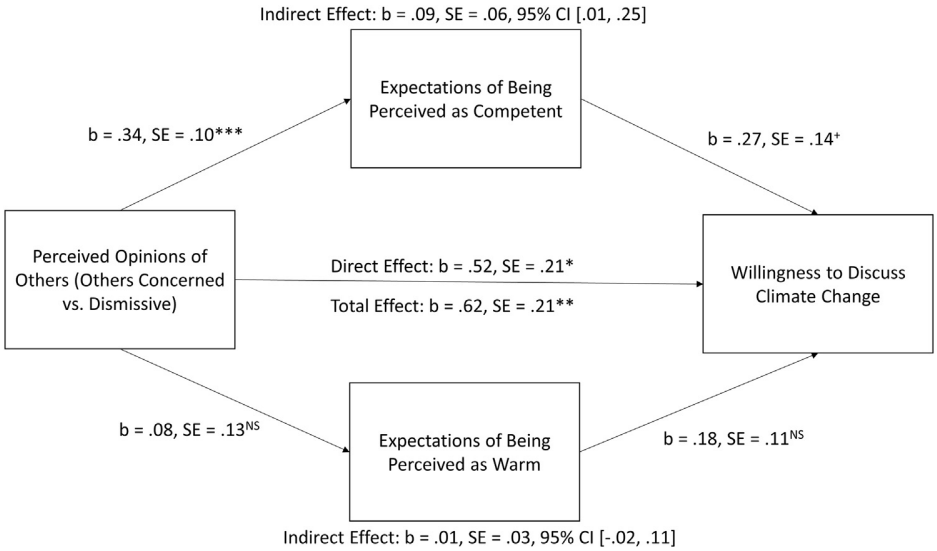

Fig. 2. Expectations of appearing competent and warm as mediators of the effects between the perceived opinions of others and willingness to discuss climate change in Study 1. Higher values on *Perceived Opinions of Others* indicate more accurate perceptions of others' opinions. See text for a full description of how these variables were entered into the model. $^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{+}\ p = 0.056$.

because the former expect to lose respect (appear less competent) in a discussion, and not because they expect to be disliked (perceived as less warm). This suggests that many individuals are uncomfortable engaging in discussions about climate change with a dissenting audience because they believe that they do not have the ability to do so, rather than being concerned about appearing socially deviant or hostile.

7. Study 2

Study 2 tested whether experimentally manipulating perceptions of others' opinions would affect willingness to discuss climate change. Most published research on pluralistic ignorance is correlational; to our knowledge, only one study has experimentally manipulated perceptions of others' opinions (opinions about drinking behavior; Schroeder & Prentice, 1998). Similarly, although research on the spiral of silence links perceptions of others' opinions to willingness to speak out on topics (Glynn & Huge, 2014; Noelle-Neumann, 1993), to our knowledge only one publication has experimentally manipulated perceptions of others' opinions to verify that these perceptions exert a direct causal influence on willingness to discuss topics (Rios & Chen, 2014). Other research, however, points to the effects of manipulating perceptions of others opinions on behaviors; for example, relative to information indicating that others are not prejudiced, information that indicates others are prejudiced increases participants' discriminatory behavior (Sechrist & Stangor, 2001). Thus, in Study 2, we extend this research by examining whether manipulating perceptions of other's opinions about climate change—thereby reinforcing or correcting pluralistic ignorance—influences willingness to discuss climate change. In addition, we reassess expectations of appearing warm and competent to test whether manipulating pluralistic ignorance affects willingness to discuss climate change via increasing expectations of being liked or respected by others.

