Cognitive Simplicity as an Idealization

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Abstract

Appeals to the simplicity of hypotheses about cognitive processes are common in comparative psychology. Much recent work has discussed the role of simplicity in privileging some hypotheses over others. Simpler hypotheses tend to be taken as the default, working hypothesis, so long as there is not any strong evidence against them. Here, I argue that cognitive simplicity also plays a role in hypothesis generation, aiding comparative psychologists to create new hypotheses about behavioural processes. I attempt to justify the role that cognitive simplicity plays here. One approach is to justify that some hypotheses really are simpler than others. Unfortunately, there are several jointly contradictory and individually problematic ways of defining cognitive simplicity that undermine this effort. Instead, I propose that cognitive simplicity is more appropriately interpreted as a family of idealizations about behavioural processes. Idealizations are useful abstractions about phenomena, based on potentially false assumptions, which are justified by serving a purpose for practicing scientists. Idealizations about the properties of behavioural processes help comparative psychologists to creatively generate novel hypotheses about animal behaviour. This is a useful strategy when handling the fact that there are usually several empirically distinct hypotheses that could explain behavioural observations. This view preserves cognitive simplicity as a useful concept for hypothesis generation, while blocking it from involvement in hypothesis selection, in line with previous work.

Keywords: Simplicity, Parsimony, Idealization, Morgan’s Canon, Hypothesis Generation.

Pavlovian conditioning, instrumental learning, and innate behavioral sequences, such as the sensitivity of herring gull chicks (*Larus argentatus*) to the red patch on their parents' beak (Tinbergen, 1953; see ten Cate, 2009), are often taken to be simpler processes than episodic memory (Crystal, 2010), metacognition (Smith et al., 2014), theory of mind (Fitzpatrick, 2009), or causal reasoning (Halina, 2022). Moreover, hypotheses that appeal to these simpler processes are often given a privileged status, serving as the default or working hypothesis until there is strong evidence to the contrary. Indeed, the evidential threshold for the confirmation of these privileged, simpler hypotheses is set lower than that of a more complex, but equally explanatory, hypothesis (Bausman & Halina, 2018; Dacey, 2021; Mikhalevich, 2017; Mikhalevich et al., 2017).[1]

The role of simplicity in comparative psychology has been discussed extensively by philosophers in recent years (e.g., Fitzpatrick, 2008, 2009, 2017; Meketa, 2014; Starzak, 2017). Much of this work has focused on the role that the relative simplicity plays in the selection of default (Dacey, 2021) or null hypotheses (Bausman & Halina, 2018), or accepted explanations (see Meketa, 2014; Smith et al., 2014; Starzak, 2017). I call this *hypothesis selection.* Here, I argue that cognitive simplicity plays a hitherto underappreciated role in comparative psychology, as a tool for generating novel hypotheses about non-human animal behavior (*hypothesis generation*).[2] Comparative psychologists use considerations of the relative simplicity of different hypotheses about animal behavior to guide the innovation of new hypotheses (see also Currie, 2021, Karin-D'Arcy, 2005; Zentall, 2018).

How can we justify the role that simplicity plays in comparative psychology? One approach is to justify that some hypotheses are simpler than others. Then, appeals to cognitive simplicity are warranted both for hypothesis generation and hypothesis selection. However, there have been several compelling arguments that suggest that no such

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[1] Note that references to *simple* or *complex hypotheses* serve as a shorthand for *hypotheses that appeal to simple* or *complex cognitive processes*.

[2] Non-human animals will henceforth be referred to simply as animals.

