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ORIGINAL RESEARCH

Evidence and Cognition

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Abstract
Cognitive theorists routinely disagree about the evidence supporting claims in cognitive science. Here, we first argue that some disagreements about evidence in cognitive science are about the evidence available to be drawn upon by cognitive theorists. Then, we show that one's explanation of why this first kind of disagreement obtains will cohere with one's theory of evidence. We argue that the best explanation for why cognitive theorists disagree in this way is because their evidence is what they *rationally grant*. Finally, we explain why our view does not lead to a pernicious kind of relativism in cognitive science.

1 Introduction

Theorists of cognition routinely disagree about the evidence supporting claims in cognitive science. As an example, consider Woodward and Cowie's concern that:

> Evolutionary psychologists largely ignore the biological evidence [...such as...] evidence from neurobiology, genetics, and developmental biology, but also any evidence from evolutionary biology, ethology and population genetics (Woodward & Cowie, 2003, p. 332).

Others, however, downplay Woodward and Cowie's concerns by arguing that it is enough for evolutionary psychologists to pay attention to behavioural and/or psychological evidence, which details the functional components of organisms by attending to functional dissociations between cognitive tasks (e.g., between language production and language comprehension). Hagen (2005, p. 148), for instance, argues that, in evolutionary psychology, functional and non-biological evidence is

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enough to support claims about "the exquisite match between organism structure and environment."

Up to now, no account has been given of why cognitive theorists disagree in this way about the evidence supporting claims in cognitive science. This is despite the fact that greater attention has been paid to the role of evidence in science more generally (Goldenberg, 2015; Psillos, 2015). But given that the viability of any explanation of cognitive phenomena depends upon the available evidence, we cannot hope to resolve debates about explanation in cognitive science without first resolving disagreements about evidence in cognitive science. And we will not be able to resolve disagreements about evidence in cognitive science until we can make sense of why those disagreements obtain in the first place.[1] Thus, those seeking the best explanations of cognition must attend to disagreements about evidence in cognitive science.

Prima facie, the disagreement about evidence in evolutionary psychology seems to be about the evidence *selected and used* in evolutionary psychology—namely, about whether we should draw upon exclusively behavioural and/or psychological evidence or both behavioural and/or psychological and biological evidence. If this account of the disagreement is right, then resolving the disagreement requires only that we determine which evidence cognitive theorists should draw upon when formulating claims about cognition. But the question remains as to whether all disagreements about evidence in cognitive science can be understood in these terms. Here we argue that this is not the case, because some disagreements run deeper: they are disagreements about the evidence *available to* cognitive theorists in the first place.

To get clear on the distinction between these two different kinds of disagreements about evidence in cognitive science, we distinguish between an agent's *body of evidence* and a proposition in this body of evidence being *evidence for* some other proposition.[2] An agent's *body of evidence* includes everything that the agent can draw upon to form and evaluate beliefs and other epistemic attitudes. Being *evidence for* a proposition requires standing in an appropriate relation (e.g., positive probabilistic dependence) to that proposition, in addition to being in the agent's body of evidence. (In this paper, we focus on bodies of evidence that are sets of propositions, but we do not claim that evidence must always be propositional. Similarly, we leave open the possibility that evidence can be evidence for models and practices, as well as propositions.)

Having set-out this distinction, we can characterise cognitive theorists' disagreements about evidence in two different ways. One possibility is that cognitive theorists disagree about the evidence that should be drawn upon in a given explanatory

[1] In this paper, we focus on cognitive science because of the importance of the ongoing and highly tendentious disputes about explanation, understanding, and discovery in cognitive science (cf. Bermúdez, 2014; Craver, 2007; Thagard, 2012). We do not deny that there are disagreements about evidence in other domains and that the reasons for these disagreements merit further research.

[2] We also recognise that bodies of evidence might be derived from *evidence bases*, where, for example, $\{\theta, \theta \rightarrow \phi\}$ is an evidence base for the body of evidence $\{\theta, \theta \rightarrow \phi, \phi\}$ (Williamson, 2015, p. 31). The distinction between a body of evidence and an evidence base, however, plays less of a role in the overall argument of this paper.

context, even though they agree about the evidence available to be drawn upon. In this scenario, cognitive theorists disagree about the propositions taken as *evidence for* a claim, even though they agree about the set of propositions comprising their bodies of evidence. The second possibility is that cognitive theorists disagree about the evidence available to be drawn upon. In this scenario, cognitive theorists disagree about the set of propositions comprising their *bodies of evidence*.

Our first claim is that some of the major disagreements in cognitive science are best understood as disagreements about bodies of evidence. But after defending this claim, we face the challenge of showing *why* cognitive theorists disagree in this way. One's answer to this question will inevitably cohere with one's theory of evidence, because one's theory of evidence will dictate how one conceives of differences between bodies of evidence. For example, if one takes evidence to be what is known, then one will explain disagreements about the set of propositions comprising bodies of evidence as disagreements about what is known.

Our argument is that we can best explain why cognitive theorists disagree about their bodies of evidence if we endorse the theory that your evidence is what you rationally grant (Williamson, 2010). To arrive at this conclusion, we first explain why some disagreements about evidence in cognitive science are best understood as disagreements about cognitive theorists' bodies of evidence (Sect. 2). Then, we show that one's explanation of this kind of disagreement will cohere with one's theory of evidence (Sect. 3). We argue that the best explanation for why cognitive theorists disagree about their bodies of evidence is because their evidence is what they rationally grant about cognition (Sect. 4). Finally, we explain why our view does not lead to a pernicious kind of evidential relativism in cognitive science (Sect. 5).

2 Disagreements About Evidence in Cognitive Science

Cognitive theorists typically draw upon evidence of four kinds of system to support their claims about cognition. Biological systems are one kind—these are complex networks of entities interacting at different scales; e.g., at the level of cells, organelles, or genes. Neurophysiological systems are a second kind—a subkind of biological systems, which involve a complex network that collects, transfers, and processes information in the brain, spinal cord, peripheral nervous system, and sense organs. Psychological/behavioural systems, on the other hand, are collections of various mental functions—e.g., perception, memory, and categorisation—that manifest in behaviour. Finally, environmentally-embedded systems are collections of various mental functions that depend, at least in part, on objects external to the brain or body.

