# Denialism as Applied Skepticism:
## Philosophical and Empirical Considerations

The active denial of messages concerning scientific consensus (and other good candidates for facts) has many sources and motivations. But it tends to have a consistent rhetorical effect: suspension of belief or outright rejection of these messages. Denialism can thus be compared to philosophical skepticism. We offer a basic framework for doing so and present a pair of empirical studies concerning the psychological effectiveness of these different skeptical strategies.

### 1. Denialism as a Social Problem

It is well known that many people feel empowered to reject evidence and expert testimony on a great number of issues. Such denials range from the absurd and trivial (that the earth is flat) to the nuanced and dangerous (that the risks of climate change have been fabricated). Denial can be "active" or "passive" (Cohen 2001), recognized by the denier as at odds with the evidence or not. It can be inwardly directed (as in the case of self-deception or *akrasia*) or discursive, as when paid spokespeople question the science of nicotine addiction (Michaels 2008). It can be motivated in various ways — either by material reward or recognition (Dunlap and McCright 2011; Oreskes and Conway 2010a) or more subtly by allegiance to one's ideological tribe, emotion, or values (Kahan *et al.* 2011; Markowitz and Shariff 2012; Norgaard 2011).[1]

When denial has an aim (explicit or implicit), this can likewise range widely. In the social epistemic context, however, a typical aim is suspension (or suppression) of belief on some question in others. It has been well documented that the denial of the dangers of cigarette smoke was intended primarily to forestall regulatory action by seeding doubt on the relevant science (though the science was well in hand). This strategy relies on an advantageous epistemic asymmetry: proponents of an issue are playing for the win; denialists are playing for the tie. Even if the aim is not the suppression of belief, that is often its effect. Denialism in this context thus operates as a form of applied skepticism.

Seen in this light, it is surprising that philosophers — particularly those interested in social epistemology — have devoted little attention to denialism (cf. Torcello 2016). At best, this represents a missed opportunity to engage with a pressing social issue. If denialism suppresses belief from where it ought to be (given our best evidence) and if this suppressed belief causes harm, then denialism causes harm. We submit that both of these "if"-clauses are pretty clearly true in general. Concerning harm, we need only reflect on the efforts of the tobacco industry and the HIV–AIDS denialism of Thabo Mbecki (Kalichman 2009) to recognize that almost certainly denialism has cost

[1] It's worth noting that while there are some natural packages of these qualities (e.g., that paid denialists will often be "active" denialists in the sense of Cohen — i.e., that they know that what they profess is incorrect or misleading), it is possible for all of these parameters to vary independently from one another.

lives. It is poised to continue to do so in the context of climate change and the question of the safety of childhood childhood vaccines as well. Concerning belief-suppression, psychologists have accumulated both direct and indirect evidence that denial campaigns have paid dividends (Leiserowitz *et al.* 2013; McCright *et al.* 2016; van der Linden *et al.* 2017). Given what is at stake, a pressing question for researchers in science education and communication (among other fields) is how we might "inoculate" the laity from the skepticism promoted by motivated denialists.

What insights can philosophers offer to address this problem? Several reasonable answers to this question are possible, including articulating clearer grounds for why the scientific consensus about, say, climate change ought to be taken seriously, equipping people to recognize the psychological dispositions that impair their sensitivity to relevant evidence (including the testimony of experts), and so on. We believe that one intriguing avenue worth exploring is anti-skepticism. While in the abstract, debates between skepticism and anti-skepticism may seem a paradigm instance of philosophy as a pointless "sentimental indulgence for the few" (Kitcher 2011, 254), they may take on renewed importance if applied to the problem of denialism.

But as with medical research, in order to make progress on a cure, we need a grasp of the disease. This is our focus on this essay. If we think of effective denialism as applied skepticism, what kind of skepticism should we think of it as? Are the strategies Cartesian or Pyrrhonian in character? What denialist challenges prove to be most effective at suppressing belief? What features are most important? Form? Content? Quantity? Answering these and related questions will be important first steps for applying insights of *anti-skepticism* in psychologically-relevant ways to the problem of denialism.

This paper is structured as follows: in the next section (§2), we distinguish between a few basic varieties of denialist challenge to different traditions of skepticism. In §§3–4, we describe two empirical studies in which we test the efficacy of different styles of denialist challenge for suppressing belief. Our results suggest that what we think of as disagreement-oriented skeptical model is more effective. We discuss the implications of this result for anti-skeptical communication/education in the final section (§5).

## 2. Denialism as Applied Philosophical Skepticism

Like "denial," "skepticism" admits of different interpretations. Individuals and groups we've called "denialists" often refer to themselves as climate change "skeptics" — highlighting their putatively positive epistemic role as counterweights to what they see as a dogmatic scientific community. Science enthusiasts are understandably reluctant to grant them this label, holding that the sort of institutional skepticism we see in science is something importantly different (Merton 1942). The skepticism promoted by denialists, for example, may be disingenuous or ideologically-motivated; Torcello (2016) labels it as "pseudoskepticism". Denialism may not be *responsible* or honestly-

motivated skepticism,[2] but given its psychological effects, it seems reasonable for anti-skeptics to treat it as skepticism nonetheless.

Consider first the comparison with Cartesian skepticism. The Cartesian skeptic asks an apparently simple question: *Can you be sure that you're not dreaming right now?* Or possibly: *Might you not be in the Matrix? Do you, in general, have any way of ruling out the possibility that you are massively deceived right now?* Such questions, of course, are supposed by the skeptic to lack good, non-question-begging answers. And if you cannot rule out that the proffered skeptical scenario is true — even if it seems absurdly unlikely — then you cannot rightly claim to know anything that such a massive deception would undermine. Something similar is apparently going on when climate change or AIDS contrarians pointedly ask whether you can be sure that everything you think you know about climate change or the HIV–AIDS link isn't in fact misinformation spread by a powerful conspiracy. Most of us have little direct, first-person acquaintance with the relevant evidence; we are almost entirely dependent on the say so of third parties. But if we cannot answer this general question about our ability to rule out the possibility of conspiracy, then how can we claim to know — and shouldn't we reduce our confidence in — the propositions we claim to know?

