Justified True Belief revisited: Systematic Divergence from Justification and Truth in Everyday Knowledge Ascriptions

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Abstract

Modern societies rely fundamentally on the production, circulation, and recognition of reliable knowledge. Yet despite the normative and institutional prominence of knowledge, we know surprisingly little about what citizens themselves count as knowledge, to whom they attribute it, and on what grounds. A dominant philosophical account defines knowledge as *Justified True Belief*, requiring that a proposition be true, believed, and adequately justified. Here, we provide a large-scale empirical test whether ordinary knowledge ascriptions adhere to this normative standard. In a preregistered conjoint experiment with a nationally quota-matched U.S. sample (N = 1,295), participants judged whether an agent "knows" propositions across a politically contested domain (climate change) and an uncontested domain (astrophysics). We fully crossed Justification (six levels varying strength and source), Truth (true vs. false), and Belief (strong vs. weak). Knowledge ascriptions systematically diverged from Justified True Belief across both domains. Belief exerted the strongest causal influence (Average causal effects: AMCE ≈ −0.42 for weak vs. strong belief), Truth was helpful but not necessary (AMCE ≈ 0.18 for true vs. false), and Justification contributed little or not at all (AMCE range across levels ≈ 0.00–0.05). This asymmetry had striking consequences: more than half of participants attributed knowledge even to false propositions when belief was strong, whereas only about one quarter attributed knowledge to true, strongly justified propositions when belief was weak. Across both domains, participants thus heavily prioritized conviction over truth and justification when judging whether others "know". By showing that ordinary knowledge ascriptions more closely follow a model of "Strong Belief with optional Truth" than the normative account of Justified True Belief, these results help explain why low-justification and even false propositions can be treated as knowledge in public discourse.

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Modern societies rely fundamentally on the production, circulation, and recognition of reliable knowledge. Policymakers invoke scientific knowledge to justify decisions during pandemics or in relation to climate change (Council et al., 2009; Ruggeri et al., 2024), courts rely on expert knowledge when weighing testimony (Line et al., 2022), citizens need to decide whether to rely on scientific knowledge when making decisions about topics such as vaccinations (Ali et al., 2022), and democracies rely on citizens sharing a body of knowledge (Lewandowsky et al., 2023). Given the centrality of knowledge, modern societies have famously been described as "knowledge societies" (Stehr, 1994). Yet despite the normative and institutional prominence of knowledge, we know surprisingly little about what ordinary citizens themselves count as knowledge, to whom they attribute it, and on what grounds. This gap is particularly consequential in high-stakes domains such as climate change, vaccination, or public health crises, where scientific claims may encounter skepticism (Ali et al., 2022; Fischer et al., 2023; Fischer & Fleming, 2024; Hornsey, 2021; Winter et al., 2022), where effective policy depends on public credibility (Bicchieri et al., 2021), and where emerging evidence points to a societal shift from evidence-based evaluation toward intuition and belief as markers of truth (Lewandowsky et al., 2025).

The question of what it means to "know" is not only pressing; it is ancient. For millennia, thinkers have debated how knowledge should be defined and how it can be distinguished from mere opinion or belief. These debates trace back to the philosophical inquiries of Socrates, Plato, and Aristotle, and the rhetorical investigations of Protagoras, Isocrates, Aristotle, and Cicero. In philosophy, such questions were explored under idealized epistemic conditions, often through carefully constructed thought experiments that allowed for precise conceptual analysis. Yet even in contemporary empirical work, knowledge has typically been examined using highly stylized scenarios intended to probe theoretically informative edge cases (e.g., (Kim & Yuan, 2015; Nagel et al., 2013). While these paradigms have been invaluable for refining philosophical distinctions, they remain atypical of everyday epistemic contexts. As a result, they leave open a fundamental question: how is knowledge ordinarily ascribed under ecologically realistic conditions?

The dominant theoretical account emerging from the philosophical quest for what it means to "know" is knowledge as Justified True Belief (JTB). According to JTB, a person knows a proposition if and only if three individually necessary conditions are met: (i) the proposition is true, (ii) the person believes it, and (iii) the belief is adequately justified. If any one of these components is absent—if a belief is false, unjustified, or not actually held—knowledge is absent.

For example, according to JTB, a person does not "know" that a dice landed on 3 – even if it did, indeed, land on 3 – because the person simply guessed correctly (the justification criterion is not met). Likewise, if a researcher has extensive evidence (and, hence, justification) for believing a particular medication is effective, but they do not actually hold the belief, they do not "know" the medication is effective (the belief criterion is not met). And lastly, an individual does not "know" that a treatment is effective, even if she does believe it to be effective and has good evidence to justify that belief, if the treatment turns out to be ineffective (the truth criterion is not met). This tripartite structure has shaped epistemological theory for decades and continues to function as the default framework in both philosophy and much empirical work on knowledge ascriptions.

Empirical studies testing knowledge as Justified True Belief

Despite the centrality of the Justified True Belief model in epistemology, remarkably little empirical work has tested whether ordinary people actually rely on this structure when attributing knowledge in everyday situations. Existing studies typically employ stylized and highly artificial scenarios, and manipulate only fragments of the full JTB framework – varying one or two components (justification, truth, or belief) in isolation (Turri, 2012) (Hofmann, 2014). As a result, it remains unclear how the three components interact, and shape knowledge ascriptions in ecologically realistic contexts.

Specifically, to date, nearly all empirical studies of the JTB account have focused on its philosophical edge cases – Gettier scenarios (e.g., Hofmann, 2014; Turri et al., 2012). These scenarios were designed to probe boundary conditions in philosophical analysis, typically involving epistemic luck or systematically misleading sensory evidence. The following two examples show the typical structure of such cases:

> Henry is driving through the countryside and sees what looks like a barn. He forms the belief that there is a barn by the road. Unbeknownst to him, the area is filled with barn façades, convincing fake structures set up by a film crew. By sheer coincidence, the one structure he happens to look at is the only real barn in the area.

Empirical research has used structurally similar scenarios to test folk intuitions. In a widely cited study (Starmans & Friedman, 2012), participants read the following: Peter leaves his watch on the table before showering. A burglar steals it and replaces it

with an identical one. Peter later believes there is a watch on the table – and there is, though not the one he left there.

In both cases, the agent's belief is justified and true, yet that truth obtains only by coincidence. Philosophers call this epistemic luck (Pritchard, 2005). These cases illustrate a central philosophical as well as rhetorical point: justification, truth, and belief may all be present while knowledge is absent, yet someone may still be ascribed to know if the justification appears adequate.