But cognitive theorists also draw upon evidence that cuts across this quadripartite distinction: evidence of mechanisms, which obtains in biological, neurological, psychological/behavioural, and environmentally-embedded systems. For example, evidence of mechanisms plays a role in claims about gene expression and regulation (Singh et al., 2018), the action potential of a neuron (Craver & Bechtel, 2006), second language fluency (Schmidt, 1992), and of the capacity for cognitive systems to

"use raindrop sounds to time and pace certain internal operations essential to some kinds of problem-solving" (Clark, 2007).

And evidence of mechanisms is not the only example here, because cognitive theorists also draw upon evidence of non-mechanistic dependencies, which are taken to obtain in biological, neurological, psychological/behavioural, and environmentally-embedded systems respectively. For example, evidence of non-mechanistic dependencies plays a role in claims about "the action of hormones and the regulation of genes" (Issad & Malaterre, 2015), "operational laws in cognition" (Bressler & Kelso, 2001), the "neuroscience of consciousness" (Thompson & Varela, 2001), or the interactions of brain–body–environment systems (Kelso, 1995).

Disagreements about evidence are now commonplace in cognitive science (cf. Taylor & Vosgerau, 2021). One might argue that such disagreements between cognitive theorists are merely about which propositions should be drawn upon—e.g., selected and used—as *evidence for* claims about cognition, and nothing more. If this view were correct, then disagreements about evidence in cognitive science would amount to nothing more than a disagreement about whether cognitive theorists should draw upon, say, propositions about neurophysiological systems or propositions about psychological/behavioural systems, or whether they should draw upon propositions about mechanisms or propositions about non-mechanistic dependencies.

Some disagreements about evidence in cognitive science can be understood as disagreements of this kind. Consider claims in psychology, which typically characterise cognitive systems in a way that captures their cognitive functioning. Some cognitive theorists seem to assume that the evidence for psychological claims is always evidence of mechanisms: "[f]unctional analysis cannot be autonomous from mechanistic explanation because the former is just an elliptical form of the latter" (Piccinini & Craver, 2011, p. 290). Others, however, argue that psychological claims "may be confirmed or disconfirmed by appeal to potentially any piece of evidence (introspective, behavioral, neurophysiological, clinical, etc.)," such that evidence of any number of different kinds may count as evidence for psychological claims (Weiskopf, 2017).

As a further example, consider claims about the dynamical nature of cognition, which characterise the behaviour of cognitive systems in terms of emergent or higher-level dependencies describing (changes to) the global state of the system (Van Gelder, 1995). Again, some cognitive theorists seem to assume that the evidence for such dynamical claims is always evidence of mechanisms, because "the explanatory force of dynamical models [...] inheres in their ability to reveal dynamic and organizational features of the behavior of a mechanism" (Kaplan & Craver, 2011, p. 623). However, others argue that the evidence for dynamical claims need not be mechanistic, because dynamical claims "abstract away from causal mechanical and aggregate micro-details" (Chemero & Silberstein, 2008, p. 12).

Our argument, however, is that *not all* disagreements about evidence in cognitive science can be characterised as disagreements about the *evidence for* particular claims. To see why this is the case, consider first the potential disagreement about whether or not cognitive theorists' *bodies of evidence* are constituted exclusively by propositions about behaviour (hereafter "behavioural propositions"). This view

might be defended by a cognitive theorist who assumes that propositions about, say, psychological mechanisms are merely theoretical hypotheses and do not count as genuine constituents of cognitive theorists' bodies of evidence. However, even this claim is open to dispute.

Note first that no cognitive theorist will deny that behavioural propositions—about both bodily and linguistic behaviour (so-called "behavioral evidence") and the behaviour of the brain (so-called "neural evidence")—are constituents of their bodies of evidence (Amer et al., 2022, pp. 257–258). Evidence of this kind is widespread and is often presented in the form of, say, iEEG data about neuron spiking rates or pixel activation data from fMRI or other neuroimaging studies. But, on reflection, some cognitive theorists may take issue with the claim that their bodies of evidence are exclusively constituted by behavioural propositions, because this would not fit with their practices of developing theoretical and predictive claims about cognitive structure and function.

To make this point explicit, consider the following claims made in the context of investigations into (cluttered and shared) memories:

> Classic behavioral work illustrates that prior knowledge shapes memory representations and recall patterns in older adults [...] (ibid., p. 258).

And:

> we found that spatial patterns of brain activity observed during movie viewing were reactivated during spoken recall (movie–recall similarity). [...] We also observed that these spatial activity patterns were similar across people during spoken recall (recall–recall similarity) and highly specific to individual events in the narrative [...]
> Overall, the results suggest the *existence of a common spatial organization for* memory representations in the brains of different individuals, concentrated in high-level cortical areas (including the default mode network) and robust enough to be observed as people speak freely about the past. Furthermore, neural representations in these brains regions were modified between perceptual experience and memory in a systematic manner across different individuals, suggesting a shared process of memory alteration (Chen et al., 2017, 116, our italics).

Note that in both cases—and many others like them—propositions about representations—e.g. "memory/neural representations exist"—are not part of the theory being advanced. However, some cognitive theorists might argue that they are playing a pivotal role as evidence for propositions about, say, the role of cluttered representations in older adults' episodic memory and the common spatial organization for memories in high-level cortical areas. According to this argument, Amer et al. (2022) and Chen et al. (2017) can only advance theories about how memory representations are "shaped" and "organized," because the proposition that "memory representations exist" is a constituent of their bodies of evidence.