Notice that in this case, the skeptic need not actually *assert* that the skeptical scenario — the conspiracy, or whatever it is — actually is the case. They merely need to raise the possibility in a way that makes it salient. To many, simply opening the question suffices to achieve the skeptical outcome. This can be observed in a philosophically and scientifically ham-fisted (yet often apparently effective) way in the context of public debate over matters that *admit* of any uncertainty. Oreskes and Conway point out in a (2010b) editorial in *Nature* are perhaps overcareful about acknowledging uncertainties and caveats, "outlining what they don't know before proceeding to what they do — a classic example of what journalists call 'burying the lead'" (687). Having granted *some* possibility that a scientific proposition might be wrong, some are erroneously inclined to think of the situation as an even-odds guess.

Cartesians can press conspiracy theories progressively further, for example by pointing to purported facts that seem anomalous or in conflict with some "official story" as suggestive that a conspiracy is afoot. The "Climategate" incident — the theft and selective quoting of private emails of climate researchers — offered a particularly rich opportunity for casting doubt on the trustworthiness of climate scientists in general. By quoting out of context correspondence between scientists that seemed nefarious to the laity, e.g., concerning the "manipulation of data" (a phrase that can sound sinister out of context), contrarians were able to raise to salience the possibility of a massive, organized deception without presenting any evidence that there was such a thing. The question then becomes *how can we be sure that there's not a massive conspiracy? Don't we need to verify that there is not before we can accept anything they have to say?*[3] This can develop into full-fledged

[2] Neither, of course, need instances of philosophical skepticism be honestly-motivated or responsible!

[3] The "Climategate" case also illustrates a common thread of denialism: despite a thorough and independent review of the stolen material that found no malfeasance (Russell *et al.* 2010), claims about

assertions that the conspiracy theory or skeptical scenario in question is in fact the case. Many well-known denialists of course take this route.

Just as Cartesian skeptics call into question the general reliability of our belief-forming mechanisms, science skeptics might likewise cast doubt on a scientific claim by asserting that science is unable to rise to the level of objectivity or marshall sufficient evidence to speak reliably on a given topic. One can do this by claiming that the specific evidence is by its nature unreliable (or cannot be trusted) or by claiming that the evidence does not exist or is incompatible with other more trustworthy or probative facts. Let us think of these cases as adopting a *general* skeptical strategy, either by raising pointed questions or making stronger assertions concerning the possibility of general scenarios that would tell against a large body of claims.

We can contrast this broadly Cartesian strategy with a *Pyrrhonian* skeptical approach. While Pyrrho (via Sextus-Empiricus 2000) offered some transcendental arguments for skepticism, one of the Pyrrhonian's go-to techniques was to raise *specific challenges*. Fogelin puts the contrast between the general and specific strategies nicely:

> At first glance, Pyrrhonian skepticism may, indeed, seem mild in comparison with various forms of Cartesian skepticism. There is something exhilarating, almost giddy, in the thought that all of our common beliefs about the world might just be false, and Cartesian skeptical scenarios seem to raise just this possibility in a vivid form…. [I]t does not take radical — globally dislocating — scenarios to introduce suspension of belief. It is quite sufficient to note — and dwell on — the fact that our empirical claims are made in the face of unchecked, though checkable, defeators…. Given any empirical assertion, it is always possible — indeed always easy — to point to some uneliminated (though eliminable) possibility that can defeat this claim. Nothing like brains in vats are needed to achieve this purpose. (Fogelin 1994, 192–193)

As before, we can think of the Pyrrhonian challenges as proceeding dialectically either via questions or assertions. For example, leaving the restaurant, you say that your car is parked on 3rd Street. The skeptic challenges: *Are you sure? Do you know, for instance, that it has not been stolen in the past five minutes?* While this question has the same effect as the Cartesian's questions — of course you probably *cannot* rule this possibility out — and so may fail to feel satisfied that you know what you claimed to know, the possibility itself may seem quite a bit more credible. Car theft, after all, is something that occurs.

The Pyrrhonian employs corresponding assertions when they draw on the skeptical modes from disagreement (Sextus-Empiricus 2000, 40–41). If my epistemic peer offers me an argument pointing to a conclusion at odds with my belief — if the considerations are indeed "equipoised" — then it seems that I ought to suspend belief. This simple idea has been much discussed in recent years under

---

scientific fraud continue to circulate in various "echo chambers" (Bernauer 2013; Dunlap and McCright 2011; Leiserowitz *et al.* 2013).

the rubric of the epistemology of disagreement. In his now classic paper, Christensen offered a case that many of us can easily relate to:

> Suppose that five of us go out to dinner. It's time to pay the check, so the question we're interested in is how much we each owe. We can all see the bill total clearly, we all agree to give a 20 percent tip, and we further agree to split the whole cost evenly, not worrying over who asked for imported water, or skipped dessert, or drank more of the wine. I do the math in my head and become highly con dent that our shares are $43 each. Meanwhile, my friend does the math in her head and becomes highly con dent that our shares are $45 each. How should I react, upon learning of her belief?
>
> I think that if we set the case up right, the answer is obvious…. I should lower my confidence that my share is $43 and raise my con dence that it's $45. In fact, I think (though this is perhaps less obvious) that I should now accord these two hypotheses roughly equal credence. (Christensen 2007, 193)

In Christensen's case, it's important that we recognize the disagreeing party as our epistemic peer. We would probably not feel compelled to suspend our belief (or even decrease our confidence) if the disagreement was with an eight year old or our friend who is notoriously bad at math.

