How Imagination Informs

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Abstract

An influential objection to the epistemic power of the imagination holds that it is uninformative. You cannot get more out of the imagination than you put into it, and therefore learning from the imagination is impossible. This paper argues, against this view, that the imagination is robustly informative. Moreover, it defends a novel account of *how* the imagination informs, according to which the imagination is informative in virtue of its analog representational format. The core idea is that analog representations represent relations 'for free,' and this explains how the imagination can contain more information than is put into it. This account makes important contributions to both philosophy of mind, by showing how the imagination can generate new content that is not represented by a subject's antecedent mental states, and epistemology, by showing how the imagination can generate new justification that is not conferred by a subject's antecedent evidence.

Keywords: Imagination, Mental Imagery, Analog Representation, Representational Format, Epistemic Justification, Epistemology of Imagination

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1. Introduction

Suppose that Daisy is wondering which of her two friends is taller: Mario or Luigi. She has never seen them stand next to each other before, and it isn't worth calling them up for such a trivial request, so she instead imagines what they would look like if they were standing next to each other. Daisy concludes, on the basis of her imagining, that Luigi is taller than Mario.

Intuitively, Daisy uses her imagination to learn something new.[1] But this gives rise to a puzzle. Didn't Daisy already need good evidence about how tall Mario and Luigi are in order to form an accurate imagining of them in the first place? If this is right, then it seems like her imagination merely recapitulated information that she already has. Conversely, if Daisy genuinely didn't have any prior evidence that Luigi is taller than Mario, then on what basis did she imagine him as such? In this case, her belief seems, epistemically speaking, no better than a lucky guess.

These considerations motivate the thought that the imagination is uninformative; you simply cannot get more out of the imagination than you put into it. And this, in turn, motivates the view that learning from the imagination is impossible. The imagination cannot justify beliefs that you did not already possess justification for, and it cannot give you knowledge that you were not already in a position to know. This constitutes a powerful and influential challenge to the epistemic power of the imagination.

This challenge is widely endorsed in both the historical and contemporary literature. Sartre and Wittgenstein both articulate versions of the claim that imagination is uninformative. Sartre argues that "one can never learn from an image what one does not know already" (1948 p. 10) and that since "it is impossible to find in the image anything more than what was put into it," therefore "the image teaches nothing" (1948 p. 146-7). Wittgenstein agrees, writing that "when we form an image of something we are not observing. The coming and going of the pictures is not something that happens to us. We are not surprised by these pictures, saying 'Look!'" (1948/1980 p. 17) and that "it is just because imaging is subject to the will that it does not instruct us about the external world" (1948/1980 p. 15).[2]

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[1] I will focus on imagination that involves mental imagery. In the literature, this is referred to as imagistic, sensory, or perceptual imagination. I will set aside what is sometimes called propositional imagination: imagination that does not involve any imagery.

[2] One might also look for historical antecedents of this view in Hume's copy principle: the claim that imaginings are copies of past perceptions. According to Hume, although we can use the imagination to

The claim that imagination is uninformative continues to find support in the contemporary literature. Casey writes that "…by imagining, we ascertain nothing that we did not know beforehand in some respect" (2000 p. 7). McGinn claims that "images are not informative" because the "object of my imaging does not feed new information to me" and only "contains precisely what I intended to bestow upon it" (2004 p. 18-19). Most recently, Egeland argues that "one cannot simply imagine one's way to new information about the world that isn't already somehow contained in one's prior beliefs and perceptual experiences" (2021 p. 512). On Egeland's view, imaginings "simply don't provide any new information about the world," and therefore do not "confer any new justification that one didn't already have" (2021 p. 512-3).[3]

These passages suggest two ways of understanding the claim that the imagination is informative that have not always been properly distinguished in the literature. The first is a descriptive claim about how the content of the imagination relates to the content of other mental states:

> **Representational Informativeness (RI):** The imagination can represent contents that are not already represented by a subject's prior non-imaginative mental states.

RI states that the imagination can generate new contents that are not antecedently represented elsewhere in the mind. This stands in need of clarification. There is an obvious sense in which it is quite easy to imagine novel contents. For example, consider Hume's famous case of imagining a golden mountain despite having never seen a golden mountain nor believing that one exists. Have philosophers been motivated to deny RI

recombine our past perceptions in new ways, we can never generate imaginings that do not ultimately recapitulate past perceptions. However, Hume also argues that by recombining our past perceptions in new ways, one can become aware of new relations between them. So, despite denying that the imagination is informative at the level of simple ideas, Hume seems to allow for the imagination to be informative at the level of complex ideas. In holding that the imagination can inform with respect to relations, Hume foreshadows an important aspect of my view.

[3] See also Spaulding 2016 and Kinberg & Levy 2023.

simply because they haven't been imaginative enough? Not quite. It is plausible that one cannot imagine a golden mountain without first intending to imagine a golden mountain. So, the imagination merely recapitulates the content of what one intends to imagine. As Sartre puts it, imagining "never precedes the intention," because "it is the intention that aims at the [imagined] object, which is to say, that constitutes it for what it is" (1948 p. 11).[4] McGinn agrees, arguing that "I no more learn from images than I learn from the sentences I write down, since in both cases I merely express my antecedent intention" (2004 p. 18-19). On this view, one can never find more content in the imagination than was intentionally put there. To vindicate RI, we not only need to show that the imagination can go beyond one's prior beliefs and experiences, but also beyond what one intended to imagine in the first place.

The second way of understanding the claim that imagination is informative is as a normative claim about what beliefs the imagination can justify:

> **Justificatory Informativeness (JI):** The imagination can propositionally justify beliefs that are not already propositionally justified by one's prior non-imaginative evidence.