The point, therefore, is that it is possible to argue that working cognitive theorists do not develop theories or make (testable) predictions on the basis of

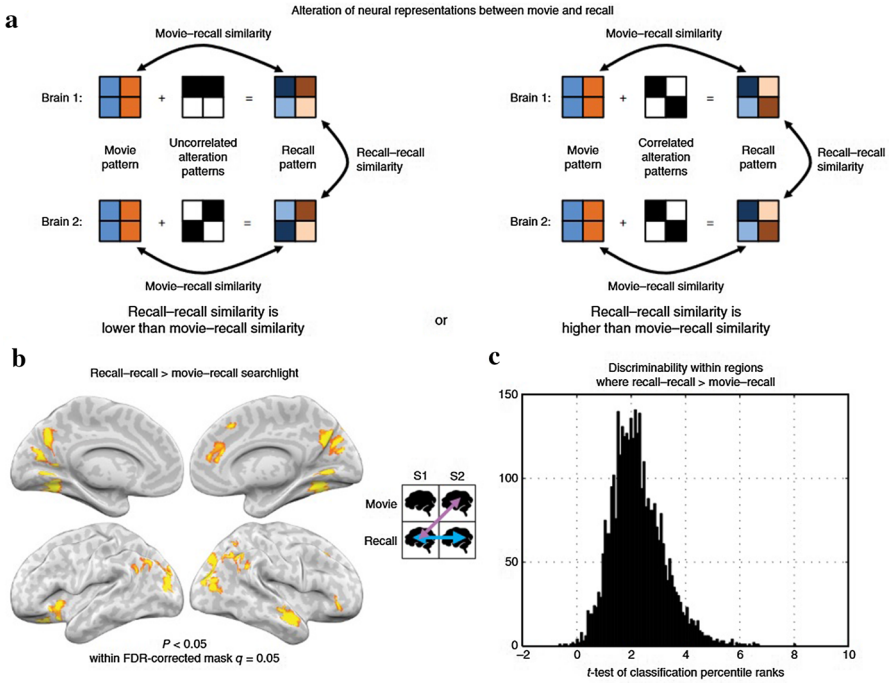

Fig. 1 Alteration of neural patterns from perception to recollection from Chen et al. (2017, p. 121). **a** Schematic of neural activity patterns during a movie scene being modified into activity patterns at recall. **b** Searchlight map showing regions where recall–recall similarity was significantly greater than between-participants movie–recall similarity. **c** Test of whether each participant's individual scene recollection patterns could be classified better using the movie data from other participants or the recall data from other participants

behavioural propositions alone, because they also appeal to propositions about the nature of cognition itself. Consider the aforementioned examples again. In each case, data were presented about neural behaviour (see Fig. 1 as an example). However, one could argue that until coordinated with other propositions about, say, the existence of memory representations, this data cannot be interpreted as pertaining to information encoded (read: represented) by patterns of neural activity. As such, cognitive theorists can argue that it is the union of behavioural propositions and non-behavioural propositions about memory representations that function as evidence for the theoretical claims and predictions about, e.g., shared memories, and that both kinds of propositions are therefore part of, e.g., Chen et al.'s (2017) bodies of evidence.

Some cognitive theorists might disagree and argue that, in these cases, it is still the case that only behavioural propositions count as evidence and that non-behavioural propositions about memory representations are mere theoretical commitments on the part of cognitive theorists. But other cognitive theorists may contest this point, perhaps because they assume that if *b* (a behavioural proposition) and *p* (a non-behavioural proposition) have the same inferential role and stand in the

same relation to q (a theoretical or predictive claim), and b is taken to be part of cognitive scientist's evidence for q, then so too should p. Alternatively, they may argue that some non-behavioural propositions enjoy the same evidential status as behavioural propositions, since even a lack of theoretical or predictive success would not be enough to bring them into question.[3]

Thus, even the basic claim about whether cognitive theorists' bodies of evidence are exclusively comprised of behavioural propositions is open to disagreement. And it is important to recognise that those who take a stand on this issue are also taking a (philosophical) stance on what evidence *is*; i.e. that cognitive theorists' bodies of evidence are/are not comprised of behavioural propositions alone. A further problem is that appeals to cognitive scientific practice cannot help to resolve the disagreement, since the attitudes of some cognitive theorists might directly contradict the evidential activities of their colleagues. For example, any insistence that only behavioural propositions count as evidence would seem to conflict with some interpretations of the evidential practices on display in Amer et al. (2022) and Chen et al. (2017).

There are other disagreements between cognitive theorists about their bodies of evidence. Consider the long-standing disagreement about evidence of propositional attitudes. Churchland (1981, p. 67) argues that any hypothesis supported by evidence of propositional attitudes will be:

> *un*fit to represent the deeper reality in all its kinematically, dynamically, and even normatively relevant respects. That is to say, a system of propositional attitudes [...] must inevitably fail to capture what is going on here, though it may reflect just enough superficial structure to sustain an alchemy-like tradition among folk who lack any better theory.

Reconstructing Churchland's argument in terms of the distinction between *evidence for* and *bodies of evidence*, we arrive at the following interpretive possibilities: either Churchland is arguing that propositions about propositional attitudes should not be drawn upon as evidence or that propositions about propositional attitudes are not available to be drawn upon as evidence.

At this point, it is important to note that many cognitive theorists do draw upon propositions about propositional attitudes as evidence, because they argue that when we draw upon such propositions we are remarkably successful in explaining and predicting cognitive (cf. Fodor, 1987; Kitcher, 1984; Lahav, 1992). For example, when explaining why children pass or fail false-belief tasks, it is standard practice to draw upon evidential propositions about how "children rely on the desires of the agent when predicting that agent's behavior" or about how "children coordinate beliefs and desires to predict behavior" (Cassidy, 1998, B3, B10) (see also Baillargeon et al., 2010; Friedman & Leslie, 2004; Repacholi & Gopnik, 1997).

[3] Perhaps they accept that a widespread lack of theoretical or predictive success would be enough to bring them into doubt, but the same could plausibly hold true of behavioural propositions. If, for example, evidence of brain behaviour had never supported theoretical or predictive success in the cognitive scientists, then this would also raise doubt about whether this evidence was relevant in this context.

