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Willingness to Defend Science Violently: Extremity Moderates the Effect of Attitude Certainty

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Objective: Who is more willing to burn trash containers, erect barricades, and protest violently to defend science? Is it those who are sure that they are in favor of science or those who are uncertain? Traditional research suggests that those most certain in their attitudes toward science would presumably be more likely to engage in attitude-consistent behaviors (i.e., attitude–behavior consistency). The present research aimed to study whether for extreme actions and situations, uncertain attitudes can be more impactful in determining attitude–behavior consistency, potentially reversing the typical effect of attitude certainty. ***Method:*** Across three studies, participants' attitudes toward a science-related topic (climate change; Study 1), science itself (Study 2), and scientists (Study 3) were assessed. Then, certainty in those attitudes was either measured or manipulated. Next, extremity was either measured or manipulated. Finally, several outcomes were assessed as dependent variables, including willingness to violently defend attitudes toward science and willingness to fight to support scientists. ***Results:*** As predicted, for low-extremity conditions, higher certainty enhanced willingness to engage in attitude-aligned behaviors, replicating prior research. By contrast, for more extreme conditions (violent behaviors), lower certainty increased attitude–behavior correspondence, introducing a novel finding in this domain. ***Conclusions:*** Extremity moderated the effect of attitude certainty.

Public Significance Statement

These studies identify factors that predict what attitudinal factors will determine who is more likely to choose peaceful versus aggressive ways of defending science. When it comes to everyday or nonviolent support for science, people who are more certain in their beliefs are more likely to act on their attitudes. However, in situations involving extreme or violent actions, it is those who are more uncertain about their views who become more willing to act.

Keywords: attitudes, certainty, extremism, science

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Data and materials can be found on the Open Science Framework at https://osf.io/8xp3r/?view_only=a78eace78e0b4f5598c69f3fa3421f04. All relevant measures and manipulations in these studies are reported.

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The experimental materials are available at https://osf.io/8xp3r/?view_only=a78eace78e0b4f5598c69f3fa3421f04.

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In 2025, the world witnessed a surge in public demonstrations aimed at defending science, particularly in response to political actions perceived as attacks undermining the role of science in society (Wadman, 2025). For instance, in that year the U.S. executive branch imposed censorship on key areas of scientific research, stripped government-funded scientists of their jobs, and cut federal funding for science. As a result, hundreds of thousands of people flooded the streets, shutting down major roads and intersections as they marched to defend science in coordinated demonstrations that brought traffic to a standstill across more than 30 cities in the United States (Berntsen et al., 2025). These events matched the ones in 2017, when millions of science supporters took to the streets of more than 500 cities all over the world (Nature, 2017). Defenders of science have been seen burning trash containers, overturning cars, and erecting barricades to block police or traffic. In several instances, demonstrations have led to direct clashes with law enforcement, including the throwing of objects, police charges, and the use of force to disperse crowds (Uysal et al., 2025).

Over the years, supporters of science-relevant topics like climate change have also engaged in aggressive behaviors such as blocking lanes of traffic and roads, spreading paint over sculptures or paintings (art vandalism exemplified by the 2023 Degas sculpture defacement at Spain's National Gallery of Art), and even scaling the cables of the Queen Elizabeth II Bridge in London to protest and raise awareness about the scientific view of climate change. Protestors have also engaged in targeted attacks on fossil fuel pipelines and industrial equipment (Bugden, 2020; Ostarek et al., 2024). In recent years, scientists have faced attacks not only from governments (Kekatos, 2025) but also from the general public, particularly through social media platforms (Ferrer, 2024). Some scientific topics have been the target of most attacks, such as climate change (Sasse, 2023; Weart, 2016), vaccines (MacDonald, 2020), and biomedicine (Hotez, 2023). In response to those attacks, some scientists and science supporters have organized collectively to confront these challenges, including movements like Scientific Rebellion (Gayle, 2023) and Stand Up for Science (Robles-Gil, 2025). These behaviors in the name of science—ranging from peaceful marches to violent demonstrations—raise a critical question: What psychological mechanisms drive individuals to engage in such actions toward science?

Theoretical Background

Social psychological research suggests that people's attitudes toward science should be predictive and especially if those attitudes are strongly held (Krosnick & Petty, 1995). Thus, a robust body of research on attitude strength has established that attitudes predict behaviors, especially when they are held with confidence (Briñol & Petty, 2022; Fazio & Zanna, 1978; Krosnick & Petty, 1995; Philipp-Muller et al., 2020; Rucker et al., 2014). For example, consistent with this view, Paredes et al. (2022) found that attitudes toward vaccination predicted intentions to advocate in favor of vaccination to a greater extent when participants' certainty in those attitudes was higher. In two studies, participants first completed two different scales assessing their evaluations of vaccination, and then their attitude certainty was either measured or experimentally manipulated. Finally, their willingness to share messages on social networks in favor of vaccines, including the COVID-19 vaccine, and their willingness to sign a petition defending the widespread use of vaccines were assessed. They found that responses to the scales were associated with advocacy willingness to a greater extent when participants were more certain of their responses to the scale. That is, as certainty increased, so too did the association between the attitude scales and subsequent advocacy willingness. Based on these findings, one would expect that it would be those who are highly certain of their pro-science attitudes who would be most likely to engage in demonstrations or advocate for science-based policies and perhaps even engage in highly aggressive actions. However, this traditional attitude certainty–behavior relationship has been primarily established in the context of relatively mundane or moderate actions such as vaccine advocacy. This leaves an important question unanswered: Does attitude certainty operate the same way when the behaviors in question involve the extreme, and sometimes violent, actions observed in some contemporary science movements?

As just noted, much of the literature on attitude certainty to date has examined attitude–behavior consistency (ABC) in the context of relatively mundane actions, or low-extremity (moderate) behaviors, such as voting for science-friendly policies or vaccination advocacy. Consequently, a critical gap remains in our understanding of how attitude certainty operates when the behaviors in question are more extreme—such as engaging in disruptive protests or acting violently for science. In fact, with respect to research on other extreme actions, some research suggests that the typical relationship between attitude certainty and ABC can reverse. For example, research on compensatory conviction has demonstrated that when individuals experience threatening doubts about their attitudes, uncertainty can become too unpleasant and motivate compensatory actions aimed at restoring a sense of certainty (Cheatham & Tormala, 2017; Hogg, 2007; Mandel et al., 2017; McGregor et al., 2001; Oettingen et al., 2022). Based on this work on compensatory conviction, we argue that in extreme situations, people who have some doubts about their attitudes toward science would experience that doubt as psychologically threatening, prompting them to seek defensive strategies to manage this threat, and therefore being more willing to act in a way that would compensate for these doubts.