JI states that the imagination can generate new propositional justification.[5] Propositional justification is the justification one has for holding a belief independently of whether one in fact holds it. JI should not be confused with the weaker claim that the imagination can justify belief. In recent years, many philosophers have argued that imagination can justify

[4] For Sartre, the question of whether the imagination can be unintentional is distinct from the question of whether it can be involuntary: "to say that there can be an image without will in no way implies that there can be an image without intention." (1948 p. 19). So, the existence of involuntary imaginings is not enough to establish RI.

[5] We can also formulate a principle of Knowledge Informativeness which states that the imagination can ground knowledge that one was not already in a position to know. This principle is closely related to JI. I'll focus my arguments on JI, but they could be reformulated with minor modifications to support Knowledge Informativeness as well.

belief.[6] But few have been explicit about whether this justification is generated anew or merely transmitted from one's prior, non-imaginative evidence.[7] One could deny JI while holding that the imagination justifies belief by preserving justification one already has. Egeland is a proponent of this view, arguing that the imagination allows "one to form one's beliefs on their proper justificatory basis, even though it doesn't confer any new justification that one didn't already have" (2021 p. 513). So, to establish JI we not only need to show that imagination can justify belief, but also that this justification is genuinely novel. While denying JI does not entail that the imagination is entirely epistemically irrelevant, it does impose a severe constraint on the epistemic relevance of the imagination; even if the imagination can help to preserve and take advantage of one's prior justification, it can never generate new justification.

In this paper, I will argue, against the orthodoxy just surveyed, that both RI and JI are true and thus that the imagination is robustly informative. In addition, I will put forward a novel theory of *how* the imagination informs. I call it *the format account*, because it says that the imagination is informative in virtue of its analog representational format. In short, the core idea is that analog representations represent relations at no extra cost over and above their non-relational content, and this explains how the imagination can contain more information than is put into it.

The paper proceeds as follows. §2 and §3 explicate and defend the format account of how imagination informs, §4 argues that the format account improves upon alternative accounts, and §5 concludes.

2. The Relational Fecundity of the Imagination

We can frame *the format account* of how imagination informs as an argument for RI and JI:

1. The imagination is analog.

[6] See Dorsch 2016, Kind 2016, 2018, Myers 2021a, 2021b, Stuart 2021, and Williamson 2016.
[7] Miyazono & Tooming (2023) explicitly defend JI. I will discuss their account further in §4.2.

2. Analog representations are relationally fecund.

C1. The imagination is relationally fecund.

3. If the imagination is relationally fecund, then RI is true.

4. If the imagination is relationally fecund, then JI is true.

C2. RI and JI are true.

This section focuses on the argument for C1: the claim that the imagination is relationally fecund. As a rough first approximation, a representation is relationally fecund when its relational content comes along for free with its non-relational content. §2.1 clarifies the concept of analog representation, §2.2 defends the premise that the imagination is analog, and §2.3 explicates the notion of relational fecundity and defends the premise that analog representations are relationally fecund.

The second part of the format account will come in §3, where I will argue that the relational fecundity of the imagination entails both RI and JI.

2.1 Analog Representation

Representational format refers to the way in which a representation encodes its content. Compare a mercury thermometer to a digital thermometer. Both thermometers represent temperature, but they do so in very different ways. The mercury thermometer is *analog* in format, while the digital thermometer is *symbolic* in format.[8] Other examples of analog representation include hand clocks, heat maps, paintings, and audio recordings, while other examples of symbolic representation include digital clocks, astrological symbols, mathematical notation, and natural language.

Although the nature of analog representation is a matter of some controversy, an increasingly popular approach holds that analog representation involves a

[8] The terms 'imagistic,' 'depictive,' and 'iconic' are sometimes used instead of 'analog,' and the term 'digital' is sometimes used instead of 'symbolic.'

representationally relevant structural correspondence between vehicles and contents.[9] In a mercury thermometer, the taller-than relation structuring the columns of mercury corresponds to the warmer-than relation structuring the temperatures that those mercury columns represent. For example, the mercury column that represents 72° is taller than the mercury column that represents 47° and shorter than the mercury column that represents 96°. Moreover, in analog representation, the structural correspondence between vehicles and contents is not merely an accidental byproduct. Instead, the structural correspondence does representational work. Mercury thermometers assign contents by mapping the taller-than relation on vehicles to the warmer-than relation on contents. By contrast, there are no relations structuring the vehicles in the digital thermometer. The numerals '72' do not bear any representationally relevant relations to the numerals '47' or '96'. The mapping from digits to temperatures is stipulative and arbitrary. Even if there were some highly gerrymandered relations that hold between the digits and that correspond to the warmer-than relation on the contents, this structural correspondence would be merely incidental; it would not do any representational work and therefore would not render the digital thermometer analog.[10]

2.2 Imagination is Analog

In this section, I will present three robust and mutually supporting lines of evidence that the imagination is analog.[11]

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[9] In other work, I have called this the 'structural approach' to analog representation (Lee, Myers, and Rabin 2023). Different theories within the structural approach disagree over what sort of structure is relevant. Options include dense structure (Goodman 1968), magnitude structure (Beck 2019, Peacocke 2019), and abstraction structure (Kulvicki 2015).

[10] In other work, I argue that a structural correspondence is representationally relevant when the system uses that structural correspondence as an interpretive rule that maps vehicles to contents (Lee, Myers, and Rabin 2023). I will not assume this approach in what follows. All I assume is that there is some difference between representationally relevant and merely incidental structural correspondences.