However, "eliminative materialists" like Churchland claim that there is nothing more to the mind than what occurs in the brain and, hence, that propositional attitudes do not really exist.[4] Thus, to argue that eliminative materialists are only disputing whether propositions about propositional attitudes should be drawn upon as evidence is to ascribe to them the unlikely view that we can have evidence involving things that do not exist. As a consequence, their view is likely to be that propositions about propositional attitudes—e.g., the propositions that children coordinate beliefs and desires to predict behaviour—are not available to be drawn upon as evidence at all.[5]

Now consider the debate about evidence of mental representations. Hutto and Myin (2013, p. 82) argue that:

> it is possible to explain a creature's capacity to perceive, keep track of, and act appropriately with respect to some object or property without positing internal structures that function to represent, refer to, or stand for the object or property in question.[6]

Reconstructing Hutto and Myin's argument in terms of the distinction between *evidence for* and *bodies of evidence*, we arrive at the following interpretive possibilities: either Hutto and Myin are arguing that propositions about mental representations should not be drawn upon as evidence or that propositions about mental representations are not available to be drawn upon as evidence.

Again, it is important to note again that many cognitive theorists do draw upon propositions about mental representations as evidence, because they argue that when we draw upon such propositions we achieve remarkable success in explaining and predicting cognitive behaviours (cf. Dretske, 1988; Fodor, 1987; Thagard, 2005). For example, when doing cognitive linguistics it is standard practice to draw upon the proposition that "the language faculty consist[s] of both representational and procedural competence" (Schwarz-Friesel, 2012); and when doing (cognitive) neuroscience it is standard practice to draw upon propositions that "The principle function of the central nervous system is to represent and transform information and thereby mediate appropriate decisions and behaviors" (Decharms & Zador, 2000).

However, "anti-representationalists" like Hutto and Myin (2017, pp. xiv, 39) argue explicitly that cognition does not involve "the picking up and processing of

[4] In this vein, Quine (1960, p. 260) argues that our best explanations of the mind will be given in terms of physical entities, because "[t]he bodily states exist anyway; why add the others?"

[5] There are two possible interpretations of the eliminative materialist claim that propositional attitudes do not exist. They may hold that propositions about propositional attitudes are propositions involving disguised definite descriptions—e.g., the mental state held by an agent towards a proposition—which are not instantiated. Such propositions may be deemed false and, hence, non-evidential (cf. Russell, 1905). Alternatively, they may hold that we cannot have well-formed propositions about propositional attitudes at all, because the singular term "propositional attitude" does not refer (cf. Quine, 1948). For our purposes, however, this distinction does not matter, because, on either interpretation, propositions about propositional attitudes will not be part of eliminative materialist's bodies of evidence.

[6] Hutto and Myin's claims are more specific: they argue that "basic cognition" is non-representational, where 'basic cognition' captures all cognitive activities except those involving public language and cultural symbol systems.

information that is used, reused, stored, and represented in the brain." Thus, to argue that "anti-representationalists" are only disputing whether propositions about mental representations should be drawn upon as evidence is, again, to ascribe to them the unlikely view that we can have evidence propositions about things that do not exist. As a consequence, their view is likely to be that propositions about mental representations—e.g., the proposition that the language faculty is representational—are not available to be drawn upon as evidence at all, because we cannot have evidence of something that does not exist.

The upshot of this discussion is that some disagreements about evidence in cognitive science are best understood as disagreements between cognitive theorists about the propositions available to be drawn upon as evidence and not as disagreements about which of the available propositions should be drawn upon. In our terms, they are best understood as disagreements about the set of propositions comprising cognitive theorists' bodies of evidence. On this account, Churchland and Hutto and Myin should be read as disputing whether propositions about propositional attitudes/mental representations form a part of cognitive theorists' bodies of evidence in the first place. In the remainder of this paper, our aim is to show *why* cognitive theorists sometimes disagree in this way.

3 Explaining Disagreements About Evidence in Cognitive Science

To explain why cognitive theorists sometimes disagree about the set of propositions comprising their bodies of evidence, one has to take a view on how to conceive of bodies of evidence in the first place. Our claim in this section is twofold. Firstly, that one's theory of evidence will dictate how one conceives of (differences between) bodies of evidence. Second, that if we endorse a number of prominent theories of evidence—e.g., as knowledge, as belief, as observationally set credence, or as information—, then we cannot adequately explain why cognitive theorists disagree about the set of propositions (or information) comprising their bodies of evidence.[7]

3.1 Evidence as Knowledge

Littlejohn (2011, p. 242) argues that "a subject's evidence is what that subject has to go on in trying to arrive at a view." But this tells us little until we have a theory about what evidence *is*. To begin with, consider the theory that evidence is knowledge, $E = K$ (Bird, 2007; Williamson, 2002). On this view, everything that you know is in your body of evidence and you know everything that is in your body of evidence. So, in the context of our discussion, the claim would be that

[7] We view this as an important deficiency of those theories of evidence, but we acknowledge that others may take the view that a theory of evidence can still be correct even if it fails to account for evidential practices in science. We do not offer any overall assessment of theories of evidence here, though we do hold that the ability of a theory of evidence to accommodate evidential practices in the sciences should be a prominent consideration in such an assessment.

cognitive theorists' bodies of evidence are comprised exclusively of propositions that are known by those theorists.

Given $E = K$, one might attempt to characterise cognitive theorists' disagreements about their bodies of evidence as pointing to differences in what they know. But it cannot be that one group of researchers knows a proposition p (e.g., a proposition about propositional attitudes or mental representation) while another group knows its negation, $\neg p$, because it cannot be that both p and $\neg p$ are true. So such a disagreement must point to a conflict between what the groups *take to be* their evidence, rather than a conflict between their actual bodies of evidence. When there is such a conflict, at least one group must be wrong about their evidence, according to $E = K$.

Thus, such disagreements must point to differences in what researchers believe they know, with one group believing they know p and the other group believing they know $\neg p$. However, even this explanation is at odds with actual practice in cognitive science. Cognitive theorists' routinely take propositions to be evidence while remaining non-committal with respect to whether those propositions are known, or even denying that they are known. Consider Gallistel's (2006, 65) claim that when it comes to explaining the dance of the foraging bee,

> There is no way to account for the behavioral facts except by assuming a read/write memory and the composition of data structures, both of which functionalities are absent in [a network] architecture. Therefore, we must assume the existence of mechanisms in the nervous system that perform these functions, despite the fact that what we currently know about the nervous system does not support such an assumption. On this analysis, what we know about behavior is a guide to what we must look for in the nervous system.