justification is forthcoming (e.g., Andrews & Huss, 2014; Meketa, 2014) or even possible in principle (Starzak, 2017). The alternative that I propose is to view cognitive simplicity as a family of idealizations about the hypotheses we use to explain animal behavior. Idealizations are useful abstractions about phenomena, based on potentially false assumptions, which are justified by serving a purpose for practicing scientists. Idealizations about cognitive simplicity include postulating that processes with lower metabolic costs are simpler, or that those that are less common taxonomically are more complex, because evolution has proceeded for longer to generate them. Elsewhere in science, idealizations serve several purposes that facilitate progress, despite their foundation on unjustified or false assumptions (Elgin, 2007; Potochnik, 2017). According to the view promoted here, idealizational cognitive simplicity helps comparative psychologists to generate novel alternative hypotheses, which is a difficult and salient challenge. Animal behavior is complex; there are often several plausible alternative hypotheses available. Comparative psychologists must first enumerate those alternatives, before designing experiments to adjudicate between them. I argue first that idealizations are a useful strategy for generating hypotheses. Then, I argue that idealizations about cognitive simplicity specifically are a common family of idealizations used for hypothesis generation in contemporary comparative psychology. Viewing cognitive simplicity as a series of idealizations has the consequence of blocking its role in privileging certain hypotheses over others, consonant with the existing literature on the topic. By acknowledging that it is founded upon not-yet-justified assumptions, it should not be used to set the evidential threshold for the confirmation or disconfirmation of a hypothesis. However, not-yet-justified assumptions are significantly less problematic for hypothesis generation.

Herein, I present two examples of cognitive simplicity being used in contemporary comparative psychology to generate alternative hypotheses. In the first case study, I examine the hypotheses surrounding the use of sticks for body care in Atlantic puffins. Some argue that this is evidence of sophisticated physical cognition, while others maintain that explanations in terms of play, nest-building, or chance are more likely, due to their simplicity. In the second case study, I examine two hypotheses used to explain food caching in corvids. One maintains that food caching is mediated by episodic memory, while the second argues that it can be explained through associative learning, taken to be a simpler behavioral process. Later in this article, I synthesise recent work arguing that we cannot yet justify claims about the relative simplicity of cognitive processes. Finally, I offer the view that cognitive simplicity should be seen as a family of idealizations, presenting several reasons why such an account is fruitful, rationalising in turn the role of cognitive simplicity in hypothesis generation.

Cognitive Simplicity & Hypothesis Generation

Tool-Use in Seabirds

In 2020, Fayet, Hansen, and Biro presented two observations of Atlantic puffins (*Fratercula arctica*) appearing to scratch themselves with sticks. This led to a discussion of the possibility that the puffins were using the sticks as a tool for body care, a practice that had been documented previously only in primates and elephants (although, see Meyerriecks, 1972, cited by von Bayern et al., 2020). Viewing objects as *tools* with specific affordances is seen as a distinctive, and sophisticated, cognitive capacity. That the puffins view the sticks as tools is one explanation for the apparent scratching behavior.

The primary evidence consists of two instances: one unrecorded event of a puffin in Wales and a recorded event four years later at a nesting site in Iceland. Fayet et al. (2020) argue that tool-use is the most plausible explanation of these observations. They argue that puffins already handle complex ocean environments and so their cognitive sophistication may have been underestimated, implying that complex cognitive processes drive tool-use in the animal kingdom. They also consider an alternative hypothesis, namely that the stick could have been picked up for nesting purposes and that the scratching happened by accident: the puffin was attempting to scratch with its beak and the stick happened to be in the way (p. 1278). This hypothesis promises to be simpler, they imply, because we already know that puffins are a nest-building species that collect nearby material to line their burrows, and so we need not invoke new cognitive processes to explain this behavior. However, they reject this hypothesis, noting that puffins typically use soft materials for nests, not sticks, and that the observation in Wales occurred on water, far from active nest-building sites.

This article sparked a flurry of debate, with frequent appeals to simplicity throughout. Farrar (2020) proposes the “simple and likely” (p.1) hypothesis that a puffin was playing with the stick and accidentally used it to scratch an itch. He further notes that both puffins were scratching easily accessible parts of their bodies, unlike other species that use tools for inaccessible areas such as the back (Shumaker et al., 2011; cited by von Bayern et al., 2020). Farrar evidences the playing hypothesis by appeal to evidence that many birds, including waterbirds such as herons and cormorants, play with objects in their environment (Heinrich & Smolker, 1998; Sazima, 2008).