Note also that it has a first-person character. Many instances of denialism, however, will be second-person — for example, when an assertion from one apparent authority is countered by a denial from another. The shift from a first-person to second-person context may actually heighten the skeptical impact of this disagreement. A neutral observer of this disagreement may not be well positioned to determine who is a relevant epistemic authority and who is not. Doing so can be difficult enough in non-contentious contexts, but is especially fraught when efforts are taken to artificially build the apparent credibility of one testifier and reduce that of the other (Almassi 2012; Collins and Evans 2007; Goldman 2001). Thus a sort of second-order skepticism can take hold: if I must suspend belief about whether the disagreeing parties are epistemic peers, then there seems to be a good case for taking their disagreement as epistemically significant and requiring that I suspend my belief. A second consequence of the disagreement's being second-person is that the neutral party often will not be in possession of information that might resolve the disagreement.

These effects can also interact: when an apparent expert challenges a generally acknowledged expert by raising a very specific or technical point — which neutral observers may be unable to follow — it may also suggest to the observers that the challenger is a well-informed, epistemic peer of the acknowledged expert.

Worse yet, few of us are actually neutral. When asked to determine whether some person with a certain range of qualifications is a "knowledgeable and trustworthy expert," our answers will often be guided mainly by whether their views fit with our cultural outlooks (Ahola 2016; Kahan 2014; Kahan *et al.* 2011, 167). Denialists adopting this strategy thus both rely on motivated cognition

while simultaneously facilitating its operation by offering skeptics of consensus science a plausible justification for why they ought to suspend their belief.

We could doubtless make other connections and comparisons, but we shall summarize the basic range of skeptical strategies as falling into four rhetorical categories defined by their form and content generality (see Table 1).

**Table 1:** Form and Content in Skeptical Strategies

| | | **Form** | |
|---|---|---|---|
| | | *Question* | *Assertion* |
| **Content** | *General* | Cartesian Skepticism | Assertive Cartesian (Conspiratorial) |
| | *Specific* | Pyrrhonian (Questioning) | Pyrrhonian (Disagreement) |

One potential benefit to seeing denialism as applied skepticism on this model (or any other) is that puts us into a position to bring to bear various anti-skeptical strategies that have been elaborated by philosophers. For example, one might adopt a Moorean response to the denialist who raises very general questions about the reliability of science as a method for making contact with the world (1925/1993, 1939/1993); or one might employ Austin's ordinary language approach to the specific question strategy (1946/1979).

Consider the latter for a moment as an example. Suppose that John makes a specific claim to knowledge — that there's a goldfinch in the garden, say — and you ask him, pointedly "How do you know?" or "Are you sure it's not a goldcrest?" Austin rightly points out that there are a number of specific questions you may have in mind; more importantly, he argues that there had better be something *behind* your question if John is to take it seriously. If John answers that he knows from the markings and you persist by saying "That's not enough," Austin thinks that something untoward is going on: "you must have in mind some more or less definite lack. 'To be a goldfinch, besides having a red head it must also have the characteristic eye-markings' [and so on] . . . If there is no definitely lack which you are at least prepared to specify on being pressed, then it's silly (outrageous) just to go on saying 'That's not enough'" (1946/1979, 84). This point can be neatly connected to Torcello's (2016) contention that denialism is "pseudoskepticism" in light of its unwholesome motivations (in contrast to those motivating a general methodological skepticism familiar in science).

The common thread here is that certain skeptical challenges are legitimately rebuffed or ignored on the basis of their origin (if, for example, they are disingenuous or better characterized as expressions of ideology rather than evidence).[4]

This is not meant as a defense of Austin's normative point.[5] But assuming that it is sound, it suggests an avenue of response to denialists that adopt a certain range of skeptical strategies. There would still remain a *psychological* question of whether the proffered response would be generally effective in turning away a denialist challenge. But before researchers address this question, it is worth knowing which of the four broad classes of skeptical strategies are psychologically more effective at instilling doubt. As noted above, we have evidence that denialism is generally effective: but *what kind* of denialist challenges deserve our attention as the most effective is so far unclear. Thus we turn to two empirical studies we conducted to answer this question.

## 3. The Studies

Here is a more precise statement of our initial research question (discussed in §3.1): given the communication of a relatively simple scientific idea, which of our four-fold content–form typology of skeptical challenges (general assertion, general question, specific assertion, specific question) are most effective at suppressing subjects' acceptance of the communicated idea? Of course, there are a number of further dimensions we could have considered (in addition to form and content). Anderson *et al.* (2014), for example, studied the effect of "tone" in online communication milleius. One could also examine a more subject-specific schema, identifying certain patterns or talking points that are familiar in the context of a particular subject (such as climate change or vaccine safety). We opted for our simple four category typology in part because of its loose mapping to broad traditions of philosophical skepticism as described above.

Our second research question (discussed in §3.2) is whether skeptical challenges exhibit a "dose-response" effect — do *more* challenges lead to greater suppressions of belief?

In this set of studies, we chose a subject matter paralleling cases where denialist efforts have been prominent — in three senses: (1) an issue on which science is primarily relevant (as opposed to, say, a question of policy); (2) for which a strong scientific consensus has emerged; and (3) a matter that concerns *risk*. However, we also sought to focus on a case that would differ from prominent instances in being (so far) relatively non-politically- or ideologically-entangled and about which many people are largely ignorant. Preliminary testing indicated that the risks of the Zika virus would fit this profile. This topic is not ideologically entangled (a finding confirmed by our results), but has suffered from some misunderstanding in the public — in particular, confusion about the ways in

[4] Similar points can be made in the context of the voluminous literature on the epistemology of disagreement concerning the circumstances in which conciliation or steadfastness is more appropriate reaction to epistemic challenge (see e.g., Lackey 2010).

[5] It is an interesting question whether Austin's anti-skeptical strategy might be applied to the kinds of skeptical challenges that we have suggested are characteristic of the Pyrrhonians.

which the virus is spread, the link between Zika and the birth defect Microcephaly, and the severity of the disease for those who contract it have been documented (HORP 2016).