Here, we find that Gallistel infers some proposition about the existence of mechanisms in bees' nervous systems from the proposition that bees' brains are information-processors with a "rules and representations" computational architecture. However, as Egan and Matthews (2006, p. 381) demonstrate, Gallistel is "laboring under [a] lack of knowledge," because *non*-rules and representations computational architectures—e.g., a connectionist architecture—are also able to "accomplish the computational feats that are constitutive of the bee's cognitive capacity," since "it is provable that standard multilayer feedforward connectionist architectures can approximate, to any desired degree of accuracy, any function computable by means of a classical architecture (Hornik et al., 1989, p. 1989)".

What matters, then, is not that Gallistel *knows* the proposition that bees' brains have a rules and representations computational architecture. Rather, what matters is that Gallistel's:

> account of the bee's capacity in terms of a classical "rules and representations" architecture renders the capacity *explanatorily transparent* in a way that an account in terms of a connectionist network architecture would not, by depicting in a perspicuous fashion the flow of information through the system (Egan & Matthews, 2006, p. 381).

In this way, Gallistel can be said to take the proposition that bees' brains have a rules and representations computational architecture as evidence not because he knows the proposition, but because taking the proposition as evidence allows him to account for how a specific segment of the bee's dance—e.g., the "waggle"—directs other bees to a nectar source; namely, by representing, by its angle with respect to the vertical, the direction of the nectar source relative to the sun (see also Frisch, 1967). Thus $E = K$ does not do justice to the evidential practices of cognitive theorists. When accounting for bee behaviour, Gallistel makes a number of inferences from putatively evidential propositions about the representational architecture of the bee's brain. However, it is not appropriate to say that Gallistel either knows or claims to know these propositions. Rather, Gallistel should be understood as taking these propositions as evidence in order to infer other propositions that best account for phenomena such as the bee's waggle.[8]

And if cognitive theorists—like Gallistel—neither know nor believe they know propositions that they take as evidence, then $E = K$ does nothing to explain how evidence is understood and used by cognitive theorists, and so $E = K$ stands no chance of explaining disagreements between cognitive theorists about their bodies of evidence.

3.2 Evidence as Belief

A second possibility is to endorse the theory that evidence consists of beliefs, or true beliefs ($E = B$). On this view, everything you (truly) believe is in your body of evidence and you (truly) believe everything that is in your body of evidence. For example, Bratman (1992, p. 10) can be interpreted as a proponent of $E = B$ when he says that "An agent's beliefs provide the *default cognitive background* for further deliberation and planning." Mitova (2017), on the other hand, takes evidence to consist of true beliefs.

However, $E = B$ suffers from a similar shortcoming as $E = K$: it fails to accommodate actual practice in cognitive science. Cognitive theorists routinely take propositions to be evidence, while remaining non-committal even with respect to whether they believe those propositions. Consider Hutto and Myin (2017, p. 19), who defend a non-representational account of (basic) cognition. When discussing potential defeaters of their view, they argue that:

> The only naturalistically respectable way to defeat [the Radically Enactive, Embodied account of Cognition] is to give it its day in empirical court, determining, in the end, whether it or unrestricted [Content Involving account of Cognition] offers the best account of various cognitive phenomena, all things considered.

[8] Much has been written on the considerations relevant for inference to the best explanation. We will not enter into that discussion here, but see, e.g., Campos (2011), Douven (1999), Lipton (2004) and McGrew (2003) for further details.

What matters for Hutto and Myin, then, is that theories of cognition meet "legitimate naturalistic demands on theorizing." In this vein, they claim that any attempt to defeat their view by appeal to "axiomatic first principles" will "violate naturalism by committing a serious methodological foul." But if one rule holds for their opponents, the same rule must hold for them. Ultimately, this is why Hutto and Myin (ibid., p. 18) think that the test of cognitive theories must issue from "Naturalistic theory building," which:

> is meant to be substantive and speculative: it takes risks and goes beyond pure forms of conceptual analysis. The test of the tenability of a proposal or hypothesis about the nature of cognition is that it accommodates existing data better than rivals. This requires making comparisons with competing theories in order to assess a theory's empirical adequacy and global fit with surrounding theories so as to generate hypotheses and test which theory provides the best explanation (Carruthers (see, e.g., 2011, p. xiii) and Sterelny (2012, p. xi)).

Still, it is clear that Hutto and Myin must take themselves to have evidence for their anti-representational theory of cognition. For example, propositions about non-representational, dynamical systems—e.g. that the equations of dynamic systems theory describe the tendencies of complex systems, including their tendencies for interacting with other such systems—, which Chemero (2009, 181) argues is "not only an appropriate language for understanding the activity of the nonlinearly coupled brain–body–environment system, [...] it is also the key to understanding the brain, and not in terms of representations." Notably, however, Hutto and Myin (2013, 7) insist that:

> for enactivists dynamical systems theory only provides a convenient platform for a new philosophical framework for thinking about the basic nature of mind. Enactivists leave to others the work of deciding exactly which set of complex temporally extended and spatially extensive dynamical responses are minimally necessary for the occurrence of this or that kind of cognition. In deciding those issues, the devil is, as ever, in the empirical details.

In our terms, the "platform" provided by dynamical systems theory is some collection of propositions in a body of evidence. The question, then, is whether it would be correct to say that Hutto and Myin *believe* the propositions about, say, dynamical systems theory from which their non-representational theory of cognition is inferred. But the answer must be: not in any substantive sense, because such a belief would be, in their terms, "scientifically hollow" until non-representational theories of cognitive have been given their "day in empirical court" and have been shown to be better than representational theories of cognition. This theoretical comparison is ongoing (Chemero, 2009; Ramsey, 2017; Shea, 2018, cf.) but we certainly have not reached a decisive conclusion on the matter yet, and the question remains open as to whether a decisive conclusion is even possible (cf. Taylor, 2021).