We add two additional dimensions to the design of Study 2. First, we expand our sample to include people with a full range of beliefs about climate change, thereby including those who disagree with the scientific view on climate change as well as those who are concerned about climate change. We include the full range to test whether correcting inaccurate perceptions that few are concerned about climate change reduces willingness to discuss the topic among those who do not share the scientific view on climate change relative to exacerbating the incorrect perception that overestimates the extent to which others' share their doubts (Leviston et al., 2013). That is, we test whether the same information provides inverse effects for those who doubt versus those who are concerned about climate change. Those who doubt climate change may also harbor concerns about expressing their opinions about the topic because people also report negative impressions of this group consistent with low warmth (Swim & Geiger, 2016b) – perceiving them as arrogant, aggressive, and dictatorial.

Second, we examined the effects of whether participants were led to believe that concern about climate change was increasing or decreasing. Spiral of Silence theory (Noelle-Neumann, 1993) and previous research (Petrič & Pinter, 2002; Taylor, 1982) suggest that perceptions of changing opinions affect willingness to discuss topics such that individuals may be more willing to discuss topics when they believe their opinion will become more popular in the future than when they think their opinion will become less popular in the future. Yet, to our knowledge, the causal relationship between these two variables has not been demonstrated in an experimental study. In Study 2, we test whether participants led to believe that their opinion about climate change is increasing report greater willingness to discuss the topic than those led to believe that their opinion about climate change is decreasing.

In addition to these added dimensions, we also altered a key aspect of the design from Study 1 to increase the external validity of our study: in contrast to the hypothetical situation used in Study 1, participants learned that they would actually speak about climate change in a classroom setting. This has been shown to enhance the validity of findings related to willingness to discuss a topic (Scheufele et al., 2001).

7.1. Methods

7.1.1. Participants

Participants were 194 students recruited from Pennsylvania State University introductory psychology classes, made up of 105 males, 88 females, and one who did not indicate gender. Most students (73%) identified as White, with the largest three ethnic minority groups being Asian (10%), Black (6%), and Hispanic (6%). Politically, more students reported being liberal (33%) than conservative (22%), with 33% identifying as moderate and 9% as libertarian. Most students (74%) reported that at least one of their parents had a 4-year college degree or higher.

7.1.2. Procedure

Participants reported to a classroom along with 10–23 others. They completed a brief survey assessing their personal concern about climate change and then answered the same question using an electronic clicker allegedly so that they could "get a feel for what the classroom thinks as a whole." The first independent variable in the 2(others' current opinions) x 2(changes in others' opinions over time) was introduced, as follows. The experimenter displayed a graph that allegedly showed the class clicker responses. However, participants were actually randomly assigned to view one of two previously created graphs that indicated that either: a) most others in the classroom were concerned about climate change, or b) most others in the classroom were unconcerned about climate change. To ensure that participants understood the graph's meaning, the experimenter explained the graph to the participants. The second independent variable was introduced through this description: the experimenter described the results as either indicating that concern was a) increasing or b) decreasing from previous years. All participants within a single timeslot were exposed to the same experimental condition.

After viewing the graph, participants were informed that they would separate into small groups and have a discussion about climate change. Before doing so, they completed a second survey, which assessed anticipated evaluations by others and willingness to participate in the discussion, as well as anticipatory affect measures which we analyzed for a different research project. After the survey, participants conducted a group discussion about climate change and completed additional surveys which we analyzed for the additional research project mentioned.

7.1.3. Measures

7.1.3.1. Personal opinion about climate change. Participants self-categorized into one of the groups presented in Study 1, with the modification that the Cautious option was not presented because the electronic clicker we used as a prop only had five buttons.

7.1.3.2. Anticipated evaluations by others. Using the same items as Study 1, participants rated their expectations of being perceived as warm ($\alpha = 0.83$) and competent ($\alpha = 0.75$) in the upcoming discussion about climate change. As in Study 1, we also assessed expectations of appearing as an environmentalist, an alarmist, and as a complainer. Again, results show null results for relationships between these variables and perceptions of others' opinions, so we do not present analyses related to these variables in the results to

Table 1
Effects of others' alleged opinions, changes in others alleged opinions over time, and participants' own opinions on dependent measures (Study 2).