### *3.1. Four Modes of Denialist Challenge (Study 1)*

Methods

*Participants*

Study 1 employed a sample of 800 participants from the American population with a completion rate of 94 percent (final sample size n = 758). The embedded experiment was conducted online using Qualtrics survey software and the sample was collected using Amazon Mechanical Turk. Participants were compensated 50 cents for completion of the survey.

*Experimental Design*

Participants were asked to take part in a study on the communication of scientific theories. The between subjects experiment began with a short expository paragraph detailing the leading theory concerning transmission and risks of the Zika virus (see online Supporting Material). After reading the expository paragraph, participants were asked to rate their degree of *belief* in three statements related to the description of the theory. *Belief* ratings ranged from zero (completely disagree) to 100 (completely agree). The belief statements were as follows:

1. The Zika virus can be spread through sexual transmission.
2. The greatest risk from the Zika virus is to pregnant women and their babies.
3. Microcephaly is a condition in which a baby's head is much smaller than expected.

All participants were told that the piece they had just read appeared in a popular science magazine. Participants then received either a denialist challenge from one of four challenge categories, or a control statement. The four challenge categories were designed to test the effects of content (general or specific) and form (question or assertion) (Table 2). The challenges were presented as public comments to the Zika theory piece. All participants were then retested on the same three belief statements, again selecting a *belief* rating between 0 and 100.

**Table 2:** Denialist challenges used in Study 1

| | | **Form** | |
|---|---|---|---|
| | | *Question* | *Assertion* |
| **Content** | *General* | Do scientists really have enough evidence to support these theories? | Scientists don't have enough evidence to support these theories! |
| | *Specific* | Can't you only get Zika through a mosquito bite? | You can only get Zika through a mosquito bite! |

After completion of the embedded experiment, participants were debriefed and offered the option to exclude their results from the study. This exclusion, and that of participants who did not fully complete the study, resulted in a final sample size of n = 758.

*Measurement*

The effectiveness of the denialist challenge statements was determined by the overall change in total belief scores. Participants scores on the three belief statements were totaled to create a *pre-belief* score out of 300, and a *post-belief* score out of 300. The difference between these scores (post-belief minus pre-belief) was the dependent variable of *belief change*. Therefore, a negative difference between pre-challenge total belief score and post-challenge total belief score would constitute an effective denialist challenge.

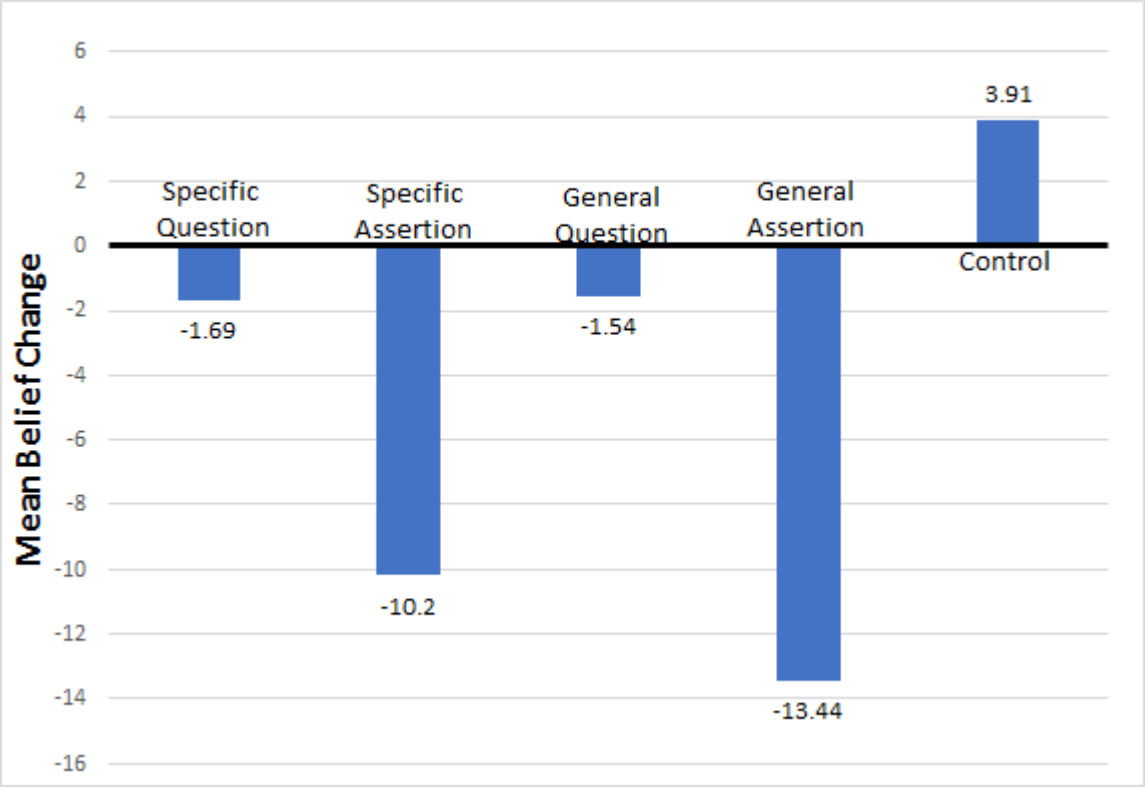
Demographic variables included were Age (M = 37, SD = 12.3), gender (50.3% female), level of education (49.5% with bachelor's degree or higher), income (M = $50,000), race (83.2% white), and political party affiliation (42% democrat). The results of all demographic measurements can be seen in the Supporting Material. In addition to these demographics, participants were asked to respond to two value predispositions. Religiosity was measured by asking "How important is religion in your life?" Responses were recorded on a 5 point scale with 1 = "Not at all important" and 5 = "Extremely important" (M = 2.36, SD = 1.49). Trust in science was measured by asking "How much would you say you trust in the findings of science?" with 1 = "Not at all" and 5 = "A great deal" (M = 4.11, SD = .855).