[11] Since this evidence has been discussed extensively in the literature, I will be brief. See Kosslyn, Thompson, & Ganis (2006) for an overview.

The first type of evidence is behavioral. The classic finding is due to Shepherd & Metzler 1971. In this study, subjects were presented with two objects at different orientations and asked to determine if the objects were the same or not. Subjects answer this question by mentally rotating one object to match the orientation of the other, and then compare the shapes of the imagined objects. Importantly, the larger the angle that one object would need to be rotated to match the orientation of the other, the longer subjects took to complete this task. This correlation between the angle of rotation and the reaction time indicates that there is a structural correspondence between imaginings and the objects that they represent. Angle of rotation relations between the represented objects correspond to functional relations between the imaginings that represent them. In another classic finding, Kosslyn 1973 and Finke and Pinker 1982 found that the time it takes to 'scan' an imagined picture correlates with the distance between the two points on the picture. This indicates that there is a structural correspondence between the spatial distance relations between parts of the represented object, and functional relations between parts of the imagining itself. In both experimental paradigms, we need to posit a structural correspondence between the vehicles of imagining and their contents to explain why response times covary with environmental properties such as angle of rotation or spatial distance.

The second type of evidence is neuroscientific. There is evidence that the primary visual cortex is organized such that activation in the visual cortex preserves the topographic structure of activation on the retina (Fox et al. 1987, Sereno et al. 1995). Imagination is not caused by retinal activation. Nevertheless, the very same topographically organized areas are activated in visual imagination (Klein et al. 2004, Slotnick et al. 2005). These results indicate that in imagination there is a structural correspondence between the topography of neural activation in the brain and the topography of the imagined scene. Moreover, this structural correspondence is representationally relevant. Damage to an area of this topographical structure yields a

blind spot in the corresponding area of the visual field (Kastner et al. 1998), and, as Kosslyn et al. (2006) point out, "the closer two damaged regions of the topographically organized visual cortex are, the closer in the visual field the corresponding [blind spots] will be" (p. 15). These results indicate that visual imagination involves analog representation of space.

The final kind of evidence comes from introspection. Consider the experience of imagining lime green, the experience of imagining teal, and the experience of imagining scarlet red. Teal is more similar to lime green with respect to hue than it is to scarlet red. Intuitively, so too is the phenomenal character of imagining teal more similar to the phenomenal character of imagining lime green with respect to its experienced hue than to the phenomenal character of imagining scarlet red. Thus, similarity relations between imaginative color experiences seem to correspond to similarity relations between the hues they represent. Similar observations apply to other properties that one can imagine. In general, imaginative experiences vary along phenomenal dimensions whose structure, as revealed by introspection, corresponds to the structure of what those dimensions represent.

None of these lines of evidence are on their own conclusive.[12] Some theorists have floated alternative explanations of the behavioral results (Pylyshyn 2002 p. 159-165) and questioned whether the retinotopic organization of the visual cortex is relevant to the format of mental images (Pylyshyn 2002 p. 174-178), and many philosophers are skeptical of appeals to introspection (Schwitzgebel 2006). I do not have the space to wade into these more granular debates. Although I agree that each line of evidence is defeasible when taken on its own, taken together they strongly suggest that the imagination is at least

[12] An additional line of evidence in favor of the view that imagination is analog comes from psychophysics. Beck (2019) argues that Weber's law, a well-established psychophysical finding, indicates that perception is analog. Given the cognitive and neural overlap between perception and imagination, an analogous argument could be made in favor of the view that imagination is analog.

partially analog.[13] There is a representationally relevant structural correspondence between the vehicles of imagination and their contents.

2.3 Analog Representations are Relationally Fecund

I will now argue that analog representations are relationally fecund. A representation is *relationally fecund* when it explicitly represents relational information at no extra representational cost over and above the non-relational information it represents.[14] The relational fecundity of analog representation is best illustrated by example. Consider a map of the contiguous United States pinned to a corkboard in which people place pins labeled with their name to represent the state in which they live:

Figure 1

[13] It is compatible with each of these lines of evidence that the imagination is only partially analog. For example, it might be that mental images represent some contents analogically, such as space, color, and pitch, but represent other contents symbolically, such as high-level contents or singular contents. This view has recently been defended by Kung (2010), Langland-Hassan (2015), and Tooming (2018), and is ultimately compatible with the format account.

[14] In other work, I have argued that analog representations are semantically fecund, meaning that they have high expressive power relative to the complexity of their interpretation functions (Lee, Myers, and Rabin 2023). Relational fecundity is a kind of semantic fecundity. Namely, semantic fecundity with respect to relational contents.

The map in Figure 1 represents that Andrew lives in Texas, Brian lives in Oregon, Chris lives in Nebraska, and David lives in Pennsylvania. Now, suppose Evan adds a pin to the map to represent that he lives in Ohio:

Figure 2

Ostensibly, only a single piece of information has been added to the map in Figure 2. Namely, that Evan lives in Ohio. However, once the pin has been added to the map a whole host of new relational information comes along for the ride. For example, Figure 2 also represents that Evan lives in a state adjacent to the one that David lives in, that Evan lives north of Andrew, that Evan lives east of Chris and Brian, that Evan lives closer to Chris than he does to Brian, that Evan lives closer to David than to Chris, and so on. All this relational information comes for free once the initial non-relational piece of information that Evan lives in Ohio is added to the map. Moreover, this information is represented explicitly. The relations are displayed on the map itself, rather than being inferentially downstream from the information displayed on the map.[15] For example,

[15] An interpreter may still need to do cognitive work to recover the information, relational or otherwise, that is represented by a map. Indeed, it is plausible that interpreting *any* representation involves inferring

Evan is represented as living closer to David than to Chris because the part of the map that represents Evan is closer to the part that represents David than the part that represents Chris.