Independent Variables	Willingness to discuss climate change			Expectations of appearing competent			Expectations of appearing warm		
	B	SE	η^2_p	B	SE	η^2_p	B	SE	η^2_p
Step 1									
Others concerned (vs. unconcerned)	0.20	0.14	0.01	0.03	0.07	0.00	0.11	0.08	0.01
Concern increasing (vs. decreasing)	0.00	0.14	0.00	−0.04	0.07	0.00	−0.06	0.08	0.00
Personal opinion (more concerned)	−0.06	0.08	0.00	0.12	0.04	0.04**	0.08	0.05	0.01
Step 2									
Others concerned × personal opinion	0.41	0.17	0.04*	0.23	0.09	0.04*	0.18	0.10	0.02
Concern increasing × personal opinion	−0.11	0.16	0.01	−0.03	0.09	0.00	−0.13	0.10	0.01
Others concerned × concern increasing	0.30	0.27	0.01	−0.10	0.15	0.00	−0.21	0.17	0.01
Step 3									
Others concerned × concern increasing × personal opinion	−0.64	0.33	0.02	−0.25	0.18	0.02	−0.05	0.20	0.00

**$p < 0.01$; *$p < 0.05$.

simplify the presentation.

7.1.3.3. Willingness to discuss climate change. Similar to Study 1, Study 2 participants answered the question: "Please indicate your willingness to participate in the group discussion on climate change," (−2 "Very Hesitant" to 2 "Very Willing"). Again, this variable was normally distributed (skewness = −0.34, kurtosis = −0.23), suggesting that OLS regression techniques were appropriate for data analysis.

7.2. Results

7.2.1. Overview

We first tested the hypotheses that the effects of both experimental manipulations would be moderated by personal opinions about climate change. We conducted a three-step hierarchical regression procedure (Cohen et al., 2003) to examine main effects and interactions, entering a) students' willingness to discuss climate change and b) anticipated evaluations by others were regressed on i) others' current alleged opinions, ii) whether participants were informed that concern was increasing or decreasing, and iii) personal opinions about climate change in Step 1, all two-way interactions in Step 2, and the three-way interaction (for exploratory purposes) in Step 3 (see Table 1). We next conducted a conditional mediation analysis to examine whether the mediation findings in Study 1 would replicate for those upon both ends of the opinion spectrum.

7.2.2. Pluralistic ignorance and discussions

The effect of others' alleged opinions about climate change on willingness to discuss climate change was moderated by participants' own concern about the topic, $b = 0.41$, SE = 0.16, $p = 0.01$ (Table 1). As predicted, undergraduates were more willing to discuss the topic when they were led to believe others would share their opinion than when they were led to believe they would not (see Fig. 3). The effect of the manipulation was of similar magnitude (but of opposite direction) for participants of opposing opinions.

In contrast, students who were led to believe that concern was increasing (vs. decreasing) were no more willing to discuss climate change and this effect was not moderated by participants' own concern about the topic, $ps > 0.10$.

7.2.3. Impression management

The effect of others' alleged opinions about climate change on expectations of appearing competent was moderated by participants' own concern about the topic, $b = .23$, $SE = 0.09$, $p = 0.01$. As hypothesized, participants expected that others would perceive them as more competent in the discussion when they believed others shared their opinions (vs. did not share their opinions) (Fig. 3). In contrast, being led to believe that concern was increasing (vs. decreasing) did not influence expectations of appearing competent and this effect was not moderated by participants' concern about the topic, $ps > 0.10$.

The effect of others' alleged opinions about climate change on expectations of appearing warm was marginally moderated by participants' own concern about the topic, $b = .18$, $SE = 0.10$, $p = 0.08$.[2] As before, students being led to believe that concern was increasing (vs. decreasing) did not predict expectations of appearing warm and this null relationship was not moderated by participants' concern about the topic, $ps > 0.10$.