Auersperg et al. (2020) revived the nest-building hypothesis, presenting photographic evidence of puffins carrying sticks during nesting season, which coincided with the timing of both of the original observations. They also support the idea of playful stick-holding leading to coincidental scratching. Alternatively, they offer a breeding-display hypothesis, suggesting that the sticks could be a signal of nest-building intent, drawing an analogy with how puffins stamp their feet to claim ownership of a nest site. Once again, these processes are deemed to be simpler than those involved in tool-use.

In this debate over whether puffins are using sticks as tools for self-care, simplicity is appealed to several times, leading to the generation of several plausible alternatives to tool-use that are deemed worthy of further pursuit.

Mental Time-Travel in Corvids

Brea, Clayton, and Gerstner (2023) discuss the processes underlying food caching in corvids. Observations of food caching have classically been used as evidence of episodic(-like) memory, the ability to relive past experiences, which is also thought to be a component of the more general capacity of mental time-travel, the ability to simulate future experiences as well as remember past ones (Corballis & Suddendorf, 1997). To investigate whether episodic memory and mental time-travel are the only plausible accounts for the observed behavior, Brea et al. contrast two computational models. They demonstrate that both accounts can explain the results of 28 experiments with food-caching corvids.

A classic experiment illustrates the food-caching behavior in question (Clayton & Dickinson, 1999 Experiment 1). Scrub jays first cached peanuts and kibble in different locations. Later, after being sated on one food type, they were allowed to retrieve their caches. The jays preferentially searched the locations containing the food they were not sated on, even if the food had been secretly removed. This suggests that they remembered what they cached, where they cached it, and could flexibly use that memory based on their current motivational state (i.e., hunger).

To simulate the birds computationally, Brea et al. (2023) formalized experiments as a reinforcement learning problem. In these, each bird is an agent, interacting with an environment external and unknown to it by performing actions. The environment contains objects like food items as well as the motivational states of the birds. Brea et al. created two models to simulate the decision-making processes of the birds. Both models include a “motivational control” module (governing actions based on hunger) and an “associative memory” module (linking what food was cached where). The key difference lay in the third module, which controlled the initial caching behavior.

In the Planning-By-Replay Model (Brea et al., 2023), the third module facilitates explicit episodic replay. This module records an explicit list of memories tagged with the time they were last edited. These memories record the features of a specific caching location, the hunger level at that time, and the outcome of the food retrieval action from that tray. When the birds come to cache more food, they compare the current state of the environment with these memories and decide whether to cache based on that comparison. If the current state of the environment is similar to a previously experienced state that resulted in a successful retrieval, then the bird is more likely to cache. If a bird had previously cached food in a tray but then returned to find that that food had been pilfered or had degraded, they were less likely to cache there in the future. So here, caching is determined by explicitly replaying previous retrieval events.

In the Plastic Caching Model (Brea et al., 2023), there is no explicit replay. Instead, caching preferences are updated based on specific features and outcomes of the caching location and the actions involved. For instance, the preference to cache in a tray decreases if a prior retrieval from that tray was unsuccessful (e.g., the food was missing or had degraded) and increases if it was successful. No explicit recollection of past events is needed.

Brea et al. (2023) appeal to the relative simplicity of cognitive processes in their discussion of these models. The Plastic Caching Model is seen as “simple associative learning”, where the Planning-By-Replay Model involves mental time-travel since the bird is able to ‘relive’ past experiences using the explicit replay of retrieval events (2023, p. 1). They see this as a “higher cognitive process” (*ibid.*). The debate over caching behaviors has concerned whether it is appropriately explained by episodic memory as part of mental time-travel, or whether associative learning, understood as a simpler process, suffices to explain it. Brea et al. begin with the mental time-travel hypothesis and then seek to develop a simpler hypothesis, using research in reinforcement- and associative learning (i.e., the Plastic Caching Model). To conduct direct comparison with the more complex hypothesis, Brea et al. formalized mental time-travel in terms of the Planning-By-Replay Model. Both models were able to account for the caching behavior of corvids. As with the puffin example, we can interpret comparative psychologists here as developing promising alternatives to established hypotheses that are deemed to be simpler.