This idea of people being more willing to act in an extreme way or support extreme actions to deal with threatening doubts has been studied recently in the context of the COVID-19 pandemic. For example, Siev et al. (2023) looked at how participants felt about COVID-19 safety policies, how confident they were in those opinions, how threatened they felt by the virus, and how willing they were to support 20 different COVID-19 mitigation behaviors, ranging from mild (e.g., frequent handwashing and disinfection) to extreme (e.g., willing to get noncompliers with COVID-19 mitigation guidelines fired). It was predicted and found that the extremity of the behavior moderated the relationship between attitude certainty and the willingness to act on one's attitudes. When people were more certain about their attitudes, they were more likely to engage in relatively low-extremity (i.e., moderate) behaviors, which matches the traditional effect of attitude strength (Rucker et al., 2014). However, they also found that the more uncertain people were of their attitudes, the more likely they were to support extreme actions, reversing the typical effect. Furthermore, these effects of uncertainty were stronger for those who felt particularly threatened by the prospect of getting ill from COVID-19.

Building on this literature, the present research investigates how attitudes, attitude certainty, and extremity interact to predict science-related actions, thereby addressing the gap between traditional

certainty research and the extreme and violent behaviors observed in some science movements. Specifically, this research introduces extremity as a new moderating variable of the impact of certainty on ABC in this important domain. As will be described shortly and in line with previous conceptualizations, extremity is treated in this research as an attribute that can be applied to any given construct, behavior, and situation, and it is defined by its deviation from social norms or its unusualness (Kruglanski et al., 2021; Siev et al., 2022). Thus, most forms of aggression can be seen as extreme behaviors, as they have been studied as nonnormative, maladaptive responses to threat, frustration, or some other emotions (Körner et al., 2025; Kruglanski et al., 2023; Severi et al., 2025; Van Teffelen et al., 2021).

Considering the three core variables examined in this research—attitudes, certainty, and extremity—we hypothesized a three-way interaction among them in predicting behavior. Under relatively low-extremity conditions or for low-extremity actions, higher certainty is expected to strengthen the alignment between science-related attitudes and behavior, consistent with prior research. However, in highly extreme situations or for high-extremity actions (including support for aggressive behavior), we expected that lower certainty would be more likely to drive ABC. In those extreme contexts, we speculate that people would feel unpleasant about their doubts, so engaging in more extreme actions could be used as a way of resolving those threatening doubts and signal their commitment to their attitudes. Therefore, we hypothesize that being doubtful (uncertain) about their attitudes would lead people to seek certainty in their position through alignment with extreme attitude-consistent behaviors. In sum, we propose that under low-extremity conditions, more confidently held attitudes will be more predictive of behavior, but under high extremity, less confidently held attitudes will be more predictive of behavior.

Overview

The purpose of the present research was to examine the role of extremity in moderating the effects of certainty on ABC. The goal was to understand when attitudes in the scientific domain and attitude certainty will be better predictors of extreme behavior, including aggressive actions. This research introduces the possibility of extremity serving as a moderating factor in determining whether higher certainty increases the correspondence between attitudes and behavior—as shown in prior research—or whether, under specified conditions, lower certainty instead enhances the association between attitudes and behavior. Across three studies, participants' attitudes toward a science-related topic (climate change; Study 1), science itself (Study 2), and scientists (Study 3) were measured. Then, certainty was assessed or manipulated, followed by manipulations or assessments of extremity. Attitude-related behaviors, including willingness to engage in violent actions, served as the main dependent variable.

Although we expected that attitudes toward a scientific topic, toward science, and toward scientists would generally be associated with attitude-consistent behaviors, our core prediction was that the nature of this relationship would be moderated by certainty and extremity. More specifically, we predicted that extremity would moderate the relationship between certainty and ABC such that for low-extremity behaviors or under low-extremity conditions, higher certainty would enhance ABC, replicating prior research in this domain. By contrast, for high-extremity behavior or under high-extremity conditions, lower certainty would increase ABC, which would be a completely new finding in this domain. In accord with the literature reviewed, we made the following hypotheses:

Hypothesis 1: Attitudes will be associated with attitude-consistent behavioral intentions.

Hypothesis 2: Extremity will moderate the relationship between attitudes and attitude certainty in determining attitude-consistent behavioral intentions.

Hypothesis 3: For low-extremity behaviors and situations (e.g., peaceful defense of science), higher certainty in attitudes will lead to greater ABC.

Hypothesis 4: For high-extremity behaviors and situations (e.g., violent defense of science), lower certainty in attitudes will lead to greater ABC.

Study 1

The goal of this study was to provide an initial examination of how extremity might moderate the relationship between certainty and ABC for a science-relevant issue, climate change. This topic has been widely studied in the context of violent protests and collective action both in favor of and against science (e.g., Anfinson, 2022; Ardoin & Bowers, 2025; Nylund et al., 2025). First, participants were asked to report their attitudes toward climate change and how certain they were in those attitudes. Then, participants were asked to indicate their willingness to engage in peaceful acts relevant to climate change (low-extremity behavior) and their willingness to engage in violent acts relevant to climate change (high-extremity behavior).

We predicted a main effect of attitudes on behavior with more favorable attitudes toward climate change being associated with greater ABC. Most importantly, we also predicted a three-way interaction between attitudes, attitude certainty, and the extremity of the behavioral outcome. Specifically, for the low-extremity behavior (peaceful defense), higher levels of certainty were predicted to be associated with greater ABC. That would be a conceptual replication of the traditional effect of attitude strength. By contrast, for the high-extremity behavior (violent defense), lower levels of certainty were predicted to lead to greater ABC. If correct, that would be a novel result in this context, reversing the classic effect of attitude certainty on ABC.

Method

Participants and Design

Three hundred forty-two participants from the United States (153 females, 180 males, and three nonbinary; $M_{age} = 42.60$, $SD = 12.39$) were collected via Connect CloudResearch in exchange for monetary compensation ($3). Measured attitudes toward climate change and certainty in those attitudes were the predictor variables. Two items that varied in extremity served as the dependent variables (within-subjects factor). A sensitivity power analysis was conducted using G*Power (Faul et al., 2007). Results indicated that our final sample size for a two-tailed test ($\alpha = .05$) had .80 power to detect an effect size of Cohen's $f^2 = .011$ for the predicted three-way

interaction. All measures, manipulations, and exclusions in the studies are disclosed. All data can be found at https://osf.io/8xp3r/?view_only=a78eace78e0b4f5598c69f3fa3421f04.

Procedure

First, participants were asked to complete a brief assessment of their attitudes toward climate change. Next, they reported their certainty in their responses to that measure. Then, participants were asked to rate the likelihood of engaging in peaceful and also in violent behaviors to reduce climate change. The order of presentation was randomized. Finally, participants completed some sociodemographic questions and were thanked, debriefed, and dismissed.

Predictor Variables

Attitudes. Attitudes toward climate change were assessed using four semantic differential scales. Specifically, participants indicated to what extent they thought that mitigating climate change was: *bad versus good*, *negative versus positive*, *unfavorable versus favorable*, and *harmful versus beneficial*, on a scale from 1 (e.g., *extremely bad*) to 9 (e.g., *extremely good*). Prior research has used similar items to assess attitudes (e.g., Crites et al., 1994; Gandarillas et al., 2018; Moreno et al., 2021). Item ratings were highly correlated ($\alpha = .96$), thus averaged to create an attitude index. Responses to the attitude measure were scored so that higher values represented more favorable attitudes toward mitigating climate change ($M = 4.26$, $SD = 2.07$).