Results and Analysis

A paired samples t-test revealed that, overall, participants presented with the challenges had a small but statistically-significantly reduced *post-belief* score (M = 259.99, SD = 53.26) as compared to their *pre-belief* score (M = 266.73, SD = 47.40); t(605) = -5.76, $p$ = .000[6]. A one-way between subjects ANOVA for *belief change* (*post-belief* minus *pre-belief*) showed a significant difference between the five treatment groups F(4,753) = 10.26, $p$ = .000. Mean *belief change* for each of the treatment groups can be seen in Figure 1, below. Post hoc analysis using Tukey's HSD indicated that the "Specific Assertion" condition (M = -10.20, SD = 25.03) and the "General Assertion" condition (M=-13.44, SD=40.58) both produced significantly more change in belief than the control (M=3.91, SD=21.99). Neither the "Specific Question" condition (M = -1.69, SD = 23.84) nor the "General Question" condition (M = -1.54, SD = 19.16) were significantly different from the control. Those in the "Specific Assertion" condition were also shown to have a significantly greater change of belief than those in the "General Question" condition, and the"General Assertion" condition participants had a significantly greater change in belief than those in the both the "General Question" and "Specific Question" conditions. In Figure 1 you can also see that those in the control condition showed an increase in belief. This is expected as an exposure-effect, as subjects saw the same group of belief questions twice.

[6] The final belief statement was not directly targeted by any of the denialist challenge statements that followed to test the effect denialism might have on a challenge-irrelevant belief. Paired samples t-tests for each of the belief statements individually showed that *post belief* did not lower as significantly ((M=-1.02, SD = 12.04); t(605) = -2.10, $p$ = .032) for the third belief statement as it did for each of the first ((M = -3.81, SD = 17.61); t(605) = -5.32, $p$ = .000), and second statements ((M = -1.91, SD = 10.41); t(605) = -4.52, $p$ = .000). This result indicates that participants were sensitive to the content of the belief statements and the denialist challenges.

**Figure 1:** Mean Belief Change for Treatment Groups in Study 1




To more explicitly test the effects of form versus content, we recoded the results to create groups based solely on these variables. A one-way between subjects ANOVA comparing *belief change* between all those participants receiving a "general" denialist prompt, all participants receiving a "specific" denialist prompt, and the control group revealed a significant difference between groups $F(2,755) = 9.32$, $p=.000$. Post hoc analysis with Tukey's HSD showed that both "specific" ($M = -5.94$, $SD = 24.77$) and "general" ($M = -7.53$, $SD = 32.30$) prompt groups changed their belief significantly compared to the control group. Both types of content were, therefore, similarly effective.

In contrast, post-hoc analysis of the significant one-way between subjects ANOVA comparing belief change between the "question," "assertion," and control groups ($F(2,755) = 20.03$, $p = .000$) revealed that only the "assertion" group ($M = -11.83$, $SD = 33.75$) was significantly different from the control, while the "question" group ($M = -1.62$, $SD = 21.59$) was not.

For all participants receiving denialist prompts, no correlations were found between belief change and religiosity, and no significant differences were found for political party affiliation. A significant relationship was found between trust in science and pre-belief, $r = .279$, and belief change, $r = .159$, (both $ps < .000$)

Discussion

The correlation between trust in science, pre-belief, and belief change indicate that, as expected, the more trust one has in science, the more inclined they are to accept messages presented as scientific conclusions and to retain these beliefs in the face of denialist challenge. The results of Study 1 indicate that denialist prompts worded as assertions rather than as questions are more effective at lowering belief in a non-ideologically entangled scientific claim. Although the general and specific assertions targeted different aspects of the scientific theory, they were still more effective at lowering belief than the specific and general questions. Statistical analysis of the difference in mean belief change between treatment groups, and those examining the differences in forms versus the effects of content support lead to a consistent finding. At least in the case of the Zika virus, form has a much more important influence on the effectiveness of denialist claims than the specificity (or lack thereof) of the content. This suggests that whether denialists formulate their skeptical challenges in grand, Cartesian generalities or Pyrrhonian specifics, they are well-advised to do so in the stronger, assertive forms. Skeptical efficacy thus seems to cut across skeptical traditions. Our results do not point to a specific psychological/philosophical explanation for this effect, but a natural hypothesis might run as follows: questions are more easily dismissed in Austinian fashion as unmotivated than are counter-assertions. Compare two versions of Christensen's dinner check-splitting example: in the original version, when your friend arrives at a different conclusion than you do it seems quite natural to suspend (or lower) your belief that you are correct; but if your friend merely asked you "Are you sure that it's that much?" it seems both normatively and psychologically plausible to remain steadfast, replying "Yes, I just did the calculation. Do you have some reason for thinking I'm wrong?"

### *3.2. Dose-Response and Interaction Effects (Study 2)*

Our second study built on the results of Study 1 by dropping our attention to the efficacy of question challenges. Our aim in this case was to (a) replicate our initial observation that counter-assertion was effective in suppressing belief in large demographically-representative sample, and (b) determine whether this suppression exhibited a dose-response effect.

Methods

*Participants*

Study 2 employed a nationally-representative sample of 1802 participants from the American population (collected by Research Now) with a completion rate of 83 percent. The embedded experiment was conducted online using Qualtrics survey software and participants were compensated $2.50 in e-rewards currency.

*Experimental Design*

As in Study 1, participants were asked to take part in a study on the communication of scientific theories. The between subjects experiment began with the same short expository paragraph detailing the leading theories of the Zika virus (see Supporting Material). After reading the expository paragraph, participants were asked to rate their degree of *belief* in the same three statements used in Study 1, with ratings again ranging from zero (completely disagree) to 100 (completely agree). Study 2 participants then received either one denialist challenge, three denialist challenges, or a control statement.

Given the results of Study 1, three specific assertions and three general assertions were used as challenges in Study 2 (Table 3). The specific assertions included the one used in Study 1, as well as two designed to target common misconceptions about Zika (HORP 2016). The general statements included the same general assertion used in Study 1, and two general statements that could be applied to any scientific theory about which members of the public might perceive risk.