7.2.4. Mediation analyses

We conducted a conditional mediation analysis (Hayes, 2013, model 8 with 5000 bootstraps) to explore whether the interaction between others' alleged opinions and personal opinions on willingness to discuss climate change was mediated by expectations of appearing competent or warm. As shown in Fig. 4, expectations about appearing competent, but not expectations of appearing warm, mediated the relation between the interaction between undergraduates' opinions and of others' alleged opinions and willingness to discuss climate change. Spotlight analyses revealed that those who were concerned about climate change were more willing to discuss climate change when they were led to believe that others were concerned (vs. not concerned) because they believed they would be perceived as more competent when others shared their views, indirect effect $b = 0.06$, $SE = 0.05$, 95% CI [0.004, 0.156]. In contrast, those who were doubtful about climate change were less willing to discuss climate change when they believed others were concerned (vs. not concerned) because they believed they would be perceived as less competent when others disagreed with their views, indirect effect $b = -0.15$, $SE = 0.10$, 95% CI [−0.36, −.02].

7.3. Discussion

Results replicate and extend Study 1 findings that concerned participants are less willing to discuss climate change when they believe others do not share their concern (vs. share their concern). Study 2 results extend this finding by revealing that this effect applies to those upon both ends of the opinion spectrum. Similarly,

[2] As anticipated, this trend was driven by participants expecting that others would perceive them as warmer when they believed that others shared their opinions (vs. did not share their opinions).