Attitude Certainty. Attitude certainty was assessed by asking people to indicate the following: "To what extent do you feel certain in your responses on this page?" (containing the attitude items; 1 = *not at all certain* to 9 = *totally certain*; $M = 5.94$, $SD = 1.23$). This is an efficient way to assess certainty as indicated by prior research (e.g., Moreno et al., 2024; Paredes et al., 2021; Santos et al., 2019).

Extremity. Participants were asked to report their willingness to engage in a peaceful act and also a violent behavior to mitigate climate change. Therefore, all participants completed both measures, with a randomized order of appearance (see dependent variables for more details).

Dependent Variable: Engagement

Peaceful Engagement (Low Extremity). Participants reported their degree of agreement on a 1 (*not at all*) to 7 (*totally*) scale with the following item: "To what extent would you be willing to engage in peaceful behaviors to mitigate climate change?" Higher values on this index indicated a greater willingness to engage in peaceful behaviors to act against climate change ($M = 3.92$, $SD = 1.87$).

Violent Engagement (High Extremity). Participants reported their degree of agreement on a 1 (*not at all*) to 7 (*totally*) scale with the following item: "To what extent would you be willing to engage in violent behaviors to mitigate climate change?" Higher values on this index indicated a greater willingness to engage in violent behaviors to fight against climate change ($M = 1.65$, $SD = 1.39$).

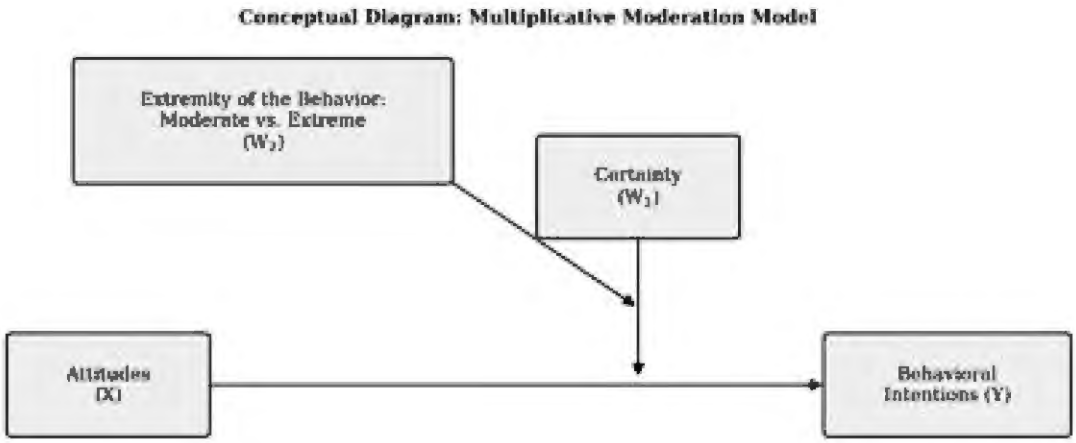
Results

Behavioral intentions were analyzed using the Mediation and Moderation in Repeated-measures designs add-on for SPSS (MEMORE Model 3; Montoya & Hayes, 2017; see Figure 1). MEMORE is specifically designed for within-subjects designs and extends the PROCESS framework to estimate moderation and mediation models when the independent variable is manipulated within participants. We selected MEMORE because extremity was manipulated within subjects, with each participant responding to both a low- and high-extremity condition, making standard between-subjects moderation procedures inappropriate. The present analysis tested a within-subject moderation model rather than a moderated mediation (conditional process) model.

Attitudes (centered), attitude certainty (centered), and their interactions were entered as between-subjects predictor variables, and behavioral intentions in each condition served as the repeated dependent measures. Contrary to expectations, attitudes had no overall effect on behavioral intentions, both for the low-extremity behavior, $B = 0.039$, $t(338) = 0.641$, $p = .522$, 95% CI [−0.081,

Figure 1

Conceptual Diagram of Mediation and Moderation in Repeated-Measures Designs for Study 1



Note. Model specification follows Mediation and Moderation in Repeated Measures Model 3 formulation (Montoya & Hayes, 2017).

0.159], and the high-extremity behavior, $B = 0.081$, $t(338) = 1.803$, $p = .072$, 95% CI [−0.007, 0.170]. However, the results showed a significant two-way interaction between certainty and extremity, $B = -0.415$, $t(338) = -4.601$, $p < .001$, 95% CI [−0.592, −0.237], such that the effect of certainty on behavioral intentions was positive for the low-extremity behavior, $B = 0.164$, $t(338) = 1.883$, $p = .061$, 95% CI [−0.007, 0.336], but negative for the high-extremity one, $B = -0.251$, $t(338) = -3.879$, $p = .001$, 95% CI [−0.378, −0.124].

Importantly, this two-way interaction must be interpreted in light of the predicted and found three-way interaction between attitudes, attitude certainty, and extremity, $B = -0.205$, $t(338) = -3.274$, $p = .001$, 95% CI [−0.327, −0.082], $f^2 = 0.011$. For the low-extremity behavior, a two-way interaction between attitudes and certainty emerged, $B = 0.118$, $t(388) = 1.947$, $p = .052$, 95% CI [−0.001, 0.237]. Specifically, among those with higher certainty scores (+1 *SD*), attitudes toward climate change were positively associated with behavioral intentions, $B = 0.164$, $t(388) = 2.868$, $p = .004$, 95% CI [0.052, 0.276]. However, for those with lower certainty scores (−1 *SD*), there was no relationship between them, $B = -0.106$, $t(388) = -0.878$, $p = .380$, 95% CI [−0.342, 0.131] (see Figure 2, top panel). This is the traditional effect of certainty on ABC.

By contrast, for the high-extremity behavior, the opposite two-way interaction pattern emerged, $B = -0.087$, $t(388) = -1.941$, $p = .053$, 95% CI [−0.175, 0.001]. Specifically, for those with higher certainty scores (+1 *SD*), there was no relationship between attitudes and behavioral intentions, $B = -0.011$, $t(388) = -0.261$, $p = .795$, 95% CI [−0.094, 0.072]. However, for those with lower certainty scores (−1 *SD*), the relationship between attitudes and behavioral intentions was positive, $B = 0.188$, $t(388) = 2.109$, $p = .036$, 95% CI [0.013, 0.363] (see Figure 2, bottom panel).[1]