Theoretically, these cases are insightful. Empirically, however, responses to Gettier-type scenarios have been strikingly inconsistent. Some findings suggest that participants generally treat truth and justification as important for knowledge, yet sometimes still attribute knowledge in Gettier conditions (Turri et al., 2015). Other research found the opposite: even when participants clearly recognized a belief as both true and justified, they nevertheless tended to deny knowledge in Gettier scenarios (Turri, 2012)(Turri, 2013). Yet other research found that knowledge ascriptions in Gettier-type scenarios may be driven by social biases in epistemic evaluation, showing that women were disproportionately described as "knowing by luck," even when judged to know to the same extent as men (Disher et al., 2021). Cross-cultural results have been similarly mixed: some studies found substantial variability in Gettier intuitions, whereas others reported no differences across cultures (Kim & Yuan, 2015; Weinberg et al., 2013).

Taken together, these inconsistencies point to three limitations of existing research that must be addressed if we are to understand the typical structure of folk knowledge ascriptions.

First, Gettier cases are ecologically unrepresentative. The very features that render Gettier cases philosophically powerful also render them highly unrepresentative cases of ordinary cognition: Gettier cases deliberately pair *strong* justification based on perceptual evidence with *lucky* truth. In everyday cognition, in contrast, justification given through perceptual input tends to be *strong and reliable:* sensory inputs typically track the truth rather than systematically diverging from it. As a result, these cases rely on an extreme and rare configuration of justification, truth, and belief—namely, situations in which individuals accurately perceive a state of affairs yet nevertheless lack knowledge. This focus on exceptional cases leaves open the question of whether individuals adhere to JTB when ascribing knowledge under ecologically valid conditions. In other words: existing research investigates how laypeople reason about philosophical problems (Gettier-type scenarios), but not necessarily whether laypeople adhere to JTB in everyday knowledge ascriptions.

Second, prior studies overwhelmingly rely on worldview-neutral domains, minimizing the influence of prior beliefs. In such scenarios (e.g., Turri et al. 2013; Starmans & Friedman 2012; Rose & Schaffer 2012), participants can evaluate justification and truth under "ideal" conditions: without directional motivation, focusing solely on the structural properties of the presented scenario. Yet, the judgments whether someone "knows" are rarely made under idealized philosophical conditions. Instead, they are formed in ecologically rich contexts, shaped by prior beliefs, and involving the judgment of contested facts (Hornsey, 2020, 2021; Lewandowsky, 2021). Decades of work on motivated reasoning and confirmation bias suggest that individuals tend to assess evidence and truth claims in light of their existing beliefs, particularly when the content is personally or politically relevant (Kahan, 2015; Kunda, 1990). Hence, a strict test of the JTB model requires more realistic scenarios in which participants' prior beliefs and discursive stakes shape their evaluation of justification and truth – and for research on knowledge ascriptions to inform real-world contexts such as science communication of contested facts or polarized topics (Adam et al., 2020; Allen et al., 2024; Rutjens et al., 2021).

Third, and as a direct methodological consequence of the field's reliance on Gettier-type scenarios, justification is typically held artificially constant and is not fully crossed with belief or truth. By design, Gettier-type scenarios involve strong (albeit misleading) justification, meaning participants are rarely exposed to genuinely low-justification conditions such as weak scientific evidence, hearsay, or testimony from unreliable sources. Holding justification constant precludes investigation of how the three components interact. Such interactions are theoretically plausible, however: psychological research suggests that individuals' assessments of evidential strength are systematically influenced by whether conclusions align with perceived truth (Bayes & Druckman, 2021; Fischer et al., 2022). This finding reflects a core tenet of rhetorical theory: the assessment of justification is never independent of prior beliefs and shared plausibilities (Kramer, 2020; Erhardt, 2025). Whether such dependencies shape knowledge ascriptions remains an open question given current designs. Moreover, while Gettier-type scenarios test whether people continue to ascribe knowledge under conditions of epistemic luck – thereby testing whether justification, truth, and belief are *jointly sufficient* – they do not address which of these dimensions are treated as *necessary*. For instance, do people ascribe knowledge when truth is absent? Addressing necessity and interaction effects requires a fully crossed design in which belief, truth, and justification are systematically varied.

The present study

The present study provides a large-scale empirical test of one of the most influential theoretical accounts of knowledge—the Justified True Belief (JTB) account—under ecologically valid conditions. Building directly on limitations identified in prior empirical work, we address issues of non-representative sampling in both materials and participants. Specifically, first, participants evaluated scenarios in which Justification varied in ways that are characteristic of everyday cognition – such as scientific evidence, social testimony, or partisan sources -- rather than being built in to be strong but misleading. This approach allows us to examine how justification, truth, and belief jointly shape knowledge ascriptions in contexts that more closely resemble ordinary epistemic evaluation.

Second, methodologically, we employed a fully crossed conjoint design that independently manipulates all three components of the JTB framework – justification, truth, and belief. Without independent variation of justification, truth, and belief, it is impossible to determine which components are treated as necessary, sufficient, or interaction-dependent in folk knowledge ascriptions.

Third, to test adherence to JTB under epistemically challenging conditions, we varied justification, truth, and belief not only in a worldview-neutral domain (astrophysics) but also in a politically contested domain (climate change), where motivated reasoning is likely. Additionally, we included an additional dimension--epistemic virtue of the knower--, that is not included in the original JTB account, but that may plausibly shape knowledge ascriptions (Zagzebski, 1996). Epistemic virtues such as intellectual conscientiousness, carefulness, and open-mindedness plausibly function as higher-order cues to whether a belief was formed responsibly and truth-tracking, and thus may guide knowledge ascriptions. Including epistemic virtue therefore allows us to test not only whether lay judgments conform to the JTB components, but also whether they systematically rely on additional epistemic criteria—potentially revealing a more ecologically realistic folk conception of knowledge.

Fourth and finally, we conducted a large-scale study using a nationally balanced quota sample. This sampling strategy provides more robust and generalizable estimates of folk epistemic intuitions than those obtained from convenience samples such as undergraduates (Nagel et al., 2013) or Mturkers (Buckwalter & Turri, 2020; Starmans & Friedman, 2012)) that diverge from the general population—particularly in terms of education (Difallah et al., 2018). Such differences are theoretically consequential, as highly educated samples may exhibit intuitions that align more closely align with normative philosophical reasoning than those of the population in general (Starmans & Friedman, 2020).