The Problem with Cognitive Simplicity

Cognitive simplicity plays an important role in the generation of plausible alternative hypotheses in comparative psychology. Given the hypothesis that tool-use was driving scratching behavior in Atlantic puffins, Farrar proposed a simpler hypothesis in terms of accidental scratching, possibly due to playing with the stick. Given the hypothesis that corvids can flexibly cache and retrieve food because they are capable of mental time-travel, Brea and colleagues postulated a simpler hypothesis, in terms of Plastic Caching. There are numerous other examples from across comparative psychology, including on theory of mind (Fitzpatrick, 2009), animal consciousness (Wynne, 2004), causal reasoning (Halina, 2022), categorical perception, animal emotion, and morality (Zentall, 2018).

Although cognitive simplicity is often used to generate or evaluate competing hypotheses in comparative psychology, there is no coherent or justifiable definition of simplicity that can reliably guide this process. First, it is generally assumed that simpler hypotheses are more likely to be true (Currie, 2021). However, this is a controversial assumption (see Sober, 2009). Second, even if we grant this assumption, no definition of cognitive simplicity has been identified that satisfies this criterion. The fundamental critique is that there are several possible definitions of simplicity, each individually problematic, which return inconsistent judgements about the relative simplicity of hypotheses about animal behavior. That the different definitions contradict each other has been understood to mean that no single, general definition of cognitive simplicity exists (Dacey, 2016; Meketa, 2014; Starzak, 2017). This is problematic because these definitions may cause the premature or erroneous selection of a hypothesis, which then influences future research (Fitzpatrick, 2008).

Definitions of cognitive simplicity in comparative psychology are usually tethered to some empirical feature of behavioral processes which carry most of the burden of justifying the truth-likelihood of a hypothesis. For example, simpler processes are those that are evolutionarily older or that are less metabolically costly; we should privilege hypotheses that invoke such processes in virtue of this definition (Currie, 2021; Dacey, 2016). The main ways that cognitive simplicity has been defined in comparative psychology are as follows:

- **Anthropomorphic Simplicity**: Simpler hypotheses are those that appeal to processes most similar to processes underlying human behavior (e.g., Romanes, 1892; see Morgan, 1894, 1903).
- **Ubiquity Simplicity**: Simpler hypotheses appeal to processes that are more common across the animal kingdom (Shettleworth, 2010; see Meketa, 2014).
- **Recency Simplicity**: Simpler hypotheses appeal to processes that evolved less recently (Karin-D'Arcy, 2005; see Allen-Hermanson, 2005; Currie, 2021; Meketa, 2014).
- **Biological Process Simplicity**: Simpler hypotheses appeal to processes that are energetically or metabolically less costly processes (Gallistel, 2008; cited by Meketa, 2014).
- **Computational Simplicity**: Simpler hypotheses appeal to processes that are computationally more efficient (Dacey, 2016).
- **Cladistic Simplicity**: Simpler hypotheses appeal to processes that are present in an ancestral species. (Sober, 2005, 2012; see Dacey, 2016).
- **Ontological Simplicity**: Simpler hypotheses appeal to processes that involve fewer distinct sub-processes (Starzak, 2017).
- **Representational Simplicity**: Simpler hypotheses appeal to processes that involve simpler mental representations (e.g., first-order rather than second-order representations; Carruthers, 2008).

- **Minimal Experience Simplicity**: Simpler hypotheses appeal to processes that require less experience or learning to produce some behavioral outcome (Call & Tomasello, 2008; Premack & Woodruff, 1978).

Some of these interpretations of cognitive simplicity are clearly contradictory. Anthropomorphic simplicity and Ubiquity simplicity are at odds, since the kinds of processes that underpin sophisticated human behaviors, such as language, reasoning, and decision-making, are not taxonomically common, *ex hypothesi*. Anthropomorphic simplicity was the parsimony principle that C. Lloyd Morgan sought to dismiss with his well-known Canon (see Allen-Hermanson, 2005). Ubiquity simplicity is also in tension with Minimal Experience simplicity. Many view associative learning as a taxonomically common process (see Heyes, 2012; Macphail, 1982). However, its reliance on extensive experience with the world has led some to view taxonomically rarer processes, such as Theory of Mind, as simpler; these processes, *ex hypothesi*, involve significantly less learning to achieve the same behavioral outcome (Premack & Woodruff, 1978).