Contrast Figure 2 with a symbolic representation of the same information:

> Andrew lives in Texas. Brian lives in Oregon. Chris lives in Nebraska. David lives in Pennsylvania. Evan lives in Ohio.

In this list of sentences, none of this extra relational information is represented. It can only be recovered by bringing to bear extensive background knowledge about the spatial relationships between different states and then engaging in some quite complicated inferences. Even if we build this background knowledge into the representation by adding sentences that specify the purely non-relational information about the size, shape, and location of each state, the spatial relations that hold between the people are still inferentially downstream from the content that is explicitly represented. This symbolic representation does not explicitly represent relations for free. Only the analog representation is relationally fecund.[16]

Similar observations apply to other analog representations. Consider a photograph of two dogs. If the part of a photograph that represents one dog is lighter and yellower than the part of a photograph that represents the other dog, then the first dog is represented as lighter and yellower than the second dog. If the part of the photograph that represents the first dog is to the left of the second dog, then the first dog is represented as to the left of the second dog. Simply by specifying the monadic color and spatial properties of each part of the photograph, one also automatically and explicitly

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what different features of the representation mean. This is compatible with this information being explicitly represented. The claim that relational information is explicitly represented is a metaphysical claim about the content of the representation, rather than an epistemic claim about how we recover that content.

[16] Relational fecundity is closely related to what Shimojima calls "free ride in inference," which is the fact that "expressing a set of information in diagrams can result in the expression of other, consequential information" (2015 p. 13).

represents the representationally relevant relations that hold between those parts. These relations are not represented by adding some extra syntactic feature over and above the features of each individual pixel. They simply come along for free.

These examples are suggestive. But we can extract a more general argument for the thesis that analog representations are relationally fecund from the account of analog representation laid out in §2.1. According to that account, analog representations assign contents by relying on a structural correspondence between vehicles and contents. This involves taking a relation on vehicles (such as the taller-than relation) and mapping it to a relation on contents (such as the warmer-than relation). This means that every part of the vehicle, in virtue of standing in the relevant vehicular relations to other parts of the vehicle, will automatically represent the relevant content relations between corresponding parts of the content.[17]

We can make this argument more precise by representing it in the following way:

i. Analog representations map vehicular relations R_v to content relations R_c.

ii. Suppose the vehicular parts of an analog representation V_1 and V_2 represent contents C_1 and C_2.

iii. From i and ii, V_1 and V_2 stand in R_v.

iv. From i and iii, C_1 and C_2 are represented as standing in R_c.

v. Therefore, if V_1 and V_2 represent C_1 and C_2, then C_1 and C_2 are represented as standing in R_c.

The first premise is the only substantive premise, and it merely restates our definition of analog representation. The upshot of the conclusion is that just by fixing the non-relational content of each part of an analog representation, the relations that hold between

[17] Strictly speaking, relational fecundity is only a feature of multi-part analog representations. A single mercury thermometer does not exhibit relational fecundity because it only has a single part and therefore has nothing to relate to. This restriction to multi-part analog representations is harmless since all of the imaginings I discuss involve multiple parts.

those parts are also represented. In other words, the vehicular features that represent non-relational content are also sufficient for representing relational content. This is the sense in which the relational content comes "for free." For example, when the pin that represents Evan is added to the map, the pin automatically stands in representationally relevant relations to other parts of the vehicle, thereby automatically representing the corresponding relations in the content. I conclude that analog representations are relationally fecund.

3. Representational and Justificatory Informativeness

Let's take stock. Here is the overarching argument for the format account:

1. The imagination is analog.

2. Analog representations are relationally fecund.

C1. The imagination is relationally fecund.

3. If the imagination is relationally fecund, then RI is true.

4. If the imagination is relationally fecund, then JI is true.

C2. RI and JI are true.

So far, I have argued for C1; the imagination is relationally fecund. In this section, I will argue for premise three (in §3.1) and premise four (in §3.2). This establishes the crucial connection between the relational fecundity of the imagination and its capacity to inform, yielding the conclusion that RI and JI are true.

3.1 Representational Informativeness

Recall our earlier formulation of Representational Informativeness:

> **Representational Informativeness (RI):** The imagination can represent contents that are not already represented by a subject's prior non-imaginative mental states.

It is relatively straightforward to see that RI is entailed by the relational fecundity of the imagination. In short: one can begin with some non-relational information, represent that non-relational information in the imagination, and end up with an imagining that also

represents relational information, thereby representing relational contents that are not already represented by any prior non-imaginative mental states.

Consider the example that we started with. Daisy is wondering who is taller: Mario or Luigi. She imagines them standing next to each other, and imagines that Luigi is taller than Mario. The challenge is to explain how it is possible for her to do this without already knowing that Luigi is taller than Mario, and without intending to imagine Luigi as taller than Mario. Here is my diagnosis: before engaging in any imagining, Daisy has some idea of what Mario and Luigi look like on their own. She has seen each friend many times and from many different angles and has a good sense of how tall they are individually. But she has not seen them standing next to each other before, and she does not have beliefs about how tall they are in a unit of measurement that makes their heights straightforwardly comparable by doing a simple mathematical inference. So, instead, she takes her perceptual memories of Mario and Luigi and integrates them into a single imaginative state. Her imaginative state is based on the non-relational information she has about them.[18] But since this imaginative state represents spatial relations analogically, it automatically and at no extra cost represents the height relations between Mario and Luigi. Daisy can then immediately conclude that Luigi is taller than Mario without any intervening inference, despite this not being part of the information on which the imagining was based. Moreover, Daisy can do this without intending to imagine Luigi as taller than Mario. She may intend to imagine Mario and Luigi standing next to each other, but the content that Luigi is taller than Mario comes along unintentionally. This is how Daisy can be surprised by the output of her imagination.