Methods and Design

Methodological approach. We employed a conjoint experimental design in which participants evaluated vignettes systematically varying all combinations of *justification*, *truth*, and *belief*, as well as *characteristics* of the knower (epistemic virtues).

Conjoint experiments are a survey-based research technique that are used to measure the preferences of respondents by presenting them with a set of hypothetical vignettes, each composed of multiple attributes with varying levels. In conjoint experiments, respondents evaluate a series of hypothetical profiles composed of attributes that vary across randomly assigned levels. By analyzing the resulting pattern of judgments, researchers can estimate the *average marginal component effect* (AMCE) of each attribute—that is, its independent contribution to the overall evaluation—while holding all others constant. This makes conjoint analysis especially well suited to quantify the causal importance of a high number of combinations of attributes that would not otherwise be practically feasible.

Vignettes were presented across two scientific domains differing in the extent to which knowledge is politically contested: a politically contested domain (climate change) and a non-contested domain (astrophysics). In each vignette, participants were asked to judge whether the protagonist "knows" a given proposition.

All dimensions – justification, truth, belief, and epistemic virtue – were fully crossed and independently randomized, allowing us to estimate the unique and joint effects of each component while minimizing carryover and order effects.

Materials

Each vignette introduced an agent (Steve) and participants evaluated whether Steve *knows* the proposition in question (i.e., whether knowledge should be ascribed to Steve). These two propositions were: "Does Steve know, that the astrophysical phenomenon, Galactic Pulse, exists?" in the domain of astrophysics and "Does Steve know that the increased nitrous oxide (N_2O) emissions accelerate climate change?" in the domain of climate change (the full table to construct all vignettes is given in the Appendix).

Experimental factors. We experimentally varied four factors: Justification, Truth, Belief, and Epistemic Virtue, and implemented these combinations across two domains: Physics and Climate Change.

The **justification (J)** dimension had six levels, reflecting both the strength and source of justification: strong or weak scientific justification, strong or weak ingroup justification (from members of the participant's own political party), and strong or weak outgroup justification (from members of the opposing political party). Importantly, justification was manipulated independently of Steve's belief state: Steve could receive strong or weak justification regardless of whether he ultimately believed the proposition with certainty or expressed uncertainty. Here's an example of strong ingroup justification:

> "Steve has heard about an astrophysical phenomenon, Galactic Pulse, from most of his friends who are members of his political party. The existence of Galactic Pulse is widely accepted among most of them."

The **truth (T)** dimension had two levels, distinguishing whether the proposition presented in the vignette was true or false. The truth manipulation stipulated the actual state of the world within the vignette, independent of Steve's evidence or beliefs. For example:

> "Suppose that the increased nitrous oxide (N_2O) emissions truly do not accelerate climate change."

The **belief (B)** dimension also had two levels, indicating whether Steve believes the proposition with certainty or expresses uncertainty. For example:

> "Steve is confident in the existence of the astrophysical phenomenon" versus
> "Steve is uncertain about the existence of the astrophysical phenomenon."

The **epistemic virtue** dimension. Beyond justification, truth, and belief, some epistemologists have argued that characteristics of the knower may also matter for knowledge ascriptions. Epistemic virtues – such as open-mindedness, intellectual humility, and willingness to revise one's beliefs – are typically conceived as stable traits of epistemic agents that contribute to reliable belief formation (Zagzebski, 1996). We focused on open-mindedness because it is among the most widely discussed epistemic virtues and can be straightforwardly operationalized. Although JTB does not include agent characteristics as a fourth condition, it remains an open question whether laypeople nonetheless factor in such traits when ascribing knowledge. We therefore included epistemic virtue as an additional factor to test whether folk knowledge ascriptions extend beyond the classical triad. Epistemic virtue had two levels: strong versus weak. In the *strong* condition, Steve was described as open to new ideas and willing to revise his beliefs:

> "Steve is open to new ideas and willing to adapt his belief".

In the *weak* condition, Steve was characterized as closed-minded and resistant to belief-updating:

"Steve is content with his current beliefs and tends to stick with them".

Study Design. All dimensions (justification, truth, belief, epistemic virtue, and domain) were varied within subjects. Each participant evaluated multiple randomly drawn scenarios, allowing within-subject estimation of all attribute effects.

Vignettes were fully crossed across all dimensions, yielding a total of 96 unique scenario combinations ($6 \times 2 \times 2 \times 2 = 48$ per domain). Each participant was exposed to a randomized subset of 16 these vignettes.

Within each vignette, the order in which information about justification, belief, truth, and epistemic virtue was presented was randomized between-participants. This procedure ensured that no single component consistently appeared first, reducing potential order effects in participants' knowledge ascriptions.

Outcome variables. Participants' judgments of knowledge were measured using two complementary indicators: (i) **Binary judgment:** Participants indicated whether the agent "knows" the proposition (*Yes/No*); **Graded judgment:** Participants rated the extent to which the agent "knows" the proposition on a 5-point Likert scale (1 = *Not at all*; 5 = *Fully*).

Power analysis. The sample size was determined by an *a priori* power analysis using cjpowr in R. Based on a small assumed effect size of 0.04, a total of 96 combinations of vignettes, and each participant evaluating a sub-sample of 16 vignettes, N = 1.440 participants are required to reach power = .90.

Preregistered hypotheses and analysis code. Our preregistered hypotheses and regression model are variable under: https://aspredicted.org/3brg-bdnr.pdf

We conducted a pretest assessing the comprehensibility of all vignettes. Based on this pretest, we preregistered the analysis code to analyse the conjoint experiment by estimating Average Marginal Component Effects (AMCE) prior to data collection of the main study.

We preregistered the following hypotheses:

1. If ordinary knowledge ascriptions follow the JTB structure, all three components should independently contribute to knowledge judgements. We therefore expect that: J, T, and B affect knowledge ascriptions, and this holds across a contested, and an uncontested domain.
2. Given that motivated reasoning shapes the evaluation of contested more so than non-contested evidence, we expect that: Justification is not equally

weighted across the contested (climate change), and the uncontested (astrophysics) domain.