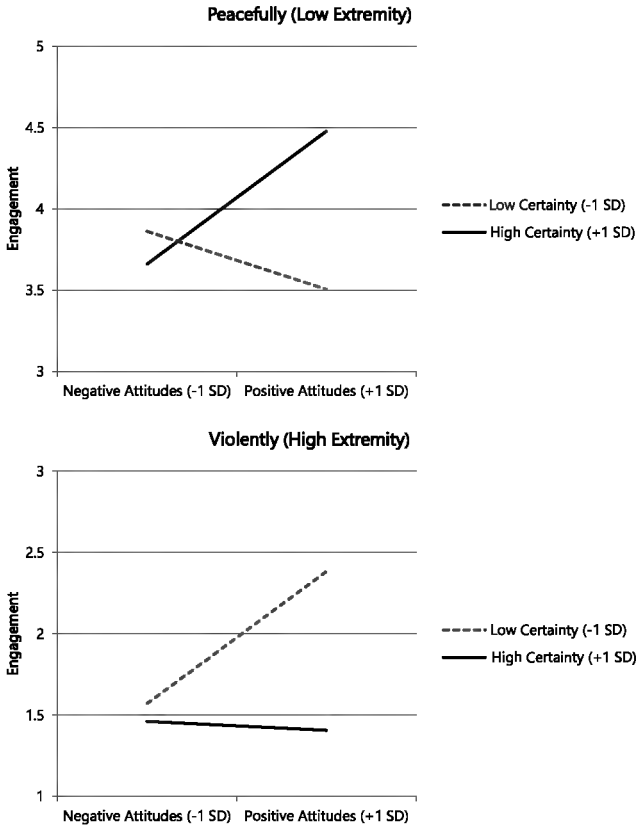
Discussion

Study 1 found that the association between attitudes toward climate change and behavioral intentions was moderated by attitude certainty and the extremity of the behavior. That is, the results demonstrated that for intentions to engage in low-extremity behaviors, attitudes toward climate change were more predictive of relevant intentions as certainty in those attitudes increased. However, the opposite was found for intentions to engage in high-extremity behaviors. That is, attitudes toward climate change were more predictive of relevant intentions as certainty in those attitudes decreased. This novel finding suggests that the relationship between certainty and ABC in a scientific domain depends on how extreme the behavior being considered is.

In this study, there were two different behaviors used in a within-subjects design to explore the extremity construct (i.e., peaceful vs. violent protesting). Given this approach, it is possible that the two behaviors could differ in dimensions other than extremity (e.g., active vs. passive, social vs. individual) and that these dimensions rather than extremity could account for the results. There was also an unanticipated order effect of measurement suggesting that a replication would be useful. Thus, the next study was designed to keep the outcome behaviors constant while manipulating extremity in a between-subjects design. In the next study, we also aimed to generalize the effect to different behaviors that varied from aggression toward to a form of aggression toward the self (i.e., willingness to endure pain). In addition, given that certainty was measured rather than manipulated in this first study, its causal role cannot be assured. Thus, to enhance internal validity, we moved to a more experimental design that randomly assigned participants to feel relatively high or low certainty. Finally, to generalize across science-related domains, we moved from assessing attitudes toward climate change to assessing attitudes toward science itself.

Figure 2

Engagement in Action as a Function of Attitudes Toward Climate Change and Certainty for Peaceful Acts (Low-Extremity Behavior; Top Panel) and Violent Acts (High-Extremity Behavior; Bottom Panel)



Study 2

This study aimed to replicate and extend the findings of Study 1 by keeping the aggressive behaviors constant and using a between-subjects extremity induction. Moreover, we wanted to increase internal validity by manipulating certainty, instead of measuring it, as well as to generalize the effect to a different and more general attitude object, science itself. This shift is relevant because of the growing distrust in science over the past years (Gauchat, 2012; Phillip-Muller et al., 2022; Rutjens et al., 2021), with people acting

[1] When adding order of appearance of the behavioral measure as another predictor variable, a four-way interaction among attitudes, attitude certainty, extremity and their order of appearance emerged, $B = -0.234$, $t(334) = -3.754$, $p = .001$, 95% CI [−0.356, −0.111]. This was such that the predicted three-way interaction was significant when the low extremity question appeared first, $B = -0.409$, $t(181) = -4.907$, $p < .001$, 95% CI [−0.574, −0.245], but not when the high extremity question appeared first, $B = 0.059$, $t(153) = 0.646$, $p = .519$, 95% CI [−0.122, 0.240].

violently either to attack or to defend science from those attacks (Gayle, 2023; Hotez, 2021; Robles-Gil, 2025). First, participants reported their attitudes toward science. Then, they were randomly assigned to remember and write down in detail a past situation in which they felt confident versus doubtful. After the certainty induction, participants were randomly assigned to the high (vs. low) extremity condition. This induction consisted of a word-completion task with words varying in extremity (adapted from Higgins et al., 1985; Paredes et al., 2019; Petty et al., 2008). The notion of this semantic priming induction is that participants' perception of extremity of the behavioral intentions they would shortly consider would be affected by the priming much as the perceived hostility of another person is impacted by hostility primes (Higgins et al., 1985). Finally, participants were asked to indicate their willingness to engage in eight different behaviors that varied in extremity, including the violent item used in Study 1.

We expected to conceptually replicate the pattern of results obtained in Study 1. When low extremity was primed, we expected to find the two-way interaction between attitudes and certainty on behavioral intentions such that greater ABC would occur under higher certainty conditions. By contrast, when high extremity was primed, we expected to find the opposite such that greater ABC would occur under lower certainty conditions.

Method

Participants and Design

Two hundred eighty-six participants from the United States (151 females, 130 males, and three nonbinary; $M_{age} = 43.03$, $SD = 13.09$) were collected via Connect CloudResearch in exchange of monetary compensation ($3). Attitudes toward science, certainty, and extremity served as predictor variables. Behavioral intentions served as the dependent variable. We could not look at prior work to obtain an estimated effect size for the predicted three-way interaction with a between-subjects induction. Given the exploratory nature of the design, we anticipated a relatively small effect (Cohen's $f^2 = .030$). A sensitivity power analysis was conducted using G*Power (Faul et al., 2007). Results indicated that our final sample size for a two-tailed test ($\alpha = .05$) had .80 power to detect an effect size of Cohen's $f^2 = .028$ for the predicted three-way interaction.

Procedure

First, participants were asked to complete a brief assessment of their attitudes toward science. Next, they completed the certainty manipulation. Then, participants were asked to fill in the missing letters in a word-completion task related to high or low extremity and completed eight questions regarding their behavioral intentions to defend science. Finally, they were thanked, debriefed, and dismissed.

Predictor Variables

Attitudes. Attitudes toward science were assessed the same four 9-point items from Study 1. Item ratings were moderately correlated ($\alpha = .78$), thus averaged to create an attitude index. Responses to this measure were scored so that higher values represented more favorable attitudes toward science ($M = 7.59$, $SD = 1.36$).

Attitude Certainty. Following completion of the attitude measure, participants were assigned to describe a past personal experience in which they felt either high or low certainty. The high certainty condition should produce relative feelings of confidence, and the low certainty condition should produce relative feelings of doubt. Participants were told that they could write about any topic they chose and not worry about grammar or spelling. An example of experience listed in the doubt condition was the following:

> I recently had a very confusing project at work, and it was taking a considerable amount of time to determine the appropriate fix because it was very complex and ever-changing. This was frustrating and led me to doubt myself and seek other opinions.

