

The Effect of Perceived Mental Effort on Comparative Knowledge Ascriptions

Abstract

It is widely held that propositional knowledge is a binary affair. Arguments in favor of this view often rely on the claim that competent language speakers systematically judge comparative knowledge ascriptions to be unacceptable. I provide evidence that the plausibility of this claim turns, in part, on the type of proposition being considered as the potential object of knowledge. Specifically, I show that there is a strong positive correlation between the amount of mental effort that people judge to be involved in knowing a given proposition and how acceptable people deem claims that someone knows the proposition better than someone else does.

1. Introduction

In contemporary epistemology, it is predominantly held that propositional knowledge (i.e., knowledge *that* something is the case) is a binary, all-or-nothing affair. That is, there are no *degrees* of propositional knowledge. Arguments in favor of this view often appeal to how we speak. For instance, when distinguishing knowledge-that from knowledge-how, Gilbert Ryle writes:

We never speak of a person having partial knowledge of a fact or truth. . . .

A boy . . . could not be said to have incomplete knowledge of Sussex being an English county. Either he knows this fact or he does not know it. On the other hand, it is proper and normal to speak of a person knowing in part how to do something (1949, p. 59).

Similarly, Fred Dretske states:

When talking about people, places, and topics (*things* rather than facts), it makes sense to say that one person knows something *better than* another. . . . But factual knowledge, the knowledge *that* something is so, does not admit of such comparisons. If we both know that today is Friday, it makes no sense to say that you know this better than I. . . . In this respect factual knowledge is *absolute*. It is like being pregnant: an all-or-nothing affair. One person cannot be *more* pregnant or pregnant *better than* someone else (1981, p. 363).

More recently, Jason Stanley (2005) has aimed to buttress such claims by considering the judgments of non-philosophers. Compare, for instance, the following four sentences (from Stanley 2005, p. 40):

- (a1) John knows that Bush is president better than Mary does.
- (a2) John knows that Bush is president better than Bill knows that Clinton is a Democrat.
- (b1) John likes Bill more than Mary does.
- (b2) John likes Bill more than Mary likes John.

Stanley surveyed non-philosophers and found that while none of his informants judged (a1) or (a2) to be acceptable, they were quite willing to judge (b1) and (b2) to be acceptable. Given this and other considerations pertaining to how we speak, Stanley concludes that “‘better than’ is not a natural way to express comparisons between levels of epistemic position with ‘know’,” and he notes that “[i]f the semantics of ‘know’ did

involve scales of epistemic strength, then there should be uncontroversial examples of non-idiomatic comparisons and modifications” (2005, p. 40).

In light of the potential importance of the acceptability of comparative knowledge ascriptions in determining whether propositional knowledge is gradable, it seems worthwhile to more closely examine exactly how people think about sentences that suggest gradations of knowledge.

One common feature of the examples presented by Ryle, Dretske, and Stanley is that the propositions used in the examples as potential objects of knowledge are propositions that, if known at all, are likely to be known in a largely passive manner with little mental effort: e.g., propositions such as, <Sussex is an English county>, <Today is Friday>, and <Clinton is a Democrat>, in contrast to propositions such as, <A photon’s energy is proportional to its radiation frequency> and <Mass is a measure of energy>.

This raises the question of whether the employment of other types of propositions (i.e., propositions that, if known, are likely to be known by way of significant mental effort) might in fact suggest that graded knowledge ascriptions are acceptable in certain cases. To illustrate, even if sentences such as, “Meredith knows better than Sean that Clinton is a Democrat,” are deemed as relatively unacceptable as sentences of the English language, might other sentences, such as, “Meredith knows better than Sean that a photon’s energy is proportional to its radiation frequency,” be deemed as acceptable?