Participants receiving one challenge (Dose 1 group) were randomly assigned one of the six challenges. Participants receiving three challenges (Dose 3 group) were assigned a random combination of 3. All possible combinations of challenges yielded 20 "treatment sets" (as we shall call them) and one control group. The challenges were again presented as public comments to the Zika theory piece, which the all participants were told had appeared in a popular science magazine. All participants were then retested on the same three belief statements, again selecting a belief rating between 0 and 100.

**Table 3:** Denialist Challenges for Study 2

| | |
|---|---|
| Specific | S1. You can only get Zika through a mosquito bite! |
| | S2. Zika symptoms aren't mild at all; they're life-threatening! |
| | S3. There's no link between Microcephaly and Zika! |
| General | G1. There isn't enough evidence to support this theory! |
| | G2. Alarmists are exaggerating this so-called "problem"! |
| | G3. There's no scientific consensus about this theory! |

*Measurement*

The effectiveness of the denialist challenge statements was determined by the overall change in total belief scores in the same way as was calculated in Study 1. Participants scores on the three belief statements were totaled to create a *pre-belief* score out of 300, and a *post-belief* score out of 300. The

difference between these scores (*post-belief* minus *pre-belief*) was the dependent variable of *belief change*.

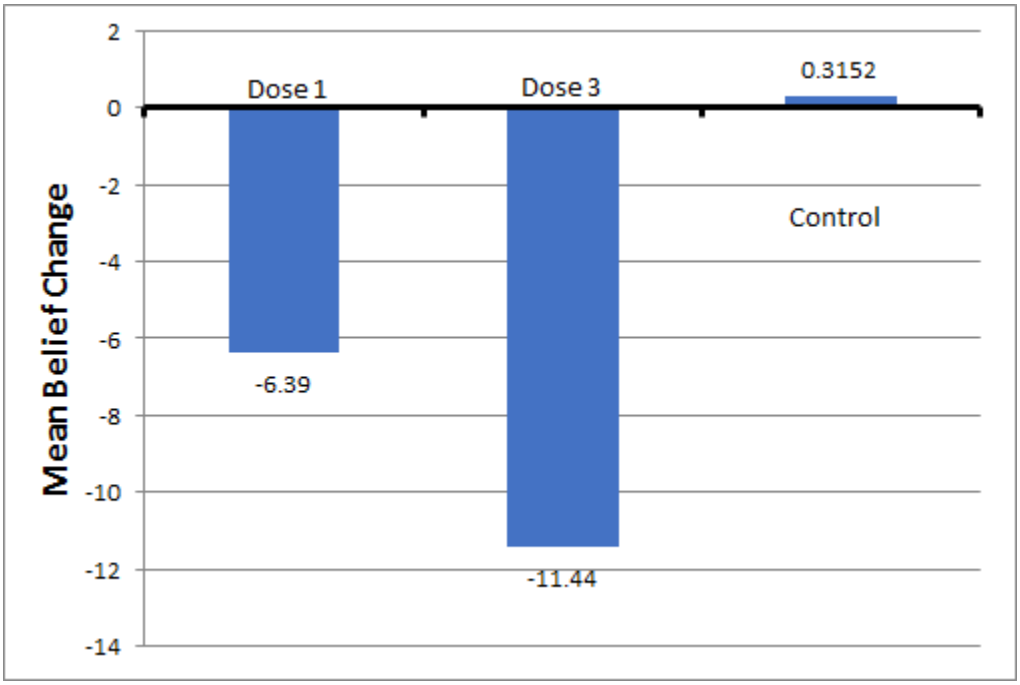
Demographic variables included were Age (M = 50.64 , SD = 14.55), gender (57.3% female), level of education (51.6% with bachelor's degree or higher), income (M = $60,000), race (87.4% white), and political party affiliation (34.2% democrat). The results of all demographic measurements can be seen in the Supporting Material to this article. The two value predispositions, Religiosity (M = 3.03, SD = 1.45) and trust in science (M = 4.02, SD = .865), were measured with the same variables as Study 1.

Results and Analysis

As before, a paired samples t-test revealed that all participants presented with denialist challenges had a statistically-significantly reduced *post-belief* score (M = 240.08, SD = 64.85) as compared to their *pre-belief* score (M = 248.97, SD = 54.42); t(1617) = -9.09, $p$ = .000[7]. A one-way between subjects ANOVA for *belief change* showed a significant difference between the three Dose groups F(2,1799) = 8.18, $p$ = .000. We chose Hochberg's GT2 for post hoc analysis as there was a great deal of variability in group size. These analyses revealed that those participants in the Dose 3 group (M = -11.44 SD = 43.48) lowered their *belief* significantly more than those in the Dose 1 group (M = -6.39 SD = 43.48) and those in the control group (M = .3152 SD = 31.49) (Figure 2).

[7] As in Study 1, belief did not lower as much for the third, challenge-irrelevant statement (M = -2.00, SD = 17.14) as for the first two statements (M = -4.21, SD = 20.10, and M = -2.72, SD = 16.36, respectively) but paired samples t-tests for all three statements showed a significant change between post-belief and pre-belief (all *ps* < .000).

**Figure 2:** Mean Belief Change across Dose Groups in Study 2




Beyond the three Dose groups, we sought to identify which particular denialist statements, or sets of denialist statements, were most effective at lowering belief. A one-way between subjects ANOVA for *belief change* showed a significant difference between the 21 Sets. Post hoc analyses with Hochberg's GT2 showed that only one of the sets of three statements (S3,G1,G3) significantly lowered belief compared to the control (See Table 4). Given the difference in sample sizes between the Dose 1 Sets and the Dose 3 Sets, ANOVAs (both significant) for *belief change* were run for all Dose 1 sets together ($F(6,996) = 5.49$, $p = .000$) and all Dose 3 sets together ($F(20,962) = 2.31$, $p = .001$). Post hoc analyses were performed using Gabriel's PCT, as the group sizes were only slightly unequal. Table 4 below shows the means and standard deviations of all of the sets. Significance level (as compared to the control) is indicated with asterisks. In these analyses, Statement 1 from the Dose 1 Set significantly lowered belief compared to the control.