The other definitions of cognitive simplicity are arguably more defensible, and yet contradictions still arise. Take the contrast between tool-use and accidental scratching. Farrar interprets the puffin behavior as accidental scratching, which is a simpler process by Ubiquity Simplicity, since we have good evidence that birds often scratch themselves with their beaks (Delius, 1988), while we have evidence that tool-use is taxonomically rare (von Bayern et al., 2020). He argues that the puffins picked up the sticks because water birds like to play with objects like sticks, as evidenced by herons and cormorants – an appeal to Cladistic Simplicity. In contrast, others argue that tool-use is the simpler explanation because puffins already have the required cognitive toolkit from nest building – an appeal to the strongest form of Cladistic Simplicity since the evidence comes from the species itself. As von Bayern et al. (2020) remarked, nest building also requires fine motor control and an understanding of the affordances of materials and nesting sites (Guillette & Healy, 2015). There is evidence that puffins can distinguish between good and bad nesting sites and materials (Boag & Alexander, 1986; Hornung, 1982). Furthermore, as Fayet et al. (2020) point out, puffins live in a large and variable physical environment that might require them to possess high behavioral flexibility, an ability to make future plans, and to reason about physical objects in their environment. Thus, the simplicity of tool-use versus accidental scratching can conflict depending on which simplicity metric is used.

Moving to the hypotheses about caching behavior in corvids allows us to explore another issue with defining and justifying cognitive simplicity: each of the above ways of defining it is individually problematic. Here, I sketch the problem as it relates to our example of caching behavior (see Meketa, 2014; Starzak, 2017, for fuller arguments). On most of the definitions of cognitive simplicity above, there is reason to say that the Plastic Caching Model is simpler than the Planning-By-Replay Model. Associative learning is taxonomically more common (Macphail, 1982); mental time-travel possibly evolved more recently than associative learning (Suddendorf & Corballis, 2007); fully replaying past memories is metabolically and computationally more expensive than storing connections between minimal representations of states and actions; corvids are phylogenetically far away from humans, the only other case of mental time-travel in animals about which no-one disagrees (see Boyle, 2020); and the Plastic Caching Model only rests on the processes of associative- and reinforcement learning, rather than introducing episodic replay and a sophisticated memory store (see Lind, 2018; Lind & Vinken, 2021 for similar arguments).

However, what justifies definitions like Ubiquity simplicity or Recency simplicity? Meketa (2014) argues that any claim that, say, Pavlovian Conditioning is widespread has relied on taking hypotheses appealing to it to be the most likely, *ceteris paribus*. While it might be true that many behavioral phenomena can be explained by appeal to associative learning, that does not entail that they can *only* be explained by associative learning. A key example of this is the work of Gallistel, Fairhurst, and Balsam (2004), who presented an alternative information-theoretic hypothesis to classical associative learning theory for explaining well-studied behaviors such as trace-eye-blink conditioning and autoshaping. As such, the apparent ubiquity of processes akin to Plastic Caching, compared to Planning-By-Replay, does not justify that they are necessarily simpler. Their apparent ubiquity is a result of their putative simplicity. Since both can explain the observed phenomena, we cannot rely on ubiquity simplicity to justify that Plastic Caching is simpler than Planning-By-Replay.

Scepticism can be levelled against Recency simplicity too. The idea here is that evolution proceeds by innovating new systems on top of old, integrating with but not supplanting them, and in so doing generating more complex and advanced systems (Karin-D'Arcy, 2005). The Planning-By-Replay Model can thus be viewed as a sophistication of Plastic Caching, making it more advanced and therefore more complex. However, Meketa argues that this general strategy relies on an overly simplistic model of evolution. It fails to acknowledge that functionally identical systems can emerge through convergent evolution.[3] Evolution is not monotonic – it does not necessarily build in more sophistication as it proceeds. Indeed, evolutionary innovations can often be lost. Take the flightless cormorant (*Nannopterum harrisi*), which evolved from a flying ancestor and subsequently lost the ability to fly (Kennedy & Spencer, 2014; Livezey, 1992). One might object, however, that in the case of mental time-travel, the computational and metabolic costs decrease the likelihood that it would evolve multiple times in distinct lineages, such as *Corvidae* and *Hominidae*. In other words, Computational and Biological Process simplicity mean that the probability of associative learning in both lineages is high (i.e., the Plastic Caching Model) but the probability of associative learning *and* mental time-travel is low. However, Starzak (2017; see also Sober, 2005) cautions against this line of thinking. It is logically true that the probability