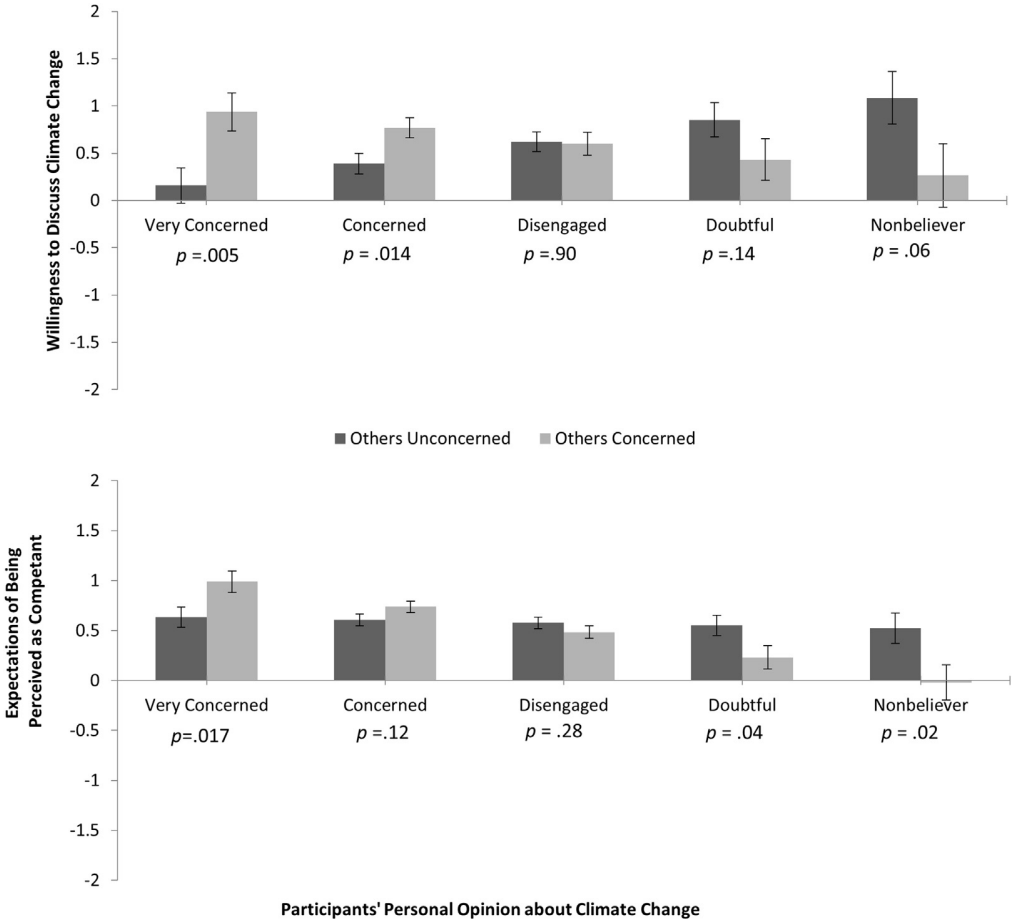

Fig. 3. Effect of perceived opinion climate on a) willingness to discuss climate change and b) expectations of being perceived as competent among participants with different personal opinions about climate change. (Study 2). Values, simple difference tests and standard error bars depicted in the figure were assessed using simple slopes analyses.

Study 2 results replicate and extend Study 1 findings that concerned participants self-silence because they expect to be perceived as less competent in a conversation about climate change with those who disagree (vs. agree) with them. Study 2 reveals that this effect occurs for those upon both ends of the opinion spectrum. Study 2 further reveals that self-silencing among those concerned

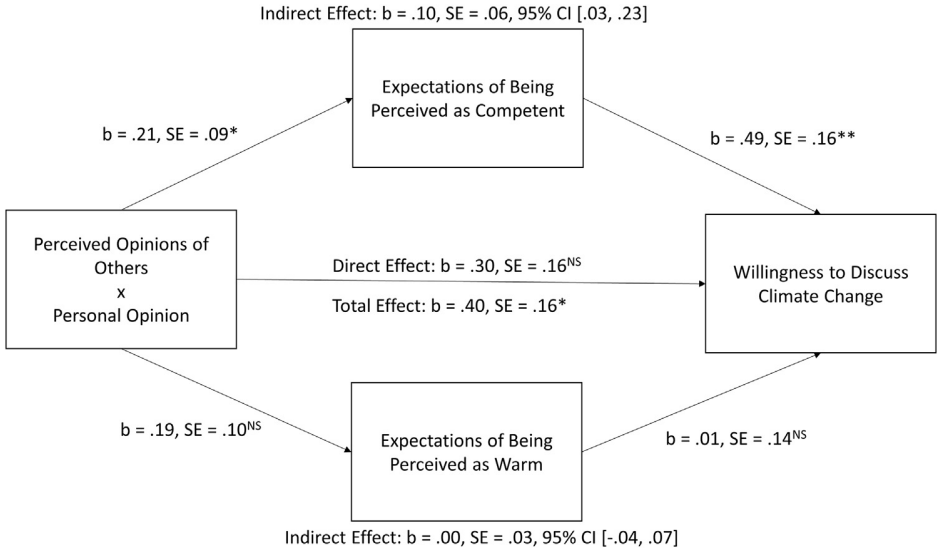

Fig. 4. Expectations of appearing competent and warm as mediators of the effects between opinion congruence and willingness to discuss climate change in Study 2. *Perceived Opinions of Others × Personal Opinion* reflects the degree to which one's opinion is congruent with perceptions of others' opinions, with higher values reflecting higher perceived opinion congruence than lower values. $^{**}p < 0.01$; $^{*}p < 0.05$.

about climate change can be countered by providing accurate information: those who hold the majority opinion are more willing to share their opinion when pluralistic ignorance is corrected (vs. exacerbated) by providing accurate information. In contrast, this accurate information is likely to silence the minority if they previously believed that their view was more common than it actually was.

In contrast to our predictions, there were no effects related to whether participants were led to believe concern was increasing (vs. decreasing). These results suggest that perceptions that others' opinions are changing to become more (vs. less) like one's own opinion do not appear to influence willingness to speak up. Instead, perceptions that others' *current* opinions differ from one's own reduce willingness to engage in discussion.