An example experience recalled in the high certainty condition was the following: "I think when I am at work I am very confident in my knowledge and understanding of what I need to do." Prior research has shown that this manipulation is successful at inducing differences in perceived certainty (Petty et al., 2002).

Extremity. Participants were asked to fill in the missing letters in a word-completion task. In the high-extremity condition, they had to fill in the letters of 12 incomplete words, five of which were directly related to high extremity (extreme, savage, intense, radical, limit). These participants also completed additional seven neutral words (e.g., table, chair). Participants in the low-extremity condition also filled in the letters of 12 incomplete words, five of which were directly related to low extremity (moderate, parsimony, measured, soft, tempered). These participants also completed the same neutral words presented to participants in the high-extremity condition. Semantic priming inductions like this based on word completion are commonly used to vary the activation of different mental constructs in psychology that affect the interpretation of subsequent information (Higgins et al., 1977, 1985).

Dependent Variable: Endorsement of Actions in Favor of Science

Participants were asked to report their willingness to engage in eight different violent behaviors to support science adapted from previous literature (Paredes et al., 2018; Sheikh et al., 2016; Siev et al., 2023; Van Zomeren et al., 2018). Some of these behaviors include the role of the participant as agent (e.g., "willingness to engage in violent acts to support science") and in some others the role as a potential receiver (e.g., "willingness suffer the physical pain associated with getting a permanent tattoo of the NASA logo on your body to show your support for science," and "willingness to suffer psychological pain to defend your opinion on science"; Santos et al., 2022). Specifically, participants indicated their willingness to engage in those behaviors using a 7-point Likert scale ranging from 1 (*not at all*) to 7 (*totally*) for the first four items and ranging from 1 (*not at all*) to 6 (*totally*) for the last four items. For all items to be analyzed with the same consistent metric, we standardized them.[2] Because the exploratory factor analysis extracted one factor and item ratings were highly correlated ($\alpha = .89$), all eight items were averaged to create a merged endorsement index. The

[2] An exploratory factor analysis was run using the Pearson correlation matrix and maximum likelihood as the estimation method (Ferguson & Cox, 1993). Only one factor was extracted, explaining more than 50% of the total variance.

items can be found on our Open Science Framework at https://osf.io/8xp3r/?view_only=a78eace78e0b4f5598c69f3fa3421f04.

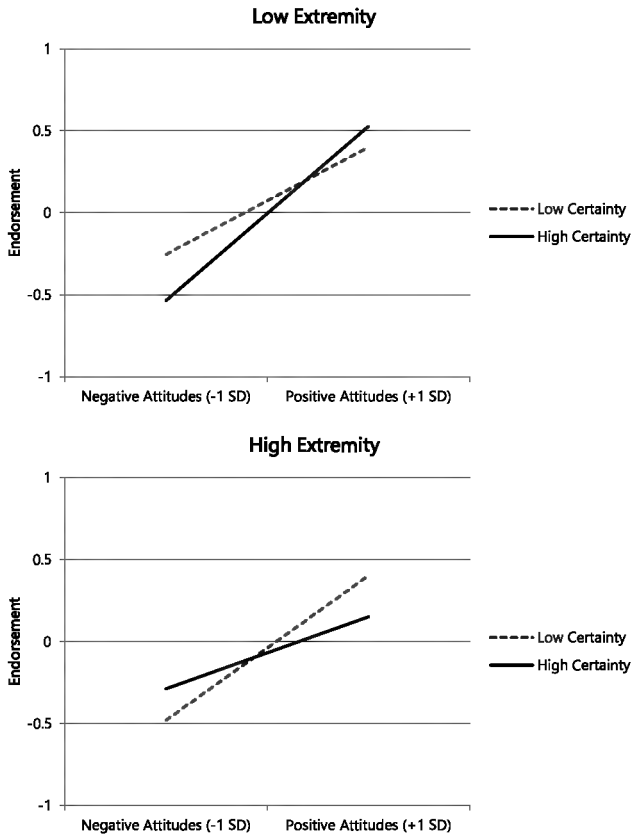
Results

Behavioral intentions were submitted to a multiple linear regression analysis tested by using the PROCESS add-on for SPSS (Model 3; Hayes, 2022). Attitudes (centered), attitude certainty (−1 = low, 1 = high), extremity (−1 = low, 1 = high), and their interactions were entered as predictor variables. To maintain consistency of effects between studies, attitudes toward science were reverse coded so the main effect on behavioral intentions was in the same direction as the previous study. Results showed a main effect of attitudes, $B = 0.280$, $t(278) = 9.774$, $p < .001$, 95% CI [0.224, 0.336], such that attitudes were positively associated with behavioral intentions.

As expected, results also revealed a three-way interaction between attitudes, certainty, and extremity, $B = -0.078$, $t(278) = -2.692$, $p = .008$, 95% CI [−0.216, −0.032], $f^2 = 0.026$. As illustrated in Figure 3 (top panel), for the low-extremity condition, there was a two-way interaction pattern between attitudes and certainty, $B = 0.075$, $t(278) = 1.894$, $p = .059$, 95% CI [−0.003, 0.154]. Specifically, among those assigned to the high certainty condition, attitudes were positively associated with behavioral intentions, $B = 0.390$, $t(278) = 6.571$, $p < .001$, 95% CI [0.273, 0.507]. For those assigned to the low certainty condition, the positive relationship between attitudes and behavioral intentions was weaker, $B = 0.240$, $t(278) = 4.535$, $p < .001$, 95% CI [0.136, 0.344]. By contrast, for participants assigned to the high-extremity condition (bottom panel), the opposite two-way interaction pattern emerged, $B = -0.081$, $t(278) = -1.915$, $p = .057$, 95% CI [−0.165, 0.002], such that among those assigned to the high certainty condition, although attitudes were positively associated with behavioral intentions, $B = 0.161$, $t(278) = 2.394$, $p = .017$, 95% CI [0.029, 0.293], for those assigned to the low certainty condition, the positive relationship between attitudes and behavioral intentions was even stronger, $B = 0.324$, $t(278) = 6.244$, $p < .001$, 95% CI [0.222, 0.426]. No other effects reached significance ($ps > .238$).

Figure 3

Endorsement as a Function of Attitudes Toward Science and Certainty for Low-Extremity Condition (Top Panel) and High-Extremity Condition (Bottom Panel)



Discussion

This second study found the predicted main effect of attitudes on behavioral intentions. Furthermore, Study 2 conceptually replicated the core finding from Study 1 while manipulating certainty and extremity and generalized those findings to a different attitude object. That is, we found that the effect of attitude certainty on ABC was moderated by extremity. For the low-extremity condition, we found a two-way interaction such that participants assigned to the high certainty condition showed greater ABC than those assigned to the low certainty condition. For the high-extremity condition, we found the opposite two-way interaction. That is, it was participants assigned to the low certainty condition that showed greater ABC.