3. If knowledge ascriptions are primarily driven by the structural components of JTB, other dimensions—even if theoretically plausible such as epistemic virtues (Zagzebski, 1996)—should not affect knowledge ascriptions. We therefore expect that: Epistemic virtues of the knower do not affect knowledge ascriptions.
4. Following the motivated reasoning literature, which predicts that prior beliefs shape epistemic evaluation primarily in domains where individuals hold strong prior beliefs (Hornsey, 2020; Kahan, 2017), we predict that: Determinants of knowledge ascriptions vary as a function of political attitude in a contested domain (climate change), but not an uncontested domain (physics).

Open data, material and code. The full data, material and analysis code are openly available under: https://zenodo.org/records/17447571

Procedure. Four initial questions collected the demographic information required (age, gender, education, and political orientation). After completing the demographic questions, participants evaluated a sequence of 16 single-profile vignettes presented in random order.

Sample. We collected a national sample of U.S. adults, quota-matched to the U.S. population in terms of age, gender, and political affiliation. According to our preregistration, we excluded n = 140 participants who failed two out of two attention checks. The final sample consisted of N = 1,295 respondents (657 women, 626 men, 10 non-binary participants, and 2 who preferred not to report their gender) with a mean age of M = 46 years (SD = 16.21; range: 18-87 years). Political orientation was broadly distributed across the ideological spectrum, with substantial representation of liberal, moderate, and conservative respondents. All participants provided written informed consent.

Results

Descriptive Results: Are J, T, and B necessary for knowledge ascriptions?

Figure 1 shows predicted probabilities of knowledge ascription across all combinations of justification, truth, and belief. Contrary to the classical account of knowledge as *justified true*

belief, participants did not treat justification or truth as necessary conditions for knowledge. By contrast, belief emerged as the closest approximation to a necessary condition.
As Figure shows, the probabilities of knowledge ascriptions clustered into largely distinct ranges depending on whether belief was strong or weak, indicating a qualitative shift in willingness to ascribe knowledge.

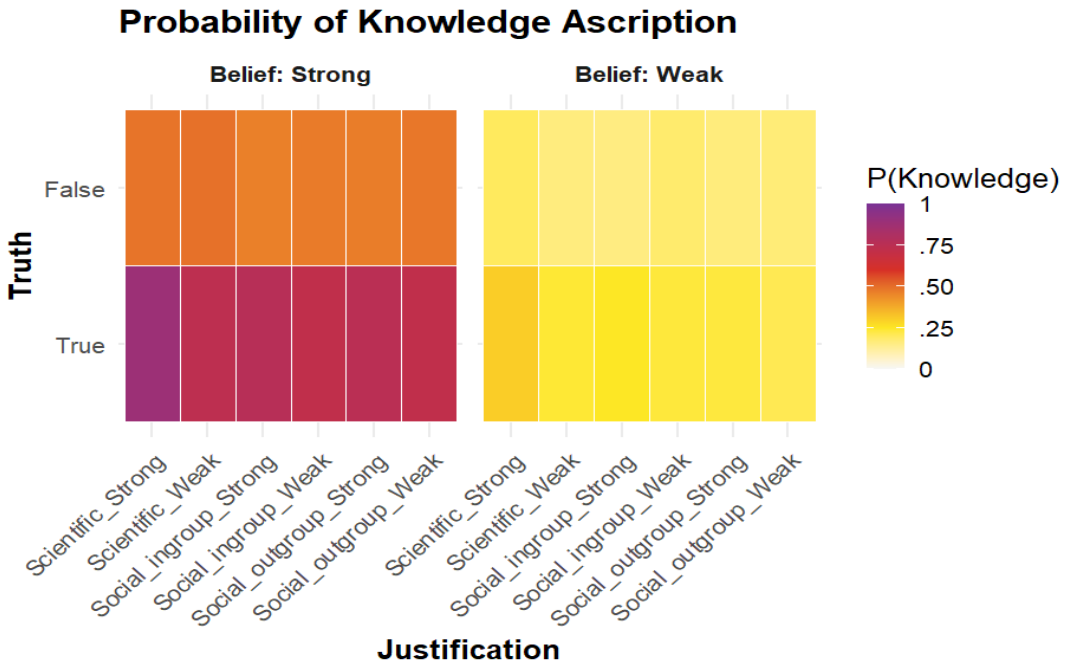
Justification was clearly not treated as necessary. Across all conditions involving weak justification—regardless of whether the evidential source was scientific, social ingroup, or social outgroup—predicted knowledge ascriptions remained high as long as belief was strong and the proposition true (e.g., astrophysics: scientific weak, $p = .74$; social ingroup weak, $p = .72$; social outgroup weak, $p = .72$).

Even Truth was not treated as necessary. When belief was strong, false propositions were frequently judged as knowledge across all justification types. Knowledge ascriptions for false propositions remained high (e.g., ps $\approx .47$–$.50$ across justification conditions), indicating that falsehood did not preclude knowledge ascriptions.

Belief, by contrast, emerged as the dimension that came closest to a necessary condition. When belief was weak, predicted knowledge ascriptions dropped markedly, even when the proposition was true and supported by strong scientific justification (e.g., $p = .31$ for scientific strong; ps $\approx .21$–$.25$ for social justifications).

In summary, participants did not treat justification or truth as necessary conditions for knowledge ascription. If any component approximated a necessary condition, it was belief: strong belief reliably sustained knowledge ascriptions even under falsehood or weak justification, whereas weak belief substantially constrained knowledge ascription even when truth was given and justification was strong.

Figure 1. Predicted probability of knowledge ascription across combinations of justification, truth, and belief.



Note. The figure shows probabilities of attributing knowledge ("Steve knows") for every possible combination of Justification (six levels), Truth (true vs. false), and Belief (strong vs. weak), across both domains. Each cell represents the estimated probability from the mixed-effects logistic model; darker colours indicate a greater likelihood of knowledge ascription.

Do Justification, Truth, and Belief affect knowledge ascriptions?

To test whether knowledge ascriptions track the core components of the justified true belief (JTB) account under ecologically valid conditions and in a fully crossed design, we estimated average marginal component effects (AMCEs) for justification, truth, and belief using a conjoint model predicting binary knowledge judgments. All estimates reflect changes in the probability of ascribing knowledge relative to a reference level, holding all other attributes constant.