[18] Importantly, this prior information may include analog representations of the height of each friend in the form of stored perceptual representations. However, since none of these analog representations represent both people at the same time, they do not represent the relations that hold between them. More generally, because analog representations only represent relations amongst their parts, one can represent new relations by integrating multiple analog representations into a single representation.

Analogous explanations hold for other stock examples that are invoked in the literature on the epistemology of imagination. Consider the case of using your imagination to gauge whether you can fit your sofa through a doorway. You imagine trying to fit the sofa through the doorway at various angles until you imagine an angle at which it just barely fits through. Once again, it is plausible that you have beliefs and experiences about the size and shape of the sofa and the doorway individually. But these beliefs are not so precise that you can simply deduce whether the sofa will fit through by mathematical inference. The sofa is irregularly shaped, so to do this you would need to know how wide it is at every angle of rotation. However, by forming an imaginative representation that is based on your information about both objects, you can thereby represent the spatial relations that hold between them at no extra cost. As you imagine rotating the sofa, your imagining is also automatically and unintentionally representing whether the doorway is wider than the sofa at that angle. Thus, your imagining can represent the doorway as being wider than the sofa at a certain angle, and therefore that the sofa will fit through the doorway, without being preceded by an explicit intention to imagine this content, and without this content being represented by your antecedent beliefs and experiences.

The examples we have considered so far all involve visual imagery. But the format account extends to the non-visual sensory modalities as well. If I am wondering which of two ingredients is sweeter, I might imagine both of their flavors and then compare the resulting experiences to arrive at a judgment. The format account predicts that all I need to do is input my non-relational information about the flavor of each ingredient and the resulting imagining will automatically represent one as sweeter than the other in virtue of its analog format. Similarly, if I am wondering which of two birdsongs is higher in pitch, I might imagine both. If I constrain my imagining with my information about each birdsong, then my imagining will automatically represent one as higher pitched than the

other. In a wide array of cases, the format account offers a simple and intuitive explanation of how the imagination can represent more information than is put into it.[19]

I conclude that RI is true. The content of the imagination can overflow the content of a subject's prior non-imaginative mental states.

3.2 Justificatory Informativeness

I will now argue that the relational fecundity of the imagination entails the truth of JI.[20] Recall our earlier formulation of Justificatory Informativeness:

> **Justificatory Informativeness (JI):** The imagination can propositionally justify beliefs that are not already propositionally justified by one's prior non-imaginative evidence.

JI is not entailed by RI. It is possible for the imagination to represent new contents without generating new justification. First, it could be that the contents generated by the imagination are not epistemically justified. Second, it could be that the imagination can only generate contents that are already epistemically justified by prior non-imaginative evidence. An adequate defense of JI needs to thread the needle between these two possibilities. To avoid the first possibility, we need to show that contents generated by the imagination are appropriately related to one's prior evidence such that they are justified. To avoid the second possibility, we need to show that contents generated by the

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[19] I have focused on how the imagination can be informative with respect to relatively low-level sensory relations. However, analog representation can in principle involve structural correspondence between relations of any kind. This suggests that the format account has the potential to explain how an even wider range of imaginative projects can be informative. Consider, for example, imaginative reasoning about other minds. It is plausible that imagining other minds has an element of analog representation: the inferential and logical relations between another's mental states are mirrored by the inferential and logical relations between your imaginings. All you have to do is imagine someone else's mental states, and the inferential and logical relations between them come along for free. Fully developing this extension of the format account would take us too far afield, so I leave it as a project for future investigation.

[20] I do not claim that being analog is necessary or sufficient for having justificatory force. The analog format of the imagination allows it to generate *new* justification, but there are other conditions that the imagination must meet to have justificatory force in the first place. See Kind (2016) and Myers (2021a) for further discussion of what grounds the justificatory force of the imagination.

imagination are not *so* closely related to one's prior evidence that they were antecedently justified.

An analogy between imagination and inference helps motivate a response. Both imagining and inferring involve transitioning from an initial set of information to a conclusion whose content differs from the initial state. For example, in modus ponens inference, the conclusion that *q* is different from premises *p* and *if p then q*. And, in the case of Daisy, the conclusion that Luigi is taller than Mario is different from the content represented by her antecedent beliefs and experiences.

Some inferences generate new justification, while other inferences merely preserve existing justification. Contrast a simple modus ponens inference with a complex chain of mathematical reasoning. It is plausible that modus ponens does not generate justification over and above the justification one had for believing the premises. If one justifiably believes that *p* and *if p then q,* then one already has justification for believing that *q*, even before carrying out the inference. By contrast, one does not possess justification for believing a complex and unobvious mathematical theorem just in virtue of having justified beliefs in some basic mathematical axioms. Intuitively, this transition between contents, even if truth-preserving, is simply too big a leap to be epistemically appropriate. Forming a belief in the complex theorem would be, epistemically speaking, no better than a lucky guess. Since a belief is doxastically justified when it is based on adequate propositional justification, and since a belief in the theorem would not be doxastically justified when based on justified beliefs in the premises, then the premises do not propositionally justify the belief in the theorem. Only after one goes through the process of inferring the theorem from the premises via a series of smaller inferential steps does one get propositional justification for believing that it is true. This motivates the claim that a transition between contents can be truth-preserving without being justification-preserving.