For our final Study, we aimed to move to a scenario with higher ecological validity in which perceived extremity is free to vary naturally. Thus, in Study 3 we held the behavior constant (similar to Study 2). However, we operationalized extremity by assessing how extreme the intended behavior was perceived by the participants. Additionally, to test the generalizability of this effect across induction orders, we also moved to a certainty manipulation that occurs before the attitudes are measured. To generalize our findings further, we also changed the attitude object in Study 3 to specific agents for science—scientists. This shift is also particularly relevant given contemporary concerns about growing anti-intellectual sentiments and prejudice against scientists observed in various public domains (Motta, 2024; Zhang & Lu, 2025). Finally, in Study 3 we moved to a more general and efficient measure of behavioral intentions by asking participants about their willingness to fight to support scientists.

Study 3

This study aimed to replicate and extend the findings of the previous studies by measuring extremity, rather than manipulating it, and changing the certainty manipulation as well as varying the attitude object. First, participants were asked to write down their thoughts about scientists, and, after doing so, they were given false feedback about their thoughts designed to increase or decrease the confidence they had in them. The notion of this certainty induction is that it leads participants to feel certainty in their thoughts, which form the basis of their attitudes. Then, higher thought certainty results in higher attitude certainty (see Petty et al., 2002). Next, participants reported their attitudes toward scientists. Finally, participants were asked to indicate their willingness to fight to support scientists and how extreme they perceived that behavior to be.

Despite these variations, we expected to again conceptually replicate the same three-way interaction between attitudes, certainty, and extremity as in the prior two studies. Specifically, for participants who perceived the behavior to be relatively low in extremity, those assigned to the high certainty condition were predicted to show greater ABC (the traditional effect). By contrast, for those who perceived the behavior to be relatively high in extremity, it would be those assigned to the low certainty condition that would show greater ABC (the novel effect).

Method

Participants and Design

Two hundred ninety-five undergraduate students from Spain (255 females, 26 males, one nonbinary, and two genderqueers; M_{age} = 19.44, SD = 3.44) participated in this study in exchange for course credit. Attitudes toward scientists, certainty, and extremity were the predictor variables. Behavioral intentions served as the dependent variable. Our final sample size was determined by the number of participants that we were able to collect during the 2 weeks in which the study was posted (295 participants). A sensitivity power analysis was conducted using G*Power (Faul et al., 2007). Results indicated that our final sample size for a two-tailed test ($\alpha = .05$) had .80 power to detect the effect size for the predicted three-way interaction in Study 2 ($f^2 = .026$).

Procedure

First, participants were asked to enter their thoughts about scientists. After doing so, they were then given false feedback about their thoughts designed to increase or decrease the confidence they had in them. Then, participants reported their attitudes toward scientists. Next, participants were asked to indicate their willingness to fight to support scientists. Finally, participants completed a question regarding how extreme they perceived the behavior was, and then, they were thanked, debriefed, and dismissed.

Predictor Variables

Attitude Certainty. After participants listed their thoughts about scientists, they were told that the thoughts they listed were going to be analyzed by the computer and compared with a pool of thoughts of 1,800 other students from public universities in Spain. After 7s, a new computer screen appeared with the outcome of the comparison. Half of the participants were told that their thoughts had been rejected for future research because they were very different from the rest of the members of their group (i.e., only 8% of their thoughts were similar to those of the other students). The other half of the participants were told that their thoughts had been accepted into the pool for future research because they were quite similar to the thoughts listed by other members of their group (i.e., 87% of their thoughts were similar to those of the other students). Previous research has revealed that this manipulation is useful to vary participants' level of confidence in their thoughts, which in turn impacts confidence in attitudes based on those thoughts (Barden & Petty, 2008; Petrocelli et al., 2007; Petty et al., 2002).

Attitudes. Attitudes toward scientists were assessed using the same four semantic differential scales used in the prior studies. Item ratings were correlated ($\alpha = .78$), thus averaged to create an attitude index. Responses to this attitude measure were scored so that higher values represented more favorable attitudes toward scientists (M = 7.98; SD = 0.92). This attitude measurement was not affected by the certainty manipulation, $F(1, 293) = 0.458$, $p = .499$.

Extremity. Extremity was assessed by asking participants to report the extremity of the behavioral intentions question that served as the dependent measure. Specifically, at the end of the study, participants responded to the following question: "How extreme do you think the behavior in the previous question was?" Responses were provided on a 9-point scale anchored at 1 (*low extreme*) and 9 (*high extreme*). This measure provides an efficient assessment of perceived extremity (M = 3.02, SD = 2.08). This extremity measure was not affected by the certainty manipulation, $F(1, 293) = 0.070$, $p = .792$.

Dependent Variable: Behavioral Intentions

Participants were asked to indicate to what extent they would be willing to fight to support scientists on a 9-point scale ranging from 1 (*not at all*) to 9 (*totally*). Responses to this question were scored so that higher values represented more willingness to engage in that behavior (M = 7.77, SD = 1.28).

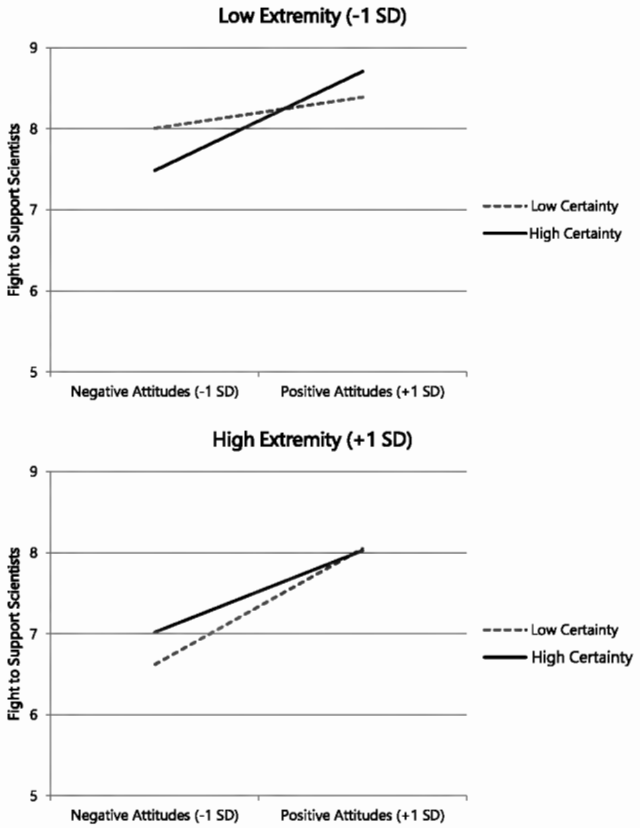
Results

Behavioral intentions were submitted to a multiple linear regression analysis tested using the PROCESS add-on for SPSS (Model 3; Hayes, 2022). Attitudes (centered), attitude certainty (−1 = low, 1 = high), extremity (centered), and their interactions were entered as predictor variables. The results showed a main effect of attitudes, $B = 0.550$, $t(287) = 7.730$, $p < .001$, 95% CI [0.410, 0.690], such that those participants who reported more favorable attitudes toward scientists were more willing to fight to support scientists. Results also showed a main effect of extremity, $B = -0.173$, $t(287) = -5.660$, $p < .001$, 95% CI [−0.234, −0.113], such that those participants who perceived the behavior as more extreme were less willing to fight to support scientists. A marginal two-way interaction between attitudes and extremity, $B = 0.050$, $t(287) = 1.627$, $p = .105$, 95% CI [−0.010, 0.109], revealed that for participants who perceived lower extremity (−1 SD), there was a weaker relationship between attitudes and behavior, $B = 0.450$, $t(287) = 4.588$, $p < .001$, 95% CI [0.257, 0.643], than for those who perceived higher extremity (+1 SD), $B = 0.653$, $t(287) = 7.176$, $p < .001$, 95% CI [0.474, 0.833].