Consistent with our expectations, lay knowledge ascriptions systematically tracked belief and truth. Diverging from our predictions based on the JTB account, however, knowledge ascriptions did non reliably track justification (Figure 2). In line with our expectation, these results were strikingly consistent across a contested vs. uncontested domain (see Figure 1). Across domains, belief emerged as the dominant determinant of knowledge ascriptions. When the protagonist expressed weak belief rather than strong belief, the probability of ascribing knowledge dropped sharply (overall AMCE = −0.42, SE = 0.013,

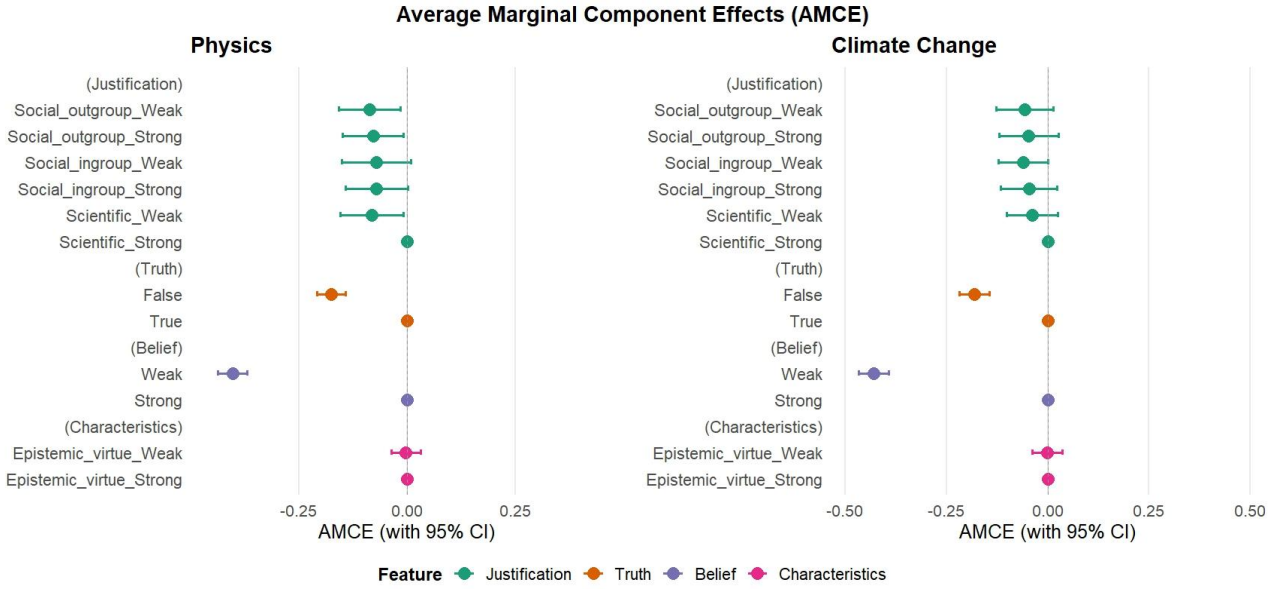
$z = -32.24$, $p < .001$, 95% CI [−0.44, −0.39]). This effect of belief was strong and robust in both astrophysics (AMCE = −0.40, $p < .001$) and climate change (AMCE = −0.43, $p < .001$), indicating that belief is treated as the strongest condition for knowledge across epistemic contexts.

Truth also exerted a strong, albeit weaker, influence on knowledge ascriptions across domains. True propositions were substantially more likely to be judged as known than false propositions (overall AMCE = 0.18, SE = 0.013, $z = 13.82$, $p < .001$, 95% CI [0.15, 0.20]). This effect was virtually identical across domains, appearing in both astrophysics (AMCE = 0.18, $p < .001$) and climate change (AMCE = 0.18, $p < .001$). Thus, objective truth increased knowledge ascriptions independently of both belief and justification, even in a politically contested domain.

The influence of justification on knowledge ascriptions was unreliable: Weak in the domain of astrophysics and absent in the domain of climate change. In the astrophysics domain, weak scientific justification significantly decreased knowledge ascriptions compared to strong scientific evidence (AMCE = −0.082, SE = 0.037, p = .028). Strong outgroup justification (AMCE = −0.079, SE = 0.036, p = .027) and weak outgroup justification (AMCE = −0.087, SE = 0.036, p = .017) also significantly reduced knowledge attributions. Effects for strong ingroup justification (AMCE = −0.071, SE = 0.037, p = .054) and weak ingroup justification (AMCE = −0.071, SE = 0.041, p = .080) were negative but not significant.

In the climate change domain, all justification contrasts were negative relative to strong scientific justification—weak scientific (AMCE = −0.038, SE = 0.033, p = .240), strong ingroup (AMCE = −0.047, SE = 0.035, p = .186), weak ingroup (AMCE = −0.060, SE = 0.031, p = .051), strong outgroup (AMCE = −0.047, SE = 0.037, p = .210), and weak outgroup (AMCE = −0.057, SE = 0.036, p = .110)—but none were statistically significant.

Figure 2. Average Marginal Component Effects (AMCE) of Justification, Truth, Belief, and Epistemic Virtues on Knowledge Ascriptions



Note. AMCEs represent the estimated change in the probability that participants judged the protagonist to "know" a given claim, relative to the reference level of each factor (Strong Scientific Justification, True, Strong Belief, Strong Epistemic Virtue). Points indicate the AMCE estimate, and horizontal bars represent 95% confidence intervals. Positive values indicate higher likelihood of knowledge ascription compared to the reference level. Plots are shown separately for two domains: Physics (non-contested) and Climate Change (politically contested).

We tested whether the effects of belief, truth, and justification interacted with domain (climate change vs. astrophysics). However, this was not the case. In a logistic regression including domain and interaction terms, none of the justification × domain interactions reached significance (e.g., $p = .202$ for Scientific_Weak × Climate Change), nor did interactions for belief or truth (all $ps > .20$). This suggests that participants applied consistent epistemic standards across both climate change and astrophysics scenarios, indicating that the epistemic hierarchy of J > T > B held in both politically contested and uncontested domains.

In summary, the results reveal a systematic divergence from the classical JTB framework in a fully crossed design. Belief and truth robustly influenced knowledge ascriptions across both politically contested (climate change) and neutral (astrophysics) domains. Justification, in contrast, did not consistently affect knowledge ascriptions, particularly not in the contested domain. Rather than treating truth, belief, and justification as jointly required conditions, lay judgments appear belief-dominated, with justification functioning as a secondary and sometimes dispensable cue. This asymmetry challenges the assumption that the JTB framework accurately captures the operative structure of folk epistemology under ecologically realistic conditions, and using a national sample.