Moreover, it is clear that Hutto and Myin (2017, 24) make a number of inferences from putatively evidential propositions about non-representational states of

cognition; e.g., the proposition that dynamical systems theory [...] has opened the way for fruitfully investigating the complex self-organizing responsiveness of learners acquiring skills in embodied activities. However, it is not appropriate to say that Hutto and Myin uphold a belief in these propositions in any meaningful sense. Rather, they should be understood as taking these propositions as evidence in order to establish further propositions, which will later be tested in "empirical court" against competing theories. It is only if the inferred theory is successful that, by their own lights, Hutto and Myin could uphold a belief in the relevant propositions from which the theory was inferred.

We find again, therefore, that individual cognitive theorists—such as Hutto and Myin—do not believe all the propositions they take as evidence. Thus, $E = B$ does nothing to explain how evidence is understood and used by cognitive theorists. And if $E = B$ cannot explain how evidence is understood and used by cognitive theorists, then, like $E = K$, $E = B$ stands no chance of explaining disagreements between cognitive theorists about their bodies of evidence.

3.3 Evidence as Observationally Set Credence

Another theory of evidence holds that evidence consists of observationally set credences ($E = C$). Credences that are the direct effect of observation are evidence in that they motivate changes in other degrees of belief (Jeffrey, 2004). As Jeffrey (1968 [1982], p. 35) puts it:

> there is something about what is seen that leads the observer to have the indicated degrees of belief … but there is no reason to think this something expressible by a statement in the observer's language

So on the view that $E = C$, cognitive theorists' bodies of evidence will be comprised entirely of propositions that are believed to some degree as the direct effect of observation.

The general motivation for defending $E = C$ is to deal with a specific problem that afflicts the view that $E = B$; namely, that propositions supported by reliable observation fail to count as evidence when they are not fully believed. For example, the proposition that a particular jacket is orange can play an evidential role even if, say, the jacket is observed in candlelight and so the proposition is only believed to degree 0.8.

The shortcoming of $E = C$ is that it shifts the focus onto observation as the means of fixing degrees of belief. Thus, all non-observational information is downplayed. In the context of cognitive science, it is, perhaps, uncontroversial that the *evidence base* from which bodies of evidence are derived will depend on observed behaviours; e.g., overt linguistic behaviours. However, cognitive theorists' *bodies of evidence* will surely include propositions about states of affairs that have not been directly observed; e.g., propositions about representational states such as "the language faculty is representational."

As a result, if we say that $E = C$, we are not well-positioned to explain why cognitive theorists disagree about the propositions comprising their bodies of evidence,

because this disagreement is not principally about observation. All cognitive theorists may agree that observed behaviours—e.g., success or failure at categorisation or memory tasks—provide the evidence base for claims about cognitive competencies. However, they will sometimes disagree about about the evidential status of propositions about non-observational states of affairs; e.g., the representational nature of cognition. $E = C$ does nothing to explain why this kind of disagreement obtains.

3.4 Evidence as Information

A further possibility is to defend the theory of evidence as information ($E = I$). According to Rowbottom (2014, pp. 139–140):

> we may be concerned not only with what scientists actually believe (or believed), but also with other information accessible to the community... it is clear that information which has been collected as a result of human effort but never believed *can* bear a confirmation (or corroboration) relation to hypotheses in which we are interested.

The idea of $E = I$ is to divorce the criteria for evidence from the propositional attitudes of an agent (e.g., the agent's beliefs), because it is at least plausible that information stored elsewhere (e.g., a notebook) could count as evidence even if that information is not believed or even entertained.[9]

If $E = I$, cognitive theorists' differing bodies of evidence are comprised of different information. It might be possible to argue that different cognitive theorists have different information in their bodies of evidence because some information is inaccessible to some cognitive theorists as the result of, say, particular institutional embeddings, research interests, or lack of resources. In this way, disagreements about the constitution of cognitive theorists' bodies of evidence could be spelled out in terms of differences in cognitive theorists' accessible information.

The problem is that this appeal to the relative accessibility of evidence is not apt for explaining why cognitive theorists disagree about whether specific pieces of information are in their bodies of evidence. It is not the case, for instance, that information about the representational nature of the language faculty is inaccessible to some cognitive theorists but accessible to others. Rather, such information is ubiquitously accessible but is not taken to count as evidence by some cognitive theorists. $E = I$ does nothing to explain why this is the case and so does nothing to explain why cognitive theorists disagree about their bodies of evidence.

We have now briefly considered four possible theories of evidence—$E = K$, $E = B$, $E = C$, and $E = I$—and have shown why none of these theories of evidence allows us to adequately explain why cognitive theorists disagree about the set of propositions (or information) comprising their bodies of evidence. The question,

[9] One obvious problem with $E = I$ is that we are very far from a consensus about what information *is*. Thus, $E = I$ can be said to trade one problem—giving a theory of evidence—for another, namely, giving a theory of information.

then, is whether there is a theory of evidence that can better explain cognitive theorists' disagreements about their bodies of evidence.

4 Evidence as What is Rationally Granted

Our claim is that an alternative theory of evidence best accounts for disagreements about bodies of evidence in cognitive science. This theory—introduced and defended by Williamson (2010, 2015)—maintains that your evidence is what you rationally grant ($E = G$). When one grants a proposition, one treats it as if it were true, but sets the question of its truth aside—at least in the present context—in order to focus on other propositions that are the main objects of interest.

Three clarifications may be helpful at this point. Firstly, we need not assume that one grants only propositions. For example, one may grant methods and experiences that are not readily expressible as propositions. When one grants a method, one treats it as if it were reliable, and when one grants an experience, one treats it as veridical, but questions of their reliability and veridicality are set aside. Second, we do not assume that one explicitly grants everything that one grants. Much of what we grant is subconscious and what we grant may even be the object of no mental state at all. For instance, we may realise with hindsight that we have implicitly taken certain presuppositions for granted that we were not previously in a position to consider. Third, we do not assume that everything that one grants is granted for the purposes of enquiry. For example, one might grant the laws of rugby when playing a match. However, we take evidence to consist of only what is rationally granted *for the purposes of enquiry*. We understand enquiry broadly, as the process of establishing and assessing claims. For the purposes of enquiry, we grant propositions, methods etc., because doing so enables us to establish more truths and rule out more falsities.[10]

Thus, $E = G$ is the view that your evidence is what you rationally grant for the purposes of enquiry. Your body of evidence can be construed as the maximal subset of what you actually grant that is rationally granted, if there is a unique such maximal subset, or the intersection of these maximal subsets if not. The body of evidence of a group of agents engaged in some common enquiry—e.g., a research group engaged in cognitive scientific research—can be understood similarly. For the purposes of their enquiry, after sufficient time for group discussion and deliberation, the group's body of evidence is the maximal subset (or intersection of maximal subsets) of what the group grants that is rationally granted. (We need not presuppose any particular connection between the evidence of a group and that of the group's members.)