Most importantly, as predicted, a significant three-way interaction emerged between attitudes, attitude certainty, and extremity on behavioral intentions, $B = -0.083$, $t(287) = -2.712$, $p = .007$, 95% CI [−0.143, −0.023], $f^2 = 0.026$. As illustrated in Figure 4 (top panel), for those who perceived the behavior as relatively low in extremity (−1 SD), a significant two-way interaction between attitudes and certainty emerged, $B = 0.227$, $t(287) = 2.258$, $p = .025$, 95% CI [0.029, 0.425]. This showed that among those assigned to the high certainty condition, attitudes toward scientists were positively associated with willingness to fight to support scientists, $B = 0.662$, $t(287) = 5.964$, $p < .001$, 95% CI [0.444, 0.881]. However, for those assigned to the low certainty condition, the relationship between attitudes and intentions was not significant, $B = 0.209$, $t(287) = 1.247$, $p = .214$, 95% CI [−0.121, 0.538]. By contrast, for those who perceived the behavior as more extreme (+1 SD), although not significant, an opposite two-way interaction pattern

Figure 4

Fight to Support Scientists as a Function of Attitudes Toward Scientists and Certainty for Low Perception of Extremity (Top Panel) and High Perception of Extremity (Bottom Panel)



emerged, $B = -0.114$, $t(287) = -1.267$, $p = .206$, 95% CI [−0.291, 0.063]. No other effects reached significance ($ps > .258$).

Discussion

Study 3 replicated the predicted main effect of attitudes on behavioral intentions found in Study 2. Of greatest interest, Study 2 also found the predicted three-way interaction obtained in Studies 1 and 2. Furthermore, this study also offered evidence of the association between measured (rather than manipulated) extremity and the effects of certainty in ABC. Specifically, higher certainty predicted stronger ABC when the behavior was perceived as low in extremity, whereas lower certainty tended to predict stronger ABC when the behavior was perceived as high in extremity. These findings provide convergent evidence around the novel outcome introduced in this work, independently of how certainty and extremity are manipulated and assessed.

General Discussion

Collapsed Data Set

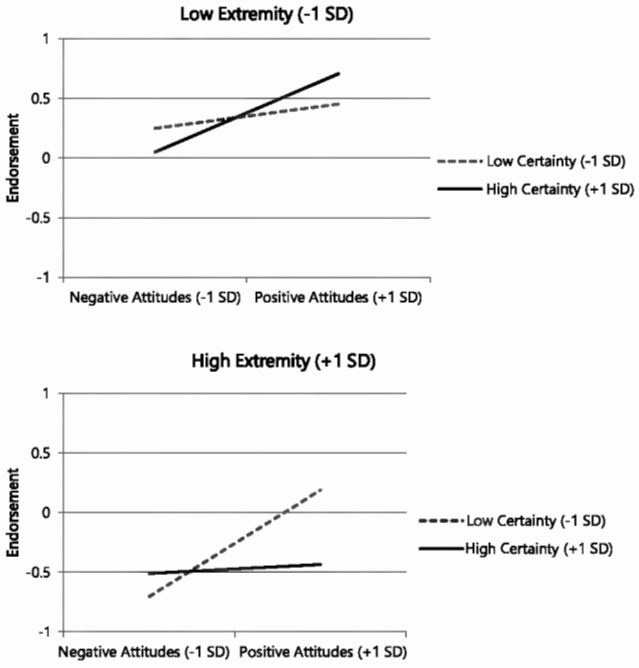
Although the predicted three-way interaction between attitudes, attitude certainty, and extremity in predicting behavioral intentions was significant in each study, the predicted two-way interactions between attitude certainty and extremity varied in their significance across studies, and thus it was important to determine if these interactions held across studies. To obtain maximum power to detect these effects, we collapsed all three studies and reran the analyses using study as an additional factor. Before aggregating the information from the three data sets, we standardized all continuous predictor variables and dependent measures. In sum, we included study as a factor in a multiple regression with attitudes, certainty, extremity, and all possible interactions as independent variables.

These analyses produced a significant main effect of attitudes, $B = 0.229$, $t(1,257) = 9.451$, $p < .001$, 95% CI [0.181, 0.276], such that more positive science attitudes were associated with more attitude-consistent behavior. There was also a significant main effect of certainty, $B = -0.048$, $t(1,257) = -2.002$, $p = .046$, 95% CI [−0.093, −0.001], such that certainty was negatively associated with behavioral intentions. A significant main effect of extremity, $B = -0.367$, $t(1,257) = -15.734$, $p < .001$, 95% CI [−0.412, −0.321], showed that extremity was negatively associated with behavioral intentions in general. Results revealed a nonsignificant two-way interaction between attitudes and certainty, $B = -0.045$, $t(1,257) = -1.714$, $p = .087$, 95% CI [−0.097, 0.007], and a two-way interaction between certainty and extremity, $B = -0.061$, $t(1,257) = -2.560$, $p = .009$, 95% CI [−0.107, −0.015].

Most importantly, these lower order interactions were qualified by a significant three-way interaction between attitudes, certainty, and extremity, $B = -0.159$, $t(1,257) = -6.246$, $p < .001$, 95% CI [−0.210, −0.109], $f^2 = .031$, that was also evident in each individual study (see Figure 5). This critical three-way interaction was not further moderated by study, $R^2 < 0.001$, $F(1, 1,255) = 0.001$, $p = .973$. The three-way interaction was a function of different and significant two-way interactions between attitudes and certainty

Figure 5

Endorsement as a Function of Attitudes and Attitude Certainty for Low Extremity (Top Panel) and High Extremity (Bottom Panel)



under high and low-extremity conditions. Under low extremity, the classic two-way interaction between attitudes and certainty was present, $B = 0.113$, $t(1,257) = 2.983$, $p = .003$, 95% CI [0.039, 0.187], showing that attitudes predicted intentions better under high than low certainty (see top panel, Figure 5). Under high extremity, the reversed two-way interaction between attitudes and attitude certainty emerged, $B = -0.205$, $t(1,257) = -5.762$, $p < .001$, 95% CI [−0.275, −0.135], showing that attitudes were more predictive of intentions for those who had low rather than high certainty (see bottom panel, Figure 5).