To explore these and related questions, three experiments were carried out. In brief, the results revealed a significant strong positive correlation between the amount of mental effort that people judge to be involved in knowing a given proposition p and how acceptable people deem sentences of the form, “ S knows better than S^* that p ,” and, “ S

knows that p better than S^* does.” After summarizing the results of the experiments, I discuss the potential importance of the findings for theorizing about gradations of propositional knowledge.

2. Experiment 1

Experiment 1 was designed specifically to test what I call the “Mental Effort Hypothesis,” i.e., the hypothesis that the amount of mental effort that people judge to be involved in knowing a given proposition corresponds to people’s judgements about whether it is acceptable to claim that someone knows the proposition better than someone else does. To test this, I constructed a variety of comparative knowledge sentences and looked to see if an overall pattern emerged when comparing people’s acceptability ratings of the comparative knowledge sentences with people’s mental effort ratings for the known propositions expressed within those sentences.

2.1. Method

One hundred participants were recruited through Amazon’s Mechanical Turk by posting a length-limited description of the task. Tasks were restricted to participants in the United States, and to those who have an approval rating on the Mechanical Turk system of at least 95%.

Participants were randomly assigned to one of two groups. Participants in the Acceptability Group were presented with a series of twenty-five comparative knowledge sentences of the form, “ S knows better than S^* that p ” (e.g., “Rachelle knows better than Kristen that velocity is a function of time”) (see Table 1 for the exact wording of each sentence). Each participant was instructed, “On a scale of 0-10, rate each sentence

according to how acceptable it is as a sentence of the English language.” “0” was labeled as “Completely unacceptable as a sentence of the English language,” and “10” was labeled as “Completely acceptable as a sentence of the English language.” For each participant, the order in which the twenty-five sentences were presented was randomized.

Participants in the Mental Effort Group completed a similar task in which they were likewise given twenty-five sentences. But rather than being asked about the acceptability of comparative knowledge sentences, participants in the Mental Effort Group were presented only with the part of each sentence that expresses the known proposition (e.g., “Velocity is a function of time”) and were instructed, “On a scale of 0-10, rate each sentence according to how much mental effort is likely required in order for a person to know that the sentence is true.” “0” was labeled as “No mental effort is required in order for a person to know that the sentence is true,” and “10” was labeled as “A great amount of mental effort is required in order for a person to know that the sentence is true.” Again, for each participant, the order in which the twenty-five sentences were presented was randomized.

2.2. Results

The mean ratings for sentences presented to those in the Acceptability Group and the mean ratings for sentences presented to those in the Mental Effort Group are displayed in Table 1. As can be seen, the mean ratings of the Acceptability Group ranged from 6.49 (on the low end) to 8.20 (on the high end), a range that is higher than one might expect if it were the case that competent language speakers systematically judge comparative knowledge ascriptions to be unacceptable.

More importantly, there was a significant positive correlation between the mean ratings of the Acceptability Group and those of the Mental Effort Group, $r = .79$, $p < .001$ (see Figure 1). In other words, there was a general tendency such that the higher the given proposition was in ratings of mental effort required to know it, the higher it was in acceptability of comparative knowledge attribution.

2.3 Discussion

In accordance with the Mental Effort Hypothesis, these results suggest that the amount of mental effort that people judge to be involved in knowing a given proposition corresponds to people's judgements about whether it is acceptable to claim that someone knows the proposition better than someone else does.