$E = G$ is motivated by the role of evidence in constraining belief. Because evidence needs to constrain belief, it must be both granted and rationally so. It must be granted because if it were in question then the constraints that it imposes would

[10] If we were to grant nothing, we would be able to establish tautologies and rule out contradictions, but little else.

also be in question. In short: if evidence were not granted, then it would not be able to impose firm constraints on belief. Evidence must be rationally held so that beliefs that fit the evidence qualify as rational beliefs. If your evidence were not rationally held, then your beliefs would not be rational even if they satisfied all the appropriate constraints imposed by evidence. Thus $E \subseteq G$.

Let us turn to the question of whether $G \subseteq E$. If you rationally grant a proposition then, within that context, the proposition in question ought to constrain your beliefs. 'I grant that it is raining but I do not believe that it is raining' would be Moore-paradoxical—it would be a kind of contradiction. Similarly, if you rationally grant a method for establishing a proposition, then that method ought to constrain your beliefs, in the sense that you ought to believe propositions established using that method, if pressed. Thus, what is rationally granted fulfils the role of evidence, $G \subseteq E$. Hence, $E = G$.

The question arises as to when one is rational to grant what one grants. Rather than provide a detailed theory of rationality as applied to granting, it will suffice here to put forward some features of such a theory.

There are some propositions that one usually cannot help but grant; e.g., the proposition that one is alive, and certain propositions about one's immediate experience. Granting those propositions one cannot help but grant can hardly be deemed irrational. One can also grant less immediate observations (e.g., the results of experiments), theories, assumptions, methods, norms, and propositions established on the basis of whatever else one grants. The key question is what constrains whether it is rational to grant these.

The purpose of granting—namely to facilitate the establishing of truths and the ruling out of falsities—imposes certain constraints on granting. One important constraint is consistency: it is not rational to grant an inconsistent set of propositions. For example, it would not be rational to grant the proposition that children coordinate beliefs and desires to predict behaviour if one also grants that propositional attitudes do not exist. Likewise, it would not be rational to grant the proposition that the language faculty is representational if one also grants that cognitive systems are not representational.

But consistency is not the only constraint on rational granting.[11] A further constraint is that we ought to use any reliable methods that we have for granting. This may include granting theories and models that stand out in terms of their theoretical virtues (e.g., explanatory power, simplicity, etc. (cf. Keas, 2018)) or using reliable inference methods to grant what we can establish from what we have already granted.

Granting is *permissive*, because what one is rational to grant may not be uniquely determined by, say, one's experiences. Thus, identical agents in the exactly the same position may be rational to grant different things. (One might worry that a permissive account of evidence might lead to a pernicious form of relativism, but we will attempt to dispell this concern in the next section.)

[11] If consistency were the only constraint on rational granting, then it would be rational to grant nothing at all. But that would not facilitate establishing truths and ruling out falsities.

Even for a single agent, whether one rationally grants what one grants can depend on one's current operating context. An astrophysicist, for instance, may be irrational to grant the laws of Newtonian mechanics in her research, but rational to grant them when designing an extension to her home. Similarly, a cognitive theorist might be irrational to grant that propositional attitudes exist when formulating claims about cognition, but rational to grant that they exist when accounting for why their friend has gone to the shop.

We have seen above that some disagreements between cognitive theorists are best understood as disagreements about the sets of propositions comprising their bodies of evidence. If we accept $E = G$, then we can easily make sense of why cognitive theorists disagree; namely, because some cognitive theorists rationally grant propositions that are not rationally granted by other cognitive theorists. For instance, the proposition that the language faculty is representational, that children coordinate beliefs and desires to predict behaviour, or that bees' brains have a rules and representations computational architecture.

To examine this idea further, we can refer back to Gallistel (2006), who claims that:

> There are no implementational mysteries here, if we *grant* the bee's nervous system the functional architecture [of a Turing machine]. When the bee is at the source, its dead-reckoning vector specifies the source's location relative to the hive (a vector structure). As the bee ingests the nectar preparatory to carrying it back to the hive, it gets a sensory input specifying its richness (a scalar structure). It writes the location vector and the richness scalar to memory. When it reaches the hive, the dance program retrieves these data structures (reads the memory) (Gallistel, 2006, 67, our italics).

It is evident that Gallistel grants that bees' nervous systems have the functional architecture of a Turing machine and he is apparently rational to grant this, because the proposition has certain explanatory virtues. In other words, Gallistel is rational to grant the proposition that bees have a rules and representations computational architecture, because by granting this proposition he establishes the basis for many subsequent and successful inferences, and, ultimately, for an account of the bees' behaviour.

Notably, however, some cognitive theorists—such as Van Gelder (1995)—will disagree with Gallistel about whether the proposition that bees have a rules and representations computational architecture is a part of their bodies of evidence. They might take this view because they grant that *non*-rules and representations architectures are also able to "accomplish the computational feats that are constitutive of the bee's cognitive capacity." Such cognitive theorists would not, therefore, be rational to grant the proposition that bees have a rules and representations computational architecture, because this proposition would be inconsistent with other propositions they have rationally granted.

Crucially, a permissive account of rational granting can accommodate the possibility that Gallistel is rational to grant that bees have a representational architecture and that Van Gelder is rational to grant that they do not. Thus, when

we endorse $E = G$, we have a clear account of how cognitive theorists can disagree about the set of propositions comprising their bodies of evidence.