Findings

The present research showed that attitudes toward a particular scientific topic (climate change), science in general, and scientists themselves generally were associated with attitude-consistent action to defend science even when aggressive (Hypothesis 1). More importantly, this research showed that extremity—whether manipulated or measured—moderated the effects of attitude certainty on ABC in the scientific domain (Hypothesis 2; see Table 1). For the low-extremity actions and conditions (e.g., peaceful actions to defend science), greater attitude certainty was related to stronger ABC (Hypothesis 3), consistent with established attitude strength research (Briñol & Petty, 2022; Rucker et al., 2014). However, under high-extremity actions and conditions (e.g., violent behaviors to defend science), being more uncertain (rather than certain) about one's scientific attitudes was associated with a greater ABC (Hypothesis 4), a pattern consistent with compensatory conviction models (Cheatham & Tormala, 2017; McGregor et al., 2001, 2010), and recent findings by Siev et al. (2023) in the context of COVID-19 behaviors. In other words, individuals less certain about their pro-science attitudes were paradoxically more willing to endorse or more willing to engage in extreme, aggressive actions (i.e., defend science violently, suffer psychological pain, and fight for science). These effects were robust across different scientific topics, aggressive measures, and methodological approaches, providing convergent evidence for a novel and perhaps counterintuitive pattern: that attitudinal uncertainty can fuel violent or extreme pro-science behaviors.

The present study on scientific attitudes contributes to our understanding of attitude certainty, extremism, compensation effects, and violence. These results add to the emerging literature indicating that conditions of uncertainty can sometimes be associated with greater ABC than conditions of certainty (Petty et al., 2023; Sawicki & Wegener, 2018; Siev et al., 2023). Concerning extremism, including the proclivity toward violence, our findings align with compensatory models stating that people can engage in or support extreme compensatory actions to manage uncertainty under various conditions (McGregor et al., 2010). Future research should further investigate this proposed compensatory mechanism and explore additional factors influencing the relationship between scientific attitudes, attitude certainty, and extremity (e.g., psychological threats). Finally, expanding research beyond laboratory settings and incorporating alternative behavioral measures could provide a more comprehensive understanding of these dynamics.

Limitations

The present research has some limitations that should be considered. First, although our sample includes participants from two different countries and linguistic backgrounds, a broader range of cultures would increase the generalizability of our findings. Second, our studies include both quasi-experimental and correlational designs; therefore, while some results allow for stronger causal inferences, others are limited to associations. Third, the observed effect sizes in this research were modest. Nonetheless, our samples' sizes provided robust statistical power, and the inclusion of diverse linguistic groups and quasi-experimental methods contributes valuable evidence to address our research question.

Future Research Directions

Across three studies employing different methods, we provided consistent evidence that extremity moderates the role of attitude certainty in attitude–behavior correspondence. In nonextreme situations, higher certainty enhanced ABC, but for more violent and extreme behaviors or situations, lower certainty enhanced ABC.

Table 1

Summary of the Interactions Found in Studies 1, 2, and 3 and the Collapsed Data Set

Variable	*B*	*t*	*p*	95% CI	
Study 1 ($n = 342$)					
Attitudes × Certainty × Extremity	−.205	−3.274	.001	−.327	−.082
Low Extremity: Attitudes × Certainty	.118	1.947	.052	−.001	.237
High Extremity: Attitudes × Certainty	−.087	−1.941	.053	−.175	.001
Study 2 ($n = 286$)					
Attitudes × Certainty × Extremity	−.078	−2.692	.008	−.216	−.032
Low Extremity: Attitudes × Certainty	.075	1.894	.059	−.003	.154
High Extremity: Attitudes × Certainty	−.081	−1.915	.057	−.165	.002
Study 3 ($n = 295$)					
Attitudes × Certainty × Extremity	−.083	−2.712	.007	−.143	−.023
Low Extremity: Attitudes × Certainty	.227	2.258	.025	.029	.425
High Extremity: Attitudes × Certainty	−.114	−1.267	.206	−.291	.063
Collapsed data set ($n = 923$)					
Attitudes × Certainty × Extremity	−.159	−6.246	<.001	−.210	−.109
Low Extremity: Attitudes × Certainty	.113	2.983	.003	.039	.187
High Extremity: Attitudes × Certainty	−.205	−5.762	<.001	−.275	−.135

Note. CI = confidence interval.

Although this pattern of results is very clear, an important question for future research remains: What does it take to shift from a low to a high-extremity situation? Although our discrete extremity conditions were successful in varying extremity and have high face validity (e.g., violently protesting to support science is clearly more extreme than peacefully protesting), one can ask where along that continuum does the certainty pattern shift from the standard one to the compensatory outcome? And is the shift gradual along the extremity continuum, or is there some threshold after which a behavior or a situation is considered extreme? The current research cannot address this question as only two levels of extremity were examined in the studies that manipulated extremity. In the study that measured extremity, the highest level measured was not sufficient to produce the compensatory pattern. Thus, this is an important question for future research. Nonetheless, the current research is very clear that at some point along this continuum, perceptions of the situation become extreme enough to reverse the role of attitude certainty in attitude–behavior correspondence.

Prevention and Policy Implications

These findings have potential implications, not only for attitudes toward science and scientists but also for movements surrounding controversial scientific issues—such as climate change and possible others including vaccine mandates, artificial intelligence, nuclear energy, space exploration, and genetic engineering—where public tensions can run high. For instance, consider a scenario wherein misinformation about climate science is spreading rapidly. Some individuals, particularly those who are unsure of their attitudes but generally lean pro-science, may respond with aggressive online behavior, harassment of skeptics, or support for violent protest tactics. This insight suggests that attitudinal uncertainty, rather than certainty, can fuel extreme or aggressive actions in defense of science under certain conditions. Moreover, for nonviolent actions, those individuals uncertain of their attitudes would be less inclined to support science. As such, designing messages and interventions that reduce uncertainty has practical relevance for both reducing extreme or aggressive actions and enhancing those when they are nonviolent. Therefore, outreach programs can focus on building certainty rather than simply boosting support for science while trying to avoid scenarios in which positive attitudes are held with threatening uncertainty.

Conclusions

Taken together, these findings provide evidence that extremity moderates the impact of attitude certainty in attitude–behavior correspondence in the domain of science. While traditional attitude strength principles hold for moderate behaviors and situations—where certainty enhances attitude–behavior correspondence—this pattern changes (even reverses) in extreme contexts, where it is uncertainty (rather than certainty) that drives greater association between attitudes and aggressive actions. This reversal, grounded in compensatory conviction theories, shows that those who doubt their pro-science attitudes may be the most prone to extreme defensive behaviors. As scientific issues continue to polarize public discourse and inspire both peaceful and violent responses, understanding these psychological dynamics becomes essential. Recognizing that uncertainty can fuel extremism offers new pathways for interventions aimed at promoting constructive science advocacy while mitigating violent or aggressive responses.

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