Does epistemic virtue of the knower affect knowledge ascriptions?

In line with our expectations, epistemic virtue of the knower had no detectable effect on knowledge ascriptions in either domain. In the astrophysics domain, the AMCE associated with weak (vs. strong) epistemic virtue was essentially zero and statistically non-significant (AMCE = −0.003, $z = -0.18$, $p = .857$). Likewise, in the climate change domain, epistemic virtue did not influence knowledge judgments (AMCE = −0.001, $z = -0.07$, $p = .940$). Holding belief, truth, and justification constant, participants were no more likely to attribute knowledge to agents described as open-minded or epistemically virtuous than to less virtuous agents.

These findings suggest that folk knowledge ascriptions were largely insensitive to character traits of the knower. Epistemic virtue, though normatively relevant in virtue epistemology, did not independently affect knowledge ascriptions beyond the structural components of belief, truth, and justification.

Do Determinants of knowledge ascriptions vary as a function of political attitude?

We expected that the predictive value of J, T, and B varies as a function of political attitude in the politically contested domain (climate change), but not the uncontested domain (physics). To test that hypothesis, we estimated average marginal component effects (AMCEs) of Justification (J), Truth (T), and Belief (B**)** separately for each combination of domain (astrophysics vs. climate change) and political orientation.

In the uncontested domain of astrophysics, the relative weights of the determinants of knowledge ascription were largely invariant across political orientations. Across all groups,

truth and belief exerted strong and comparable effects, whereas justification played a consistently secondary role. False statements were reliably penalized (AMCEs ≈ −0.14 to −0.20, *ps* < .001), as was weak belief (AMCEs ≈ −0.35 to −0.43, *ps* < .001), with little variation in effect size across political attitudes. By contrast, justification effects were small, inconsistently significant, and did not show a systematic pattern of amplification or attenuation as a function of political orientation. Thus, in astrophysics, the weighting of truth, belief, and justification appears politically stable.

In the contested domain of climate change, by contrast, the weighting of these dimensions varied as a function of political orientation. Although truth and belief remained strong predictors across all groups—false claims (AMCEs ≈ −0.14 to −0.20, *ps* < .001) and weak belief (AMCEs ≈ −0.38 to −0.45, *ps* < .001) were consistently penalized in knowledge ascriptions—the impact of justification differed markedly by political attitude. Among liberal and somewhat liberal participants, non-scientific justifications, particularly social outgroup justifications, were weighted more heavily and reliably reduced knowledge ascriptions (AMCEs up to −0.17, *ps* ≤ .049). In contrast, among moderate participants, justification effects were weaker and less consistently significant, indicating a reduced sensitivity to justificatory source in knowledge judgments.

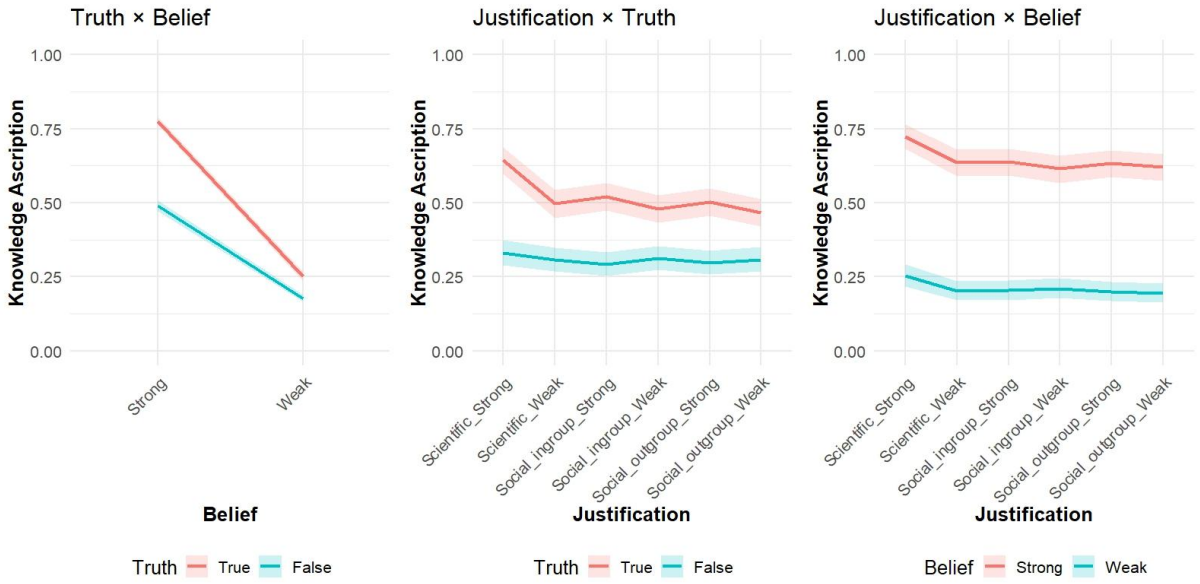
Overall, these findings indicate that the relative weights of the dimensions underlying knowledge ascriptions are politically invariant in an uncontested domain. In a contested domain, however, Justification (but not Truth or Belief) varied with political attitude, indicating that political attitude selectively explains how evidence is weighted when ascribing knowledge.

Do Justification, Truth and Belief interact in shaping knowledge ascriptions?

We examined whether the three dimensions J, T, and B interact in shaping knowledge ascriptions--which may have been obscured in prior studies, which selectively combined only fractions of Justification, Truth, and Belief. To do so, we estimated mixed-effects logistic regression models including all two-way interactions among justification, truth, and belief separately for each domain. This allowed us to test whether the influence of any single component depended on the status of the others, beyond their additive effects. Across both domains, we observed interaction across all three dimensions J, T, and B (Fig. 3), indicating

that knowledge ascriptions are not governed by independent evaluations of belief, truth, and justification.

Figure 3. Predicted Probability of Knowledge Ascriptions for Interactions Between the Three Facets of JTB. Predicted probabilities of knowledge ascriptions from mixed-effects logistic regression models are shown for the three primary interactions among belief, truth, and justification. Lines represent model-predicted probabilities and shaded areas indicate 95% confidence intervals.



Note. Across both domains, knowledge ascriptions systematically reflect the integration of epistemic cues rather than additive effects: the impact of truth is modulated by belief, and weaker justifications are attenuated when claims are false or belief is low.