We can distinguish between *basic* and *non-basic* transitions between contents. A transition is *basic* when propositional justification is preserved from premises to conclusion.[21] Modus ponens is an example of a basic transition. A transition is *non-basic* when the premises alone do not propositionally justify the conclusion. The transition from basic mathematical axioms to a complex mathematical theorem is an example of a non-basic transition. The correct philosophical account of this distinction is controversial, and I do not wish to take a stand on this thorny issue here.[22] For my purposes, all I need is a heuristic that can be applied to particular cases. An intuitive criterion for basic transitions is that one can recognize that the conclusion is entailed by the premises on the basis of the premises alone.[23] While one can recognize that *q* follows from *p* and *if p then q* simply in virtue of understanding the premises, one is not able to recognize how the complex mathematical theorem follows from their naïve mathematical beliefs. This makes an epistemic difference. When one is already able to recognize that a conclusion follows from some premises, it is plausible that one already has propositional justification for believing that conclusion, even before carrying out any inference. But when one is not already able to recognize that the conclusion follows from the premises, then it is plausible that one only gets justification for believing the conclusion after carrying out the inference and thereby coming to recognize that the conclusion follows. This delivers

[21] I use 'premise' quite broadly to include all content-bearing states—not just states with content that can be formulated linguistically as an argument.

[22] Available options include a conceptualist analysis (Boghossian 2003), dispositional analysis (Wedgwood 2006), intuitionist analysis (Dogramaci 2013), and pragmatic analysis (Schechter 2019). All of these views are compatible with my argument for JI, since all of them uphold the distinction between basic and non-basic transitions.

[23] I want to remain as neutral as possible about what it means to recognize that a conclusion is entailed by some premises. As such, I do not assume that it needs to involve explicit metacognitive beliefs or reflective awareness about entailment relations. Instead, it may merely be constituted by a disposition to draw certain inferences.

the intuitive verdict that modus ponens merely preserves existing justification while complex mathematical reasoning generates new justification.[24]

Now, let us apply the distinction between basic and non-basic transitions to the imagination.[25] Daisy's prior information consists of perceptual memories of seeing Mario and Luigi individually, but never together. Since she has no memories of them standing next to each other, her memories may simply not put her in a position to directly infer that Luigi is taller than Mario. Even though her memories in fact support the conclusion that Luigi is taller than Mario, from her perspective directly forming a belief in this conclusion based on her memories would be a mere guess. For this reason, the transition from Daisy's memories of Mario and Luigi to the conclusion that Luigi is taller than Mario is non-basic. The memories alone do not propositionally justify the conclusion.

Daisy's imagining bridges this non-basic transition and thereby generates new justification. Whereas Daisy's prior non-imaginative mental states do not put her in a position to directly infer that Luigi is taller than Mario, they do put her in a position to imagine Mario and Luigi. And because this imagining explicitly represents the novel content that Luigi is taller than Mario, it puts her in a position to directly infer this

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[24] On some views, propositional justification is just a logical relation between contents such that one has propositional justification for believing all the contents that are entailed by one's justified beliefs (e.g. Smithies 2015). There are two things to say in response. First, propositional justification is normative while logical entailment is not (Harman 1984). A proposition might be entailed by one's beliefs, but it may nevertheless be epistemically inappropriate for one to believe that proposition. Second, to avoid a verbal dispute over what counts as 'propositional justification,' I can grant that propositional justification is a matter of logical entailment. Nevertheless, there is a distinct epistemic status—we can call it *propositional justification**—that is preserved in basic transitions and not in non-basic transitions. Propositional justification* is not identical to doxastic justification since a proposition can be a basic entailment of one's evidence without being believed, and without being properly based on that evidence. I can then reframe my arguments in terms of propositional justification*.

[25] I concede that there are cases in which the imagination merely involves a basic transition and therefore does not generate new justification. For example, suppose that Daisy imagines Mario and Luigi standing next to each other despite antecedently knowing both of their heights as measured in centimeters. In this case, it is plausible that her prior non-imaginative information already propositionally justifies believing that Luigi is taller than Mario and that her imagining does not contribute anything new.

conclusion. In effect, Daisy's imagining turns a non-basic transition into a basic transition. The transition from her non-imaginative premises to the conclusion is non-basic, but by adding her imagining to the set of premises, the transition becomes basic, and the conclusion becomes propositionally justified. This is exactly analogous to the case of complex mathematical reasoning that breaks a large non-basic transition down into a series of smaller basic transitions. In both cases, an intermediate state (either an imagining or an intermediate inference) turns a non-basic transition into a basic transition, generating new justification that was not conferred by the initial set of premises alone.

The thesis that imaginings can generate justification by bridging non-basic transitions becomes even more plausible once we consider examples in which the transition from premises and conclusion is even more complex and unobvious. Consider again the example of imagining the sofa fitting through the doorway. Even if your prior information entails that the sofa will fit, it does not put you in a position to recognize this fact. In other words, it is a non-basic transition. However, by imagining the sofa next to the doorway, you can 'see with your mind's eye' the spatial relations that hold between them. The imagining puts you in a position to draw a conclusion that was entailed by your prior non-imaginative information, but that you were not able to recognize on the basis of this information alone. In doing so, it generates propositional justification for believing that the sofa will fit through the doorway.