**Table 4:** Mean and Standard Deviation for *belief change* by Statement Set (negative values represent decreases from pre-belief to post-belief)

| | Statement Sets | N | Mean | Std. Deviation |
|---|---|---|---|---|
| | Control | 184 | .32 | 31.49 |
| Dose 1 Sets | S1 | 143 | -15.80* | 45.98 |
| | S2 | 137 | 1.56 | 25.27 |
| | S3 | 130 | -6.71 | 32.42 |
| | G1 | 137 | -6.93 | 39.42 |
| | G2 | 135 | .71 | 20.57 |
| | G3 | 137 | -10.69 | 34.35 |
| Dose 3 Sets | S1,S2,G1 | 48 | -8.50 | 37.35 |
| | S1,S2,S3 | 41 | -23.22 | 57.10 |
| | S1,S3,G1 | 42 | -19.64 | 61.34 |
| | S1,S2,G2 | 35 | -2.43 | 39.96 |
| | S1,S3,G1 | 48 | -18.13 | 59.47 |
| | S1,S3,G2 | 34 | -13.26 | 40.19 |
| | S1,S2,G3 | 37 | -14.27 | 36.09 |
| | S2,S3,G2 | 38 | -6.08 | 31.37 |
| | S1,S3,G3 | 49 | -17.10 | 40.14 |
| | S1,G1,G2 | 52 | -14.79 | 53.13 |
| | S2,S3,G3 | 34 | -6.68 | 44.56 |
| | S2,G1,G2 | 38 | -1.63 | 26.63 |
| | S1,G1,G3 | 36 | -7.61 | 31.64 |
| | S3,G1,G2 | 39 | -18.36 | 41.46 |
| | S2,G1,G3 | 40 | 5.28 | 28.51 |
| | S1,G2,.G3 | 34 | -7.32 | 27.93 |
| | S3,G1,G3 | 49 | -28.63* | 65.48 |
| | S2,G2,G3 | 30 | .73 | 32.59 |
| | S3,G2,G3 | 36 | -10.22 | 26.64 |
| | G1,G2,G3 | 39 | -3.03 | 17.00 |

*indicates mean is significantly different from the control at the .001 level

For those participants who received denialist challenges, *belief change* was slightly related to religiosity, $r = -.049$, $p = .04$ (this negative correlation indicates that as religiosity goes up, people are more likely to lower belief) and more strongly related to *trust in science,* $r = .091$, $p = .000$ (as trust in science increases, people are less likely to lower belief). Trust in science is also significantly related to pre-belief, $r = .324$, $p = .000$. Again no significant differences were found for *political party affiliation*.

Discussion

The results of Study 2 support the idea of a "dose-effect," in which increasing the number of denialist challenges to which a participant is exposed causes them to further lower their belief. Some of the sets contained statements that contradicted one another, but it appears that the dose-effect was strong enough to counter any effect these contradictions might have had. For example, two of the general statements, G2 and G3, could be seen as contradictory to S2. As Table 3 shows, some groups with contradictory statements barely lowered belief, or in some cases actually raised belief, possibly as a response to perceived absurdity in the contradiction. Nevertheless, the strength of the dose-effect was enough to outweigh these responses on balance.

Further analysis revealed that one specific statement was more effective compared to the others in the single statement Dose group. One possible explanation for the statement's relative effectiveness is that S1 ("You can only get Zika through a mosquito bite!") may play into the most common misconception held by the public about Zika (HORP 2016). One combination of statements, (S1,G1,G3), was most effective at lowering belief. This combination includes the most effective single statement, and two general statements challenging the existence of a scientific consensus and sufficient evidence. Given that few other patterns can be seen in the effectiveness of other sets at lowering belief, it remains unclear what exactly about this combination was so compelling.

In this larger sample size, participants were slightly more likely to lower belief if they indicated that religion was more important to them. This relationship was small but significant. As in Study 1, as participants' trust in science increased, they were less likely to lower belief in response to denialist claims.

## 4. Conclusion & Next Steps

While we saw in Study 1 that skeptical challenges that had the form of assertions were more potent in suppressing belief than the question equivalents, Study 2 shows that — at least in the present context — content matters. Subject to this caveat, so does "dose": in general, the more skeptical challenges one faces, the more one tends to lower their belief. This is reflected in the results of McCright *et al.* (2016) that confirm the efficacy of messaging that incorporates a number of distinct denials at various levels of specificity.

This suggests that our research focus in pursuing strategies for forestalling denialism's effects ought to focus in the first instance on the more "disagreement-focused" analysis of denialism. Are there ways in which members of the public can be "inoculated" from this form of denial in initial communication and education efforts? Are there ways in which the skeptical effects of counter-messaging can be reversed after the fact — e.g., by getting subjects to recognize counter-messaging that is motivated by ideology or material gain (Christensen 2014)? There are clearly rich opportunities for philosophical–psychological collaboration on such projects. Philosophical accounts of the normative appropriateness of steadfastness might be used to guide further psychological experiments to determine whether we may apply such norms in real world contexts.[8]

It of course is an open question at this point whether our results generalize to other cases. As discussed, we intentionally chose a case that showed little interaction with political or religious ideology in order to focus on the epistemic phenomena. This may provide insight into prospective use of denialist skeptical strategies but interactions with ideology will presumably complicate matters in cases about which there is already significant denialist noise. But how exactly this works and how it can be combatted are important questions that deserve philosophers' and psychologists' attention.

## REFERENCES


Ahola, Salla (2016) "Why (Not) Disagree? Human Values and the Readiness to Question Experts' Views," *Public Understanding of Science* DOI: 10.1177/0963662516637818 (Online First).

Almassi, Ben (2012) "Climate Change, Epistemic Trust, and Expert Trustworthiness," *Ethics & the Environment* 17 (2):29–49.