Specifically, we observed truth × belief interactions, which emerged as a strong interaction effect: the positive impact of truth on knowledge judgments was significantly attenuated when the agent's belief was weak rather than strong (astrophysics: $b = 1.89$, SE = 0.25, $z = 7.65$, $p < .001$; climate change: $b = 1.21$, SE = 0.24, $z = 5.07$, $p < .001$), suggesting that truth mattered more for knowledge ascriptions when belief was strong.

We further observed broadly convergent justification × truth interactions across domains. In both astrophysics and climate change, weaker or socially sourced justifications were penalized less strongly when the proposition was false, as indicated by significant positive interaction terms for most justification levels (astrophysics: $bs = 1.11–1.41$, $zs \geq$

4.60, all *ps* < .001; climate change: significant effects for weak scientific and weak social justifications, *bs* = 0.74–1.01, *zs* ≥ 3.23, *ps* ≤ .001, with remaining contrasts marginal).

In contrast, evidence for justification × belief interactions was weak, and differed by domain. In astrophysics, all justification × belief interactions were statistically reliable (*bs* = 0.86–1.13, *zs* ≥ 3.39, all *ps* < .001), whereas in the climate change domain only a limited subset—most notably involving weak ingroup justification—reached significance (*b* = 0.65, SE = 0.24, *z* = 2.75, *p* = .006), with other contrasts non-significant.

Discussion

The present work provides a systematic empirical test of how citizens integrate Justification, Truth, and Belief when ascribing knowledge under ecologically realistic conditions: Using socially meaningful scientific claims, allowing Justification to vary naturally in a fully crossed resign rather than artificially pairing strong justification with lucky truth, and drawing on a nationally quota-matched U.S. sample rather than a convenience population. Across both a politically contested domain (climate change) and an uncontested domain (astrophysics), Belief robustly and strongly shaped knowledge ascriptions. Truth also influenced knowledge ascriptions, but to a markedly lesser extent, and Justification exerted only a small—and in parts non-significant—effect. With average causal effects (AMCEs) of −0.403 for Belief (weak vs. strong), −0.175 for Truth (false vs. true), and −0.04 to −0.06 for Justification (across levels), the causal effect of Belief was more than twice as large as that of Truth and roughly four to five times larger than that of Justification. These results suggest that low-justification and even false propositions can be treated as knowledge in public discourse.

This asymmetric weighting of Justification, Truth and Belief had striking consequences. More than half of participants judged false propositions as knowledge as long as Belief was strong; indicating that Truth was not treated as a necessary condition for "knowledge" by a substantial share of the population. In contrast, only about one quarter ascribed knowledge to true and strongly justified propositions when Belief was weak; indicating that strong belief was typically treated as the only necessary condition for knowledge. These results suggest a default skepticism toward weakly held beliefs—even when those beliefs are accurate, combined with a readiness to attribute knowledge to strongly held belief, even when they lack justification or truth.

Under ecologically realistic conditions, everyday knowledge ascriptions therefore diverged from JTB in two ways: they sharply down-weighted Justification and treated Truth as helpful but optional rather than necessary. Everyday knowledge ascriptions thus align more closely with a model of "Strongly-held Belief with optional Truth", rather than the classical ideal of Justified True Belief. Importantly, this hierarchical weighting of Belief > Truth > Justification was robust across contested and uncontested domains; suggesting that it reflects a general feature of folk epistemology rather than a domain-specific effect of motivated reasoning confined to contested domains (Bayes & Druckman, 2021; Hornsey, 2020; Kahan, 2015). Theoretically, these results inform debates about the folk concept of knowledge (Nagel et al., 2013; Starmans & Friedman, 2012) by showing that divergence from JTB is not confined to Gettier cases but emerges robustly under more ecologically realistic judgments.

These findings dovetail with the notion of an "epistemic drift" from evidence-based truth seeking toward sincerity-based standards in public discourse (Lewandowsky et al., 2023; Lewandowsky & Garcia, 2026). In our conjoint design, participants treated strong belief as the dominant criterion for "knowing," while justification had little to no impact and truth was frequently waived—such that false propositions were often judged as knowledge when belief was strong. This asymmetric weighting of justification, truth, and belief resembles a sincerity-centered conception of truth (Lewandowsky & Garcia, 2026), where a claim can be judged "honest" when it appears genuinely believed—even when factually false and weakly supported by evidence. Our results hence provide a cognitive foundation for this epistemic drift: Everyday knowledge judgments already privilege conviction over evidence and truth—lowering the barrier for strongly held yet false beliefs to count as "knowledge".

This belief-first standard of knowledge can help explain the uptake and circulation of low-reliability information, particularly about scientific topics such as vaccinations, public health measures, or climate change (Allen et al., 2024; Boatman et al., 2024; van Eck et al., 2020). If "knowledge" is granted primarily on the basis of conviction, while truth is treated as helpful but optional and justification is largely ignored, then belief-based claims can more easily attain epistemic status in public debate. Speakers can be treated as "knowing" without meeting evidence-based standards, lowering the social cost of circulating low-quality content. Further, when strong belief is the dominant route to "knowledge," disagreement becomes harder to resolve through shared evidence or a shared commitment to accuracy: positions can remain rhetorically knowledge-like even when they are evidentially thin, or largely indifferent to truth.

Beyond unequal weighting, the three dimensions of Justification, Truth and Belief also did not operate independently. Instead, we observed a stable interaction between belief and truth across domains: truth substantially increased knowledge ascriptions when belief was strong, but its effect was markedly reduced when belief was weak. In other words, people rewarded truth primarily when the agent appeared personally convinced. This interaction is in line with a belief-first architecture in folk epistemology: Objective truth is helpful—but primarily once the personal conviction of the agent is established. Taken together, the unequal weighting of the three components—including the fact that neither justification nor truth functioned as necessary conditions—and their interactive structure empirically inform long-standing debates about the relation between normative and folk epistemology (Heintz & Taraborelli, 2010).

The uncovered deviations of folk definitions of "knowledge" from normative accounts helps explain why propositions that lack adequate justification—or even truth—may nonetheless perform the work of knowledge: they are used to justify decisions and explain events, treated as credible, and deferred to in argument. During the COVID-19 pandemic, for example, claims that hydroxychloroquine or ivermectin effectively treated COVID-19 often functioned as knowledge-like propositions that guided treatment-seeking, public advocacy, and political argument even after major health authorities concluded that the evidence did *not* support their use for COVID-19 (Oren et al., 2020). These cases illustrate how departures from normative standards of knowledge ascription may contribute to the public uptake and persistence of weakly supported claims.