8. General discussion

The present research demonstrates the effects of pluralistic ignorance in promoting public silence on the socially relevant topic of climate change. Study 1 results reveal the costs of pluralistic ignorance on discussion about climate change among those who do not doubt the science. Survey respondents who did not themselves doubt climate change were less willing to discuss the topic when they inaccurately believed fellow students would not share their opinion than when they accurately perceived they were in the majority. Study 2 results show that when accurate portrayals of others' beliefs were presented, those who were concerned about climate change were more willing to discuss the topic relative to concerned individuals led to inaccurately believe that others would not share their views. Both studies show that the reason individuals are more willing to discuss climate change when they perceive that others agree than when they perceive that others disagree is because they expected to be respected more (i.e., appear more competent) by the former audience. In contrast, expectations of being liked (i.e., appearing warm) do not play a role facilitating discussion in either study.

Our findings have practical implications for those who seek to facilitate greater public engagement with climate change among the majority of the population that express concern about climate change. One way to promote discussion is to correct pluralistic ignorance, informing them that a majority of others share their concern. In contrast, correcting pluralistic ignorance is likely to reduce discussion among those who are not concerned about climate change. Thus, while the correction of pluralistic ignorance could increase participation by the silenced majority group it could decrease participation by those holding minority opinions if the minority opinion holders previously believed that they were in the majority, which may not be desirable to those interested in hearing what individuals who reject the scientific consensus believe.

Consistent with previous research (Larimer, 2010; Oshagan, 1996), our results suggest that correcting pluralistic ignorance may only be effective at facilitating discussion when the opinions of the audience with whom one will discuss the topic are made salient, rather than the opinions of the general American public. This points to a practical weakness of accurately informing individuals of others' opinions: given geographic and political polarization of climate change concern (Howe, Mildenbarger, Marlon & Leiserowitz, 2015), in some subgroups a majority of people are unconcerned about climate change. Thus, informing members of these subgroups that a majority of others are concerned about climate change may be unbelievable or may be disconfirmed if they talk about climate change within their subgroup. In these situations, it may be more effective to instead focus on decreasing expectations about losing respect from these audiences in a discussion, as we describe below.

8.1. Impression management and self-silencing

The present research indicates that impression management concerns about losing respect (appearing less competent), but not concerns about being disliked (appearing less warm), explain self-silencing on the topic of climate change. These results differ from previous research on confronting prejudice which revealed the silencing effect of concerns about being disliked (e.g., Shelton & Stewart, 2004; Swim & Hyers, 1999; Woodzicka & LaFrance, 2001). As we describe in the introduction, impression management concerns related to not being respected may play a role in self-silencing on climate change due to the scientific nature of the topic.

These impression management concerns suggest that improving individuals' confidence in their ability to talk about climate change (i.e., *self-efficacy*) could also counteract the negative effects of perceiving themselves to be in the minority by allowing individuals to overcome expectations of appearing incompetent. This idea is supported by correlational research suggesting that those with greater self-efficacy about their ability to discuss climate change discuss the topic more frequently (Swim et al., 2014) and experimental research showing that watching short videos about climate change which increase individuals' self-efficacy about their ability to contribute to conversations bolster willingness to engage in discussions about the topic (Geiger, Swim, & Fraser, 2016). Individuals could potentially increase their confidence about discussing climate change through learning about the mechanisms by which climate change is occurring (e.g., Ramney & Clark, 2016) or receiving information that most scientists agree that human caused climate change is occurring (e.g., Cook & Lewandowsky, 2016), possibilities which could be tested in future research. Confidence could also be obtained via observing others competently discuss climate change. These role models could decrease concerns about appearing incompetent because they could illustrate how to talk about climate change (Geiger et al., 2016). Observing high status individuals discuss climate change could be another potential buffer to expectations of appearing incompetent. Incorporating more high-status characters who discuss climate change into the media (e.g., Cameron, Weintraub, & Schwarzenegger, 2014; Cornwell, Bajger, & Higgins, 2015) or promoting greater public discussion among those holding positions of power (Corner, 2014) could encourage others to follow their lead. Last, altered social norms could encourage conversations about climate change if the norms promoted discussion about aspects of the topic that were more accessible to nonscientists, thus increasing individuals' self-efficacy about contributing to these conversations.