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[3] Take, for example, the evolution of the placenta, a relatively complex biological system on many accounts, which has evolved multiple times, in mammals, amphibians, reptiles, and several taxa of fish (Griffith & Wagner, 2017).

of system A, *p*(A), is always higher than the probability of system A and B, *p*(A&B). However, Starzak suggests that this is the wrong framing in the context of evolution. We must instead compare *p*(A&B) with the probability of A *without* B, *p*(A&¬B). The probability of associative learning *and* mental time-travel is not necessarily higher than the probability of associative learning *and the absence* of mental time-travel. As such, appealing to Recency simplicity also does not help us decide which of the two processes are simpler.

The problem with simplicity is twofold: we lack a consistent way to define cognitive simplicity, and even where definitions do exist, they offer little reason to think simpler hypotheses are more likely to be true. This situation has compelled many to reject cognitive simplicity entirely (Fitzpatrick, 2008, 2009, 2017; Meketa, 2014; Starzak, 2017).

The Idealization View of Cognitive Simplicity

The motivation for rejecting cognitive simplicity outright has mostly arisen in cases where comparative psychologists appeal to it to privilege some hypotheses over others (e.g., Le Pelley, 2012; van der Vaart et al., 2012; see also Smith et al., 2014). If we cannot justify why one hypothesis is simpler than another, then that apparent simplicity should not ground some preference for selecting one of them, lest that simplicity be the artefact of a misleading bias with downstream effects on experimental designs and theory building (Bausman & Halina, 2018; Dacey, 2021).

However, when it comes to hypothesis generation, I posit that justification of the relative simplicities of different cognitive processes is independent of whether thinking in terms of simplicity is useful to generate hypotheses. If it helps to think about simpler processes (according to one metric of simplicity) when trying to generate new hypotheses, then that is an advantage, regardless of whether cognitive simplicity has been well-defined and justified (see Karin-D’Arcy, 2005; Zentall, 2018 for a similar idea). This aligns with the attitudes of some practicing comparative psychologists who participated in a recent survey (Voudouris et al., 2025).

I aim to offer an alternative way to think about cognitive simplicity that reifies this. I make two separate claims. The first is that idealizations about the processes driving animal behavior are useful for generating hypotheses about them. The second is that contemporary comparative psychologists are using idealizations that correspond but are not necessarily limited to the definitions offered in the previous section, such as Cladistic or Metabolic Process simplicity. Idealizations are useful abstractions about phenomena, based on potentially false assumptions, which are justified by serving a purpose for practicing scientists. I use ‘idealization’ in the sense of Potochnik – a set of “assumptions made without regard for whether they are true, generally with full knowledge that they are false” (2017). Idealizations have been identified across the sciences, and “there are many *intertwined reasons to idealize* that reflect not just features of the world but also researchers’ interests” (p.19, emphasis original). Often, scientists idealize to simplify a complex phenomenon, rendering it easier to understand and manipulate. Take the notion of the perfectly competitive market, an idealization about economic markets which assumes that, *inter alia*, there are always many buyers and sellers, there is no collusion between subgroups of them, that the agents (i.e., companies or individuals) in the system have a small buying power relative to the market size, and that buyers and sellers are rational. None of these are necessarily true of real markets (Hausman, 2021). However, perfectly competitive markets remain a useful idealization about economic systems, facilitating understanding, which in turn facilitates the development of novel models and hypotheses in economics (e.g., Alós-Ferrer & Ania, 2005).

To help generate hypotheses, contemporary comparative psychologists can be interpreted as making idealizations about cognitive processes. The simplicity of Plastic Caching relative to Planning-by-Replay is arguably the result of an idealization where hypotheses invoking taxonomically more common processes are taken to be simpler.