The strong focus on Belief as the main driver of "knowledge" suggests that efforts to improve public reasoning about contested science—such as climate change, public health measures, or childhood vaccination—may be undermined if communicators focus exclusively on supplying better evidence. If strong belief functions as a near-gating cue for "knowing," then evidence and accuracy may be discounted when an agent appears uncertain, conflicted, or weakly committed. This highlights a potential dilemma for science communication: epistemic humility is normatively appropriate under uncertainty, yet it may inadvertently reduce perceived "knowledge" in lay audiences. Communicators may therefore be most effective when aligning expressed conviction with evidential strength—communicating warranted confidence for well-established claims (see also (Fischer & Huff, 2025).

The present findings also speak to a longstanding tension between philosophical and rhetorical conceptions of knowledge. Philosophy has traditionally treated justification, truth, and belief as logically independent criteria that jointly constitute knowledge. Rhetoric, by

contrast, has emphasized that epistemic evaluation is embedded in social contexts, prior commitments, and shared plausibilities, thus suggesting that the components may not operate independently. The belief-first structure observed here aligns more closely with the rhetorical than the philosophical tradition. Psychological research on knowledge ascriptions can benefit from drawing on both traditions as complementary lenses. Empirical research on knowledge ascriptions can thus inform this longstanding debate by revealing how epistemic criteria are actually weighted in ordinary cognition.

Conceptually, the dominance of belief raises further questions about how its role should be interpreted. Philosophically, belief is typically understood as an internal mental state. Rhetorically, however, belief can function as a social signal of competence, integrity, or alignment with shared plausibilities. Strong belief may signal not only inner conviction but also epistemic commitment, credibility, or trustworthiness. Similarly, truth may be evaluated less as abstract correspondence and more as perceived plausibility within a shared framework; and justification may operate not purely as evidential strength but as persuasive fit within a community of evaluation. Disentangling these mentalistic and doxastic dimensions represents a promising direction for future research at the intersection of psychology, epistemology, and rhetoric.

Several limitations should be noted. First, both domains involved scientific claims. Whether the same hierarchical structure holds for completely uncontested factual knowledge (e.g., Berlin is the capital of Germany), or for interpretive domains remains to be tested. Second, the present study focused on propositional knowledge (knowing that). Whether the same pattern holds for everyday factual knowledge (e.g., how social media platforms generate revenue), or interpretive claims in the humanities (e.g., conceptual analysis, historical explanations or literary interpretations) remains to be tested. And third, more broadly, real-world epistemic contexts often require the integration of different types of knowledge: a neurosurgeon, for instance, draws on anatomical facts, motor skills, and perceptual judgment simultaneously. How folk epistemology operates across different knowledge types and their interaction remains to be empirically explored.

Conclusion

When examined under ecologically realistic conditions, folk knowledge ascriptions systematically diverge from the classical account of knowledge as Justified True Belief. Rather than treating Justification, Truth, and Belief as equally necessary components,

citizens' knowledge judgments were structured by a clear asymmetry: strong Belief carried the greatest weight, Truth was helpful but not necessary, and Justification contributed little to nothing. In this sense, ordinary knowledge ascriptions are better captured by a model of "strong Belief with optional Truth" than by the classical ideal of Justified True Belief. By showing that knowledge is granted primarily on the basis of conviction these findings highlight a key vulnerability of civic discourse: firmly held beliefs can acquire epistemic credibility and function as knowledge even when they are weakly justified or outright false.

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Appendix

Full study material

1. Domain: Astrophysics

Dimension	Level	Text
Justification	**Scientific – Strong**	Steve has read multiple high-quality studies with extensive data, demonstrating the existence of a novel astrophysical phenomenon, termed *Galactic Pulse*.
	Scientific – Weak	Steve has read a few preliminary studies with limited data, indicating the potential existence of an astrophysical phenomenon, termed *Galactic Pulse*.
	Social-Ingroup – Strong	Steve has heard about *Galactic Pulse* from most of his friends in his political party. Its existence is widely accepted among them.
	Social-Ingroup – Weak	Steve has heard about *Galactic Pulse* from a few friends in his political party. Only a few accept its existence.
	Social-Outgroup – Strong	Steve has heard about *Galactic Pulse* from most acquaintances in an opposing party. Its existence is widely accepted among them.
	Social-Outgroup – Weak	Steve has heard about *Galactic Pulse* from a few acquaintances in an opposing party. Only a few accept its existence.
Truth	**True**	*Galactic Pulse* truly exists.

	False	*Galactic Pulse* does not truly exist.
Belief	**Strong Belief**	Steve is confident in the existence of *Galactic Pulse*.
	Weak Belief	Steve is uncertain about the existence of *Galactic Pulse*.
Knower	**Epistemic Virtue – Strong**	Steve is open to new ideas and willing to adapt his beliefs.
	Epistemic Virtue – Weak	Steve is content with his current beliefs and tends to stick with them.

2. Domain: Climate Change

Dimension	**Level**	**Text**
Justification	Scientific – Strong	Steve has read multiple high-quality studies with extensive data, showing that factory farming increases nitrous oxide (N_2O) emissions, accelerating climate change.
	Scientific – Weak	Steve has read a few preliminary studies with limited data, indicating that factory farming increases N_2O emissions, which may accelerate climate change.
	Social-Ingroup – Strong	Steve has heard from most friends in his political party that factory farming increases N_2O emissions, which is widely accepted among them.
	Social-Ingroup – Weak	Steve has heard from a few friends in his political party that factory farming increases N_2O emissions, but only a few accept this.
	Social-Outgroup – Strong	Steve has heard from most acquaintances in an opposing party that factory farming increases N_2O emissions, which is widely accepted among them.

	Social-Outgroup – Weak	Steve has heard from a few acquaintances in an opposing party that factory farming increases N_2O emissions, but only a few accept this.
Truth	True	N_2O emissions truly do accelerate climate change.
	False	N_2O emissions do not truly accelerate climate change.
Belief	Strong Belief	Steve is confident that N_2O emissions accelerate climate change.
	Weak Belief	Steve is uncertain whether N_2O emissions accelerate climate change.
Knower	Epistemic Virtue – Strong	Steve is open to new ideas and willing to adapt his beliefs.
	Epistemic Virtue – Weak	Steve is content with his current beliefs and tends to stick with them.