Anderson, Ashley A., Dominique Brossard, Dietram A. Scheufele, Michael A. Xenos, and Peter Ladwig (2014) "The "Nasty Effect:" Online Incivility and Risk Perceptions of Emerging Technologies," *Journal of Computer-Mediated Communication* 19 (3):373–387.

Austin, J.L. (1946/1979) "Other Minds", reprinted in his *Philosophical Papers*. Oxford: Oxford University Press.

Bernauer, Thomas (2013) "Climate Change Politics," *Annual Review of Political Science* 16:421–448.

Christensen, David (2007) "Epistemology of Disagreement: The Good News," *Philosophical Review* 116 (2):187–217.

Christensen, David (2014) "Disagreement and Public Controversy," in Jennifer Lackey (ed.), *Essays in Collective Epistemology*. New York: Oxford University Press.

Cohen, Stanley (2001) *States of Denial: Knowing About Atrocities and Suffering*. Cambridge: Polity Publishers.

Collins, Harry, and Robert Evans (2007) *Rethinking Expertise*. Chicago: University of Chicago Press.

Dunlap, Riley E., and Aaron M. McCright (2011) "Organized Climate Change Denial," in John S. Dryzek, Richard B. Norgaard and David Schlosberg (eds.), *The Oxford Handbook of Climate Change and Society*. Oxford: Oxford University Press.


[8] We draw no conclusions from our results concerning the normative or philosophical significance of the different models of skepticism (as compared with, e.g., Nichols *et al.* 2012), being persuaded by Hannon's (2017) critique of this argument.

Fogelin, Robert J. (1994) *Pyrrhonian Reflections on Knowledge and Justification*. New York: Oxford University Press.
Goldman, Alvin (2001) "Experts: Which Ones Should You Trust?," *Philosophy and Phenomenological Research* LXIII (1):85–110.
Hannon, Michael (2017) "Skepticism about Meta-Skepticism: Meditations on Experimental Philosophy," *Episteme* 14 (2):213–231.
HORP (2016) "Public Views of the Zika Virus Outbreak Topline Data", in, Harvard T. H. Chan School of Public Health: Harvard Opinion Research Program
Kahan, Dan M. (2014) "Making Climate-Science Communication Evidence-Based — All the Way Down," in Deserai A. Crow and Maxwell T. Boykoff (eds.), *Culture, Politics and Climate Change: How Information Shapes our Common Future*. Abingdon: Routledge, 203–220.
Kahan, Dan M., Hank Jenkins-Smith, and Donald Braman (2011) "Cultural Cognition of Scientific Consensus," *Journal of Risk Research* 14 (2):147–174.
Kalichman, Seth C. (2009) *Denying AIDS: Conspiracy Theories, Pseudoscience, and Human Tragedy*. New York: Copernicus Books.
Kitcher, Philip (2011) "Philosophy Inside Out," *Metaphilosophy* 42 (3):248–260.
Lackey, Jennifer (2010) "A Justificationist View of Disagreement's Epistemic Significance," in Adrian Haddock, Alan Millar and Duncan Pritchard (eds.), *Social Epistemology*. Oxford: Oxford University press.
Leiserowitz, Anthony A., Edward W. Maibach, Connie Roser-Renouf, Nicholas Smith, and Erica Dawson (2013) "Climategate, Public Opinion, and the Loss of Trust," *American Behavioral Scientist* 57 (6):818–837.
Markowitz, Ezra M., and Azim F. Shariff (2012) "Climate Change and Moral Judgement," *Nature Climate Change* 2:243–247.
McCright, Aaron M., Meghan Charters, Katherine Dentzman, and Thomas Dietz (2016) "Examining the Effectiveness of Climate Change Frames in the Face of a Climate Change Denial Counter-Frame," *Topics in Cognitive Science* 8:76–97.
Merton, Robert K (1942) "The Normative Structure of Science", reprinted in his *The Sociology of Science: Theoretical and Empirical Investigations*. Chicago: University of Chicago Press.
Michaels, David (2008) *Doubt Is Their Product: How Industry's Assault on Science Threatens Your Health*. Oxford: Oxford University Press.
Moore, G.E. (1925/1993) "A Defence of Common Sense," in T. Baldwin (ed.), *G. E. Moore: Selected Writings*. London: Routledge.
Moore, G.E. (1939/1993) "Proof of an External World," in T. Baldwin (ed.), *G. E. Moore: Selected Writings*. London: Routledge.
Nichols, Shaun, Stephen Stitch, and Jonathan Weinberg (2012) "Meta-Skepticism: Meditations in Ethno-Epistemology," in Stephen Stitch (ed.), *Collected Papers, Volume 2: Knolwedge, Rationality, and Morality*. Oxford: Oxford University Press.
Norgaard, Kari Marie (2011) *Living in Denial: Climate Change, Emotions, and Everyday Life*. Cambridge, MA: The MIT Press.
Oreskes, Naomi, and Erik M. Conway (2010a) *Merchants of Doubt*. New York: Bloomsbury Press.
Oreskes, Naomi, and Erik M. Conway (2010b) "Defeating the Merchants of Doubt," *Nature* 465:686–687.

Russell, Muir, Geoffrey Boulton, Peter Clarke, David Eyton, and James Norton (2010) *The Independent Climate Change E-mails Review*. Available at: http://www.cce-review.org/.

Sextus-Empiricus (2000) *Outlines of Scepticism*. Translated by Julia Annas and Jonathan Barnes. Cambridge: Cambridge University Press.

Torcello, Lawrence (2016) "The Ethics of Belief, Cognition, and Climate Change Pseudoskepticism: Implications for Public Discourse," *Topics in Cognitive Science* 8:19–48.

van der Linden, Sander L., Anthony Leiserowitz, Seth Rosenthal, and Edward Maibach (2017) "Inoculating the Public against Misinformation about Climate Change," *Global Challenges* DOI: 10.1002/gch2.201600008.