Here is one more example. Suppose you are wondering how many regions are formed by drawing lines that connect four points on the perimeter of a circle to each other. Unless you have memorized the (surprisingly complicated) function that takes as input the number of points on a circle and outputs the number of regions formed by connecting them and are particularly good at mathematical inference, then you will probably not be able to non-imaginatively infer the answer to this question. (If you are doubtful, take a moment to try to answer this question yourself without imagining anything or looking at Figure 3). The premise that there are lines connecting four points

on the perimeter of a circle does not on its own give you the ability to recognize how many regions are formed—it is a non-basic transition. This correctly predicts the intuitive judgment that you do not yet possess justification for believing that (spoiler alert) eight regions are formed simply in virtue of having justification for believing the premise. However, the answer that eight regions are formed is easy to arrive at by imagining a circle with lines connecting four points on its perimeter and counting the resulting number of regions represented by the imagining. This is because the imagining represents relations between the lines that are entailed but not represented by your initial set of information.

I have argued that imaginings can generate new justification when they bridge a non-basic transition. I have also argued that several examples meet this condition. More generally, the relational fecundity of the imagination ensures that the imagination can bridge non-basic transitions with non-relational premises and relational conclusions. I conclude that JI is true; the imagination can generate new justification.

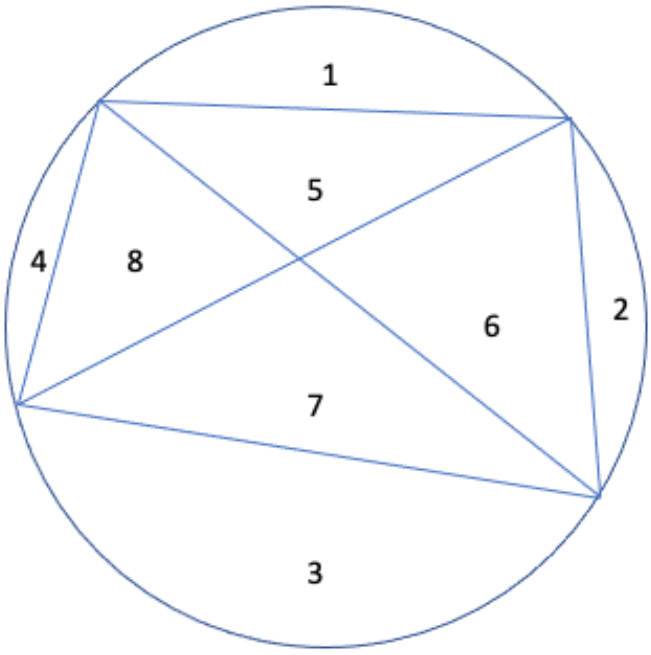

Figure 3

4. Other Accounts

The format account is a novel account of how imagination informs.[26] But it is not the only account to have been proposed in the literature. In this section, I will briefly canvas two existing views and argue that the format account improves upon them. My goal is not to argue that these views are false, but rather to make dialectical and theoretical space for the format account.

4.1 The Argument from Computer Simulations

Kind (2018) argues that the imagination is informative by way of an analogy between imagination and computer simulation. Kind claims that "a computer simulation contains only the facts that are put into it, but it can nonetheless provide us with information about the world" (2018 p. 241). As evidence for the claim that computer simulations are informative, Kind points to the fact that "computer simulations have become ubiquitous in both science and social science, and they are generally considered to be a critical part of the scientific enterprise" (2018 p. 236). Kind then argues that imaginings are analogous to computer simulations. While computer simulations are simulations that are run on external hardware, imaginings are simulations that are run in one's head. If computer simulations are informative, then so too are imaginings.

I am broadly sympathetic to the argument from computer simulations. I agree with Kind that computer simulations can be informative and that imaginings are in many ways relevantly analogous to computer simulations. However, a full defense of the informativeness of the imagination should, in addition to establishing *that* imaginings are informative, explain *why* imaginings are informative. This argument analogizes imagination to computer simulation but does not give a deeper explanation of why either is informative. Indeed, Kind's argument from computer simulation is ultimately

[26] Though see Meynell (2018) for a related discussion.

compatible with the format account, insofar as the format account has the resources to explain how both imagination and computer simulation are informative.

4.2 The Architectural Account

Several theorists have put forward an *architectural account* of how imagination informs. The architectural account appeals to the cognitive architecture of the imagination, rather than its representational format, to explain how it is informative. The core idea behind the architectural account is that the imagination is informative because it has access to information that other cognitive systems cannot access.

The architectural account has been developed in the most detail by Langland-Hassan (2016), Williams (2021), and Miyazono and Tooming (2023).[27] Langland-Hassan argues that imaginings develop according to a perceptual 'forward model' whose role it is to generate predictions of incoming sensory input given certain motor commands. These predictions "are grounded in learned perceptual regularities and contingencies" (2016 p. 70) and they constitute an "imaginative 'algorithm' that constrains the development of subsequent stages in the imagining" (2016 p. 71). Because imagining involves running the perceptual system 'offline,' it has direct access to this forward model in a way that other non-perceptual cognitive systems do not. Williams (2021) expands on this account, arguing that we should understand imaginings as relying on the more general notion of a perceptual generative model. Perceptual generative models encode information about environmental regularities, not just correlations between motor commands and sensory input.[28] For example, suppose you use your imagination to determine which direction a basketball will move in when it once it bounces on the ground. The architectural account holds that the imagination can draw on a perceptual

[27] Theorists in the literature on scientific thought experiments have appealed to similar ideas (Gendler 1998, Miščević 1992, Nersessian 2007).