	CK1	ME	CK2	CE
Mark knows better than Jordan that Barack Obama is President.	6.49	1.35	4.16	8.29
Amber knows better than Kathryn that 26 is greater than 5.	6.80	1.41	5.25	8.19
Mary knows better than Beth that 4 is an even number.	6.96	1.19	5.47	8.27
Ashley knows better than James that red is a primary color.	7.10	2.15	5.82	8.40
Deborah knows better than William that George Washington is no longer alive.	7.18	0.69	4.53	7.98
Justin knows better than Kendal that a 3-centimeter line is shorter than a 2-meter line.	7.18	2.87	5.53	8.23
Emily knows better than Steven that there are 52 weeks in a year.	7.18	2.07	5.35	7.87
Alex knows better than Meredith that Augusta is the capital of Maine.	7.20	4.19	5.12	8.37
Cheryl knows better than Kate that $2+3$ equals $3+2$.	7.33	1.74	5.18	8.00
Annie knows better than Josiah that Alaska is north of the Equator.	7.35	2.39	5.25	8.37
Jules knows better than Scott that Hillary Clinton is a Democrat.	7.53	1.83	4.71	8.35
Nikki knows better than Jonathan that the ideal gas law only approximates the behavior of real gases.	7.55	7.24	5.82	8.04
Jeremiah knows better than David that the freezing point of water is 32 degrees Fahrenheit.	7.59	2.96	4.92	8.48
Alyssa knows better than Philip that every integer is the product of primes.	7.61	6.24	5.66	8.04
Cindy knows better than Bryan that sound can be propagated in an elastic medium.	7.63	7.67	6.18	8.48
Tim knows better than Sean that mass is a measure of energy.	7.67	5.65	6.38	8.40
Ben knows better than Ricky that the Ptolemaic system does not accurately represent the motion of planets.	7.68	7.41	5.59	8.35
Rachelle knows better than Kristen that velocity is a function of time.	7.71	6.80	5.98	8.35
Jessie knows better than Matthew that DNA is a nucleic acid.	7.71	5.67	6.00	8.56
Elizabeth knows better than Paul that the speed of light is a physical constant.	7.78	6.11	6.12	8.40
Samantha knows better than Nicole that a circle's diameter is twice as long as its radius.	7.82	5.00	5.41	8.29
Sarah knows better than Lisa that the ring particles of Saturn consist mostly of ice.	7.96	5.13	5.63	8.54
Christina knows better than Monica that electromagnetism is a fundamental force.	8.00	6.59	6.06	8.48
Micah knows better than Charles that air resistance is a frictional force.	8.06	6.02	5.92	8.58
Omar knows better than Michael that a photon's energy is proportional to its radiation frequency.	8.20	8.30	5.75	8.06

Table 1. First column (Sentences): twenty-five comparative knowledge sentences. Second column (CK1): mean acceptability ratings for each sentence given by participants in the Acceptability Group from Experiment 1. Third column (ME): mean mental effort ratings given by participants in the Mental Effort Group from Experiment 1 (where participants were only presented with the part of each sentence that

follows the word “that”). Fourth column (CK2): mean acceptability ratings given by participants in Experiment 2 (where sentences were of the form, “ S knows that p better than S^* does,” rather than, “ S knows better than S^* that p ”). Fifth column (CE): mean acceptability ratings given by participants in Experiment 3 (where sentences were of the form, “ S has more evidence than S^* that p ”).

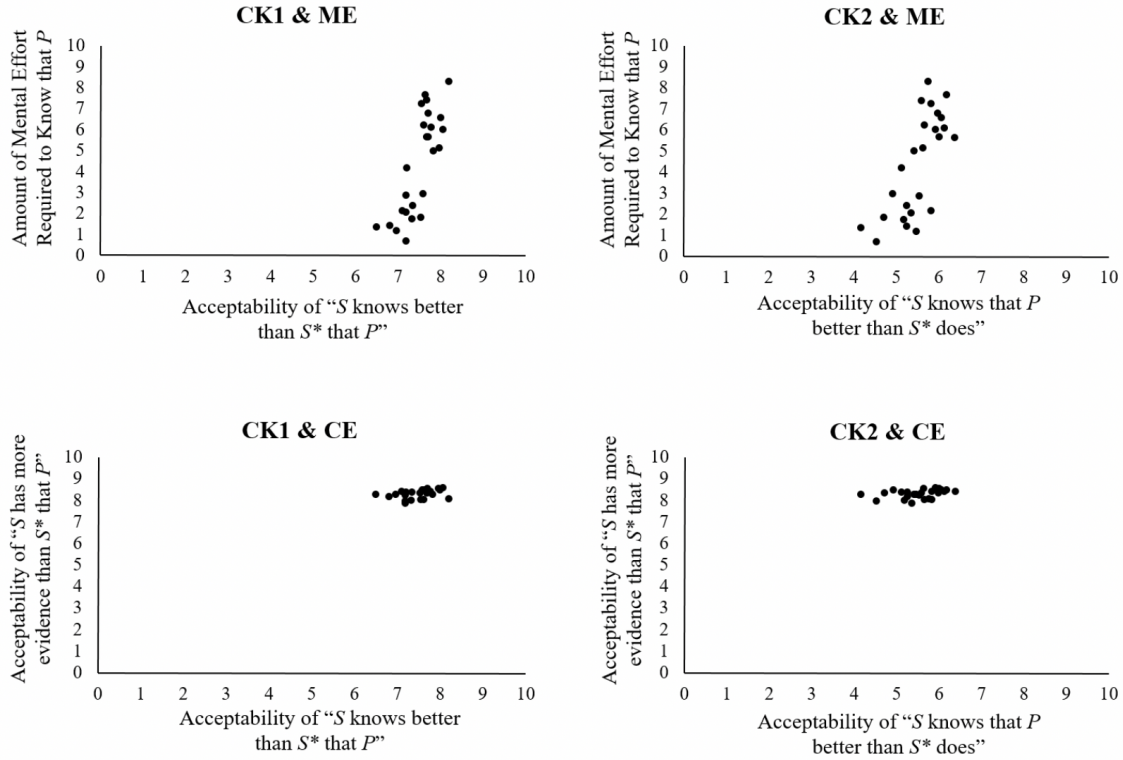


Figure 1. Top left (CK1 & ME): scatterplot comparing the mean ratings given by participants in the Acceptability Group from Experiment 1 with the mean ratings given by participants in the Mental Effort Group. Top right (CK2 & ME): scatterplot comparing the mean ratings given by participants in the Acceptability Group from Experiment 2 with the mean ratings given by participants in the Mental Effort Group. Bottom left (CK1 & CE): scatterplot comparing the mean ratings given by participants in the Acceptability Group from Experiment 1 with the mean ratings given by participants in Experiment 3. Bottom right (CK2 & CE): scatterplot comparing the mean ratings given by participants in the Acceptability Group from Experiment 2 with the mean ratings given by participants in Experiment 3.

3. Experiment 2

Experiment 2 was designed to further explore the Mental Effort Hypothesis by examining the relation between the amount of mental effort that people judge to be involved in knowing a given proposition p and how acceptable people deem sentences of

the form, “ S knows that p better than S^* does” (in contrast to sentences of the form, “ S knows better than S^* that p ,” used in Experiment 1).

3.1. Method

Fifty new participants were recruited using the same methods as those used in Experiment 1. In Experiment 2, however, all participants received a series of twenty-five comparative knowledge sentences that were like those given to participants in the Acceptability Group from Experiment 1, except that all sentences were of the form, “ S knows that p better than S^* does” (rather than, “ S knows better than S^* that p ”). To illustrate, rather than being presented with the sentence, “Rachelle knows better than Kristen that velocity is a function of time,” the participants in Experiment 2 were presented with the sentence, “Rachelle knows that velocity is a function of time better than Kristen does,” and similarly for the other twenty-four sentences. Moreover, as with the participants in the Acceptability Group from Experiment 1, the participants in Experiment 2 were instructed, “On a scale of 0-10, rate each sentence according to how acceptable it is as a sentence of the English language.” “0” was labeled as “Completely unacceptable as a sentence of the English language,” and “10” was labeled as “Completely acceptable as a sentence of the English language.” For each participant, the order in which the twenty-five sentences were presented was randomized.

3.2. Results

The mean ratings for sentences presented to those in Experiment 2 were compared with the mean ratings for sentences presented to those in the Mental Effort Group from Experiment 1 (see Table 1). Analyses performed on these means again revealed a

significant strong positive correlation between acceptability judgements and mental effort judgments, $r = .73, p < .001$ (see Figure 1).

The mean ratings for comparative knowledge judgements in Experiment 1 were then compared with the mean ratings for comparative knowledge judgements in Experiment 2. Mean ratings for comparative knowledge judgements in Experiment 1 ($M = 7.49, SD = .40$) were found to be significantly greater than those in Experiment 2 ($M = 5.51, SD = .53$), $t(48) = 14.58, p < .001$ (see Table 1).

3.3 Discussion

Despite the fact that participants were significantly more willing to deem as acceptable sentences of the form, “ S knows better than S^* that p ,” than they were willing to deem as acceptable sentences of the form, “ S knows that p better than S^* does,” there was nevertheless a significant strong positive correlation, with respect to both types of comparative knowledge sentences, between the amount of mental effort that participants judged to be involved in knowing a given proposition and how acceptable participants deemed claims that someone knows the proposition better than someone else does. This provides further support in favor of the Mental Effort Hypothesis, and it also suggests that people's acceptability judgements regarding comparative knowledge sentences can be affected by the grammatical form of such sentences (i.e., with people favoring sentences of the form, “ S knows better than S^* that p ,” over sentences of the form, “ S knows that p better than S^* does”).

To summarize the results presented thus far, Experiment 1 gathered data from two different groups: (i) the Acceptability Group from Experiment 1 (which consisted of participants who were asked to rate the acceptability of sentences of the form, “ S knows

better than S^* that p ”), and (ii) the Mental Effort Group (which consisted of participants who were asked to rate the amount of mental effort likely required to know that p). Then, in Experiment 2, a third group was added: i.e., an additional Acceptability Group (which consisted of participants who were asked to rate the acceptability of sentence of the form, “ S knows that p better than S^* does”). Three analyses were then performed. First, the acceptability judgments from Experiment 1 (i.e., judgments of sentences of the form, “ S knows better than S^* that p ”) were compared with the mental effort judgments, item-by-item, and a significant strong positive correlation was found between the two types of judgments. Secondly, the acceptability judgments from Experiment 2 (i.e., judgments of sentences of the form, “ S knows that p better than S^* does”) were compared with the mental effort judgments, item-by-item, and again, a significant strong positive correlation was found between the two types of judgments. Finally, the mean acceptability ratings from Experiment 1 were compared with the mean acceptability ratings from Experiment 2, and the former means were found to be significantly greater than the latter means.

4. Experiment 3

Experiment 3 was designed to test whether the participants who were presented with comparative knowledge sentences might have been interpreting the sentences as claims about having *more evidence*. This is relevant since some opponents of the gradability of propositional knowledge grant that we sometimes make comparative knowledge claims, but they suggest that such claims are best understood as claims about the amount of evidence that one has. Dretske, for instance, acknowledges that there are cases in which people make comparative knowledge claims, but he notes, “I take such

constructions to be describing, not better knowledge, but more direct, more compelling, kinds of evidence” (1981, p. 378).¹

4.1. Method

Fifty new participants were recruited using the same methods used in Experiments 1 and 2. But rather than being presented with comparative knowledge sentences, all participants in Experiment 2 were presented with a series of twenty-five comparative *evidence* sentences (i.e., sentences of the form, “*S* has more evidence than *S** that *p*”) which correspond to the comparative knowledge sentences presented to those in the Acceptability Group from Experiment 1. For instance, rather than being presented with the sentence, “Rachelle knows better than Kristen that velocity is a function of time,” the participants in Experiment 3 were presented with the sentence, “Rachelle has more evidence than Kristen that velocity is a function of time,” and similarly for the other twenty-four sentences. As with the participants in the Acceptability Group from Experiment 1, participants in Experiment 3 were instructed, “On a scale of 0-10, rate each sentence according to how acceptable it is as a sentence of the English language.” “0” was labeled as “Completely unacceptable as a sentence of the English language,” and “10” was labeled as “Completely acceptable as a sentence of the English language.” For

¹ In contrast to Dretske’s suggestion, one might hold that the gradability of knowledge is not at odds with the view that comparative knowledge claims are best understood as claims about the amount of evidence that one has. Supposing that this idea is correct, Experiment 3 is still relevant in that it serves to test a particular interpretation of the data from Experiments 1 and 2.

each participant, the order in which the twenty-five sentences were presented was randomized.

4.2. Results

The mean acceptability ratings for comparative evidence judgments are displayed in Table 1. These ratings were examined to see if they were correlated with the acceptability ratings for the two types of comparative knowledge sentences (namely, the ones from Experiment 1 and those from Experiment 2). The results show that comparative evidence ratings were not significantly correlated either with the comparative knowledge ratings from Experiment 1, $r = .33, p = .1$, or with the comparative knowledge ratings from Experiment 2, $r = .33, p = .1$ (see Figure 1).

4.3. Discussion

The lack of a significant correlation between the acceptability of comparative knowledge sentences and the acceptability of comparative evidence sentences suggests that participants were not merely reading the comparative knowledge sentences as sentences about having more evidence.

5. General discussion

In sum, this paper provides data from two experiments (i.e., Experiments 1 and 2) that reveal a significant strong positive correlation between the amount of mental effort that people judge to be involved in knowing a given proposition p and how acceptable people deem sentences of the form, “ S knows better than S^* that p ,” and, “ S knows that p

better than S^* does.” Furthermore, data from Experiment 3 provide evidence against the hypothesis that participants were merely interpreting the comparative knowledge sentences as sentences about how much evidence one has.

These findings open up the possibility that the amount of mental effort that people judge to be involved in knowing a given proposition influences their judgements about whether it is acceptable to claim that someone knows the proposition better than someone else does. What might explain such an influence of perceived mental effort on the acceptability of comparative knowledge ascriptions? One possible answer can be seen by comparing the verb “knows” to the verb “draws.” Consider, for instance, the following claims:

- (c1) Joan draws landscapes better than Nathan does.
- (c2) Joan draws portraits better than Nathan does.
- (c3) Joan draws amorphous shapes better than Nathan does.
- (c4) Joan draws dots better than Nathan does.
- (c5) Joan draws random squiggles that come to mind better than Nathan does.

While the verb “draws” clearly accepts degree modifiers, claims (c3) – (c5) seem more difficult to make sense of than claims (c1) and (c2). One potential explanation for this difference is that evaluative comparisons with respect to human agents tend to be comparisons about what one has *achieved*, and thus presuppose some type of active, effortful skill performed by an agent. To illustrate, the claim, “Joan draws x better than Nathan does,” suggests that Joan has *achieved more* in drawing x than Nathan has, and thereby suggests that drawing x involves the performance of some type of active, effortful

skill. How does this help explain the greater intelligibility of (c1) and (c2) relative to (c3) – (c5)? It does so by way of the fact that while drawing landscapes and portraits are quite naturally seen to involve some type of active, effortful skill, it is more difficult to see how such skill might be involved in drawing amorphous shapes, dots, and random squiggles that come to mind, and thus it is more difficult to see how one might draw such figures *better than* another person.

A similar point might explain why examples sometimes used by epistemologists make it seem as if propositional knowledge is not gradable: i.e., because such examples employ propositions that, if known at all, are likely to be known without any significant amount of mental effort or skill. For instance, consider the proposition, <Barack Obama is President>. Given the relatively minimal amount of mental effort that is likely to be involved in knowing this proposition, it is hard to see how there could be significant variation in the amount that one might *achieve* in knowing the proposition. And without significant variation in potential achievement, it may well be difficult to make sense of a claim that someone knows the proposition *better than* someone else does. By contrast, consider the comparative knowledge sentence with the highest mean acceptability rating in Experiments 1 and 2: namely, the sentence, “Omar knows better than Michael that a photon’s energy is proportional to its radiation frequency.” Here, it seems easier to imagine that knowing the relevant proposition (i.e., the proposition, <A photon’s energy is proportional to its radiation frequency>) involves a relatively high amount of mental effort, which allows for a relatively wide range of potential achievement in knowing it. It is perhaps this relatively wide range of potential achievement that provides a path by

which one can make sense of the claim that someone knows the proposition *better than* another person does.

What bearing do such results have on theorizing about gradations of propositional knowledge? In particular, if graded propositional knowledge ascriptions are acceptable in certain cases, then what determines the various gradations? One finding that might suggest an answer can be seen by comparing sentences in the top half of Table 1 (i.e. comparative knowledge sentences with lower mean acceptability ratings) with sentences in the bottom half of Table 1 (i.e., comparative knowledge sentences with higher mean acceptability ratings). While sentences in the top half of the table are largely free of technical terminology, the majority of sentences in the bottom half of the table employ such terminology. Accordingly, the amount of mental effort that is involved in knowing a proposition might be understood largely in terms of the amount of mental effort that is involved in grasping the proposition's constituents and the relations among them.

Given this, I offer the following provisional account of graded propositional knowledge: How well a subject knows some proposition p is an increasing function of how well the subject grasps p 's constituents and their relations (or, to put it differently, it is an increasing function of how well the subject grasps the proposition's content).² To illustrate, suppose that Edgar is attending a mathematics lecture in which the professor utters the sentence, "Every positive integer is the product of primes." Edgar rightly believes that the teacher is speaking truthfully when she utters the sentence, and he

² Note that, on this view, a person might obtain an increase in knowing a given proposition p even if the person's justification for p remains fixed.

therefore commits the sentence to memory. After pondering over the sentence for quite some time, Edgar becomes increasingly fascinated by the sentence, and he even writes the sentence on a test in response to the question, “What is the most interesting fact that you have learned in this course?” However, Edgar has only a weak grasp of the notion of primes. For instance, he is unable to use the definition of primes to show why four of the first ten positive integers are prime. And when one of his classmates remarks, “7 is not prime because it is divisible by 10, since 7 divided by 10 equals 0.7,” Edgar becomes confused by the comment and cannot think of any satisfactory response. Nevertheless, Edgar still has a few general ideas about primes, such as that Euclid demonstrated that there are infinitely many, and that the first few are 2, 3, 5, 7, 11, 13, and 17. Given such a case, it seems that one could intelligibly say that while Edgar has at least some knowledge that every positive integer is the product of primes, Edgar does not know this as well as someone who has obtained a much stronger grasp of all the relevant constituent notions of the proposition and how the relevant notions relate to one another. Assuming that this line of thought is correct, it suggests that there is a scalar structure encoded in the verb “knows” that measures (perhaps among other things) how well one *grasps the content* of the proposition in question. This stands in contrast to the idea, sometimes associated with epistemic contextualism, that there is a scalar structure encoded in the verb “knows” that measures how well *justified* one is in believing the proposition in question. But the two ideas are not incompatible. For, there might be more than one scalar structure that is encoded in the verb “knows,” or the scalar structure that is associated with gradations of grasping might be associated with gradations of other features (e.g., justification) as well.

5.1. Conclusion

The results from these experiments shed new light on how people think about comparative knowledge ascriptions, and they also raise a number of questions. For instance, what features inform people's judgements about the amount of mental effort that is required in order to know a given proposition? How exactly do people think (and how *should* we think) about gradations of knowledge regarding propositions that require a significant amount of mental effort to know? Are there other features of propositions that might influence the acceptability of comparative knowledge ascriptions? It is to such questions that I hope to turn in future research.

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