8.2. Future directions

Future research might address alternate contexts in which expectations of being disliked following an interaction would play a role in silencing. In the present research, Study 1 involved a hypothetical situation and Study 2 involved a setting where participants did not anticipate repeated interactions with the audience in the future. Expectations of being disliked may play a greater role in self-silencing in situations where extended contact with others is expected. Contexts more similar to those found in the prejudice literature could also lead to increased salience of expectations of being disliked. For instance, in some contexts speaking up about climate change would require confronting another's environmentally harmful behavior. In this context, individuals may self-silence out of concern of being appearing hostile and unfriendly (i.e., cold). Individuals may also expect to be disliked or rejected from a group if speaking up required directly arguing with an in-group member who denies the existence of anthropogenic climate change.

Future research might examine whether individual differences moderate effects. Those who are high self-monitors (Snyder, 1974), for instance, may be more likely than others to self-silence due to a greater tendency to attend to audience opinions. Participant age might also moderate the findings: older participants may have more practice negotiating difficult interactions or be less influenced by peer pressure than the university age students in the present sample (Sears, 1986). The ubiquity of climate change silence among a variety of demographics (Norgaard, 2011) and Study 2 results showing that pluralistic ignorance can lead to silencing for those on both ends of the opinion spectrum suggests that our results may generalize to other demographics not captured in the present samples.

More detailed assessments of self-silencing should also be considered in future research to gain a broader insight into this process. Lack of discussion about climate change could be an intentional choice to not speak up, or simply indicate lack of personal interest in discussing the topic, a contrast which should be teased apart in future research. Future research could also assess self-silencing using behavioral measures, such as response latency – the tendency to hesitate before sharing one's opinion (Bassili, 2003; Rios & Chen, 2014). Response latency could be practically important to examine because subtle temporal delays can alter the tone of interactions (Pearson et al., 2008). Using behavioral measures also hold benefits related to not relying on self-report measures.

Alternative methods for assessing perceptions of others' opinions could also be assessed in future research. As we note in section 5.3, these perceptions could be assessed as a continuous measure to determine whether the relationship between opinion perceptions and willingness to discuss climate change is linear or whether self-silencing primarily occurs only when individuals believe that a majority of others hold opinions directly opposed to their own. These perceptions could also be assessed using the *decision by sampling* model (Stewart, Chater, & Brown, 2006) in which individuals consider what percentage of relevant others are perceived to be less concerned about climate change than they are by comparing themselves to each relevant other (cf. Wood, Brown, & Maltby, 2012). Wood et al. (2012) found that using this approach predicts perceived riskiness of individuals drinking behavior more strongly than participants' perceptions of how their drinking behavior compares to the "average."

8.3. Conclusion

The present research demonstrates that pluralistic ignorance can be a barrier to discussions about climate change among those most concerned about climate change and this barrier can be removed by correcting this pluralistic ignorance. Our findings advance the theoretical understanding of self-silencing, showing that with regard to this topic, pluralistic ignorance hinders discussions because individuals expect to be respected less by a dissenting audience, rather than expectations of being disliked by those who disagree. This suggests that building resilience to communicating with audiences of differing opinions may be facilitated by improving communication skills or boosting efficacy about discussing climate change (Swim et al., 2014; Geiger et al., 2016). Indeed, a large-scale effort is currently underway to develop communication skills and efficacy among interpreters at and visitors to aquariums and zoos around the US (Bunten & Arvizu, 2013; Geiger et al., 2016; Swim & Fraser, 2013, 2014).

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