[28] Miyazono & Tooming (2023) also expand on the architectural account by arguing that the imagination has access to domain-specific information about intuitive physics and core object principles.

model of the physics of your environment to represent the trajectory of the basketball, even though you do not have a fully articulated and cognitively accessible theory of physics at your disposal.[29]

The appeal to perceptual generative models on its own does not yet establish that the imaginative is informative in the sense relevant to RI and JI. This is because the environmental regularities encoded in these models are, in an important sense, information that one already has. More needs to be said to establish that imaginings that draw on these models contain *new* information or confer *new* justification.

We can distinguish between two broad strategies for responding to this challenge that are available to proponents of the architectural account. The first strategy targets RI. It holds that the information in perceptual models is not represented at all and is instead merely implicit in the functioning of the system.[30] This is very briefly suggested by Langland-Hassan himself when he suggests that the information in the forward model may not be "explicitly represented at all" (2016 p. 70) and by Shea, who says that it "may be implicit in processing dispositions" (2022 p. 2). If this suggestion is on the right track, then imaginings can explicitly represent information that was implicit in the functional architecture of the system but not part of the content of any pre-existing representational state, yielding the conclusion that RI is true. However, this suggestion is highly speculative. As far as I am aware, we have no evidence that bears on whether the perceptual models that constrain how imaginings unfold are explicitly represented or merely implicitly encoded. Thus, it is an open empirical question whether the architectural account ultimately vindicates RI. By contrast, the core empirical claim of the

[29] Stuart (2021) relies on a different, albeit similar, architectural distinction between system 1 and system 2 processes to explain the epistemic import of the imagination.

[30] See Johnson (2020) for further discussion of what she calls "representationally implicit" or "merely encoded" content.

format account—that imagination is analog—is widely accepted and backed by extensive empirical evidence.

The second strategy targets JI. It holds that the information in perceptual models, even if it is explicitly represented, is not accessible except through the imagination. This is because the information in perceptual models is stored in the perceptual system itself and is not accessible except by running one's perceptual system offline in imagination. The crucial move is to then claim that because this information is only accessible by the imagination, it does not count as part of one's prior non-imaginative evidence. Only after the imagination makes it available to personal-level cognition does it play a justificatory role. This strategy is defended most recently and comprehensively by Miyazono and Tooming, who argue that "imagination can serve as a generative source of justification when… imagination is properly constrained by imaginative constrainers that are cognitively inaccessible" (2023 p. 19-20).[31] This strategy targets JI, insofar as it concedes that the imagination recapitulates contents that are already represented in perceptual models, but holds that only when those contents are represented in imagination do they play a justificatory role. However, this assumes that states must be accessed by personal-level cognition to confer justification. This is controversial, and it will make this second strategy unpalatable for those inclined towards both externalism and forms of internalism that do not posit an access requirement on justification. The format account does not rest on this assumption and therefore does not share this dialectical limitation.

In my view, it is a mistake to see the architectural account as a rival alternative to the format account. Both accounts are compatible with each other. According to the architectural account, the imagination is informative because it has access to a store of

[31] See also Gendler (1998), who argues that the imagination has access to "unarticulated knowledge of the world" that is not "propositionally available" (p. 415), Aronowitz and Lambrozo (2020), who hold that the epistemic role of the imagination is that it "makes information available to a system in a new way" (p. 15), and Myers (2021b), where I argue that "the imagination, in virtue of being housed in the perceptual system, plausibly has access to modular information that other systems cannot *as a matter of principle* access" (p.115).

perceptual information that other cognitive systems do not. It is silent on the format that this information is encoded in. According to the format account, the imagination is informative because it encodes information in a format that represents extra information for free. It is silent on where the initial information comes from and whether it is accessible by other cognitive systems. In principle, both accounts could be true. The imagination could be informative in more ways than one.

However, the architectural account is, at best, only a partial explanation of how the imagination informs. The architectural account holds that the imagination has access to perceptual models that encode environmental regularities. As a result, the architectural account will be best suited to explaining how the imagination can be informative concerning how causal processes unfold in our environment. But consider the case of Daisy imagining Mario and Luigi to figure out who is taller. Nothing about this imaginative project requires the representation of environmental regularities. It does not draw on any information about dynamic causal processes. Indeed, the imaginative project simply involves a static image of two people. The architectural account does not have the resources to explain how this imaginative project is informative, leaving room for the format account to pull its explanatory weight. The format account is not similarly limited. It has the resources to explain how both static and dynamic imaginings can be informative, insofar as both kinds of imaginings are relationally fecund. So, the format account has greater explanatory power than the architectural account.

5. Conclusion

I have argued that the imagination is informative in virtue of its analog representational format. Analog representations are relationally fecund, and the relational fecundity of the imagination entails that one can get more out of the imagination than one puts into it. The format account makes important contributions to both philosophy of mind, by showing how the imagination can generate new content that is not represented by a subject's antecedent mental states, and epistemology, by showing

how the imagination can generate new justification that is not conferred by a subject's antecedent evidence.

The format account contributes not just to the epistemology of imagination but also to the epistemology of analog representation more generally. It is plausible that many other mental kinds are analog, such as perceptions, episodic memories, cognitive maps, and cognitive representations of magnitude. Moreover, there are many non-mental analog representations, such as pictures, models, diagrams, and maps. As a result, the format account has the potential to offer a unifying explanation of how a wide variety of both mental and non-mental analog representations can be informative.

The format account suggests that the imagination is a distinctive form of ampliative reasoning. Imagination is a form of reasoning insofar as it depends on information that one already has. But it is ampliative insofar as it outputs more information than one puts into it. This theory offers a simple but powerful explanation of how imagination informs.[32]

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