Having set out how $E = G$ can explain cognitive theorists' disagreements about their bodies of evidence, the task remains to show that $E = G$ is the *best* explanation of such disagreements. To achieve this end, we will now briefly demonstrate that $E = G$ avoids the problems identified for other theories of evidence in Sect. 3.

Unlike $E = K$ and $E = B$, $E = G$ does not require that cognitive theorists must know or believe evidential propositions when they are called into question. The idea, then, is that there is an important distinction between one's attitude towards an evidential proposition in the context in which it is granted and in the context in which it is under scrutiny. Such a proposition will be believed in the former context, but not in the latter context. For example, in most contexts in which one is writing, one would grant the proposition that there is a hand in front of one and, granting it, one ought to (and would) believe it. However, in a context in which that proposition is called into question by a philosophical sceptic, one may no longer be rational to grant the proposition and it could become reasonable to withhold belief.

$E = G$'s distinction between one's attitudes towards propositions in the context of granting and in the context of scrutiny is crucial here. We saw above that Gallistel grants that bees have a particular cognitive architecture in the context of normal research, but disavows knowledge when calling this proposition into question. Similarly, Hutto and Myin grant a non-representational account of cognition in their research, but withhold belief when bringing it into question. $E = G$, with its distinction between the contexts of granting and scrutiny, can account for this practice perfectly. $E = K$ and $E = B$ cannot.

Furthermore, $E = G$ does not shift the focus onto observation as a means of fixing belief as does $E = C$, because $E = G$ leaves open the possibility that cognitive theorists can grant propositions about unobservable states of affairs; e.g., the proposition that the language faculty is representational. At the same time, $E = G$ does not rely on an unjustifiable appeal to the relative accessibility of cognitive theorists' evidence to explain their disagreements about their bodies of evidence. Unlike $E = I$, therefore, $E = G$ is able to explain how disagreements about bodies of evidence can occur when information is ubiquitously accessible, because different cognitive theorists with the same information can still grant different propositions.

Thus, $E = G$ avoids the aforementioned pitfalls of the other possible theories of evidence—$E = K$, $E = B$, $E = C$, and $E = I$—while still offering a clear explanation for why cognitive theorists disagree about the set of propositions comprising their bodies of evidence. Our claim, then, is that $E = G$ offers the best explanation for why cognitive theorists disagree about their bodies of evidence. We do not make the further claim that $E = K$, $E = B$, $E = C$, and $E = I$ are false. But if one takes the view that a theory of evidence ought to accommodate the actual practices of (cognitive) science, then this consideration counts against these theories of evidence and in favour of $E = G$.

5 Evidential Permissivism in Cognitive Science

We have defended $E = G$ as the theory of evidence best able to explain why cognitive theorists disagree about their bodies of evidence. But to some it might seem as though $E = G$ suffers from a damning problem: that it is rationally permissible for (groups of) cognitive theorists to grant very different propositions, even given the same pool of studies. For example, that it is rationally permissible for one group of cognitive theorists to grant representationalism and for another group of cognitive theorists to grant anti-representationalism, based on the current state of the art. If $E = G$, this seems to lead to a relativistic notion of evidence, because two groups may have two incompatible, but equally rationally permissible, bodies of evidence.

In one sense it is true that $E = G$ permits a relativistic view of evidence. However, to assuage those who are worried about this, it may be helpful to conclude by making three points. First, $E = G$ is a view about *evidence* and not about *truth*. As a consequence, even if $E = G$ leaves open the possibility of multiple permissible bodies of evidence in a given context, this does not imply that truth is in any way relative. Given the current state of research in cognitive science, $E = G$ allows that different—and potentially contradictory—claims in cognitive science can each be justifiably inferred from different bodies of evidence, because different bodies of evidence can be rationally granted by different groups of cognitive theorists. As long as disputes are disagreements about matters of fact, at most one party can be right, even though both parties may be rational.

There are open and difficult questions about the relation between scientific explanation and truth, which we do not have space to engage with here. Still, with this in mind it is important to stress a second point about $E = G$: that the kind of relativism likely to fall-out of $E = G$ will be limited in scope in some important respects. While $E = G$ allows for different (groups of) cognitive theorists to rationally grant different propositions as evidence, it does not follow that different (groups of) cognitive theorists will rationally grant *entirely* different bodies of evidence. There will be many propositions common to different bodies of evidence—including, for example, propositions of the form 'study X reports results Y'—even though cognitive theorists may disagree in their evaluations of these studies. Much evidence about observed regularities in behaviour will also be shared. Thus, according to $E = G$ there will be some common ground between cognitive theorists who have different bodies of evidence.

Finally, $E = G$ does not preclude the possibility of progress and convergence with respect to cognitive theorists' bodies of evidence. The expectation is that key disputes will be resolved in time, as further empirical data about cognition are acquired and better theories of cognition are developed. For example, when further new studies are performed that more decisively favour the representational theory of mind over the non-representational theory of mind, or vice versa, rationality will demand that one party should revisit and revoke some of their previous evidence.

Thus, $E = G$ does not lead to any pernicious form of relativism, because evidence is what is rationally granted and not what is merely granted on the basis

of personal whim. That said, $E = G$ does focus our attention on the problem of deciding between the diverse claims of cognitive science. It is notable that cognitive theorists are most liable to differ in their bodies of evidence with regard to currently unobservable features of cognition; for example, propositional attitudes and mental representations. But when we accept $E = G$, we are able to frame disagreements in terms of divergent acts of rational granting and the inconsistent bodies of evidence that follow from these actions.

In the current literature, disputes about the virtues and the causal standing of different kinds of claims about cognition are commonplace (cf. Taylor, 2022). But the question remains as to why these disputes are so difficult to resolve. In the light of $E = G$, we are better placed to give an explanation of why these disputes obtain and, perhaps, to find a way to move beyond these disputes altogether. The idea is that disputes involving contradictory claims in cognitive science will often, on closer inspection, turn out to reflect variation in what is rationally granted and, hence, what counts as evidence. So by studying acts of rationally granting more closely, we can hope to uncover the complex web of commitments that prop up the different explanatory paradigms in cognitive science and so begin to understand each side on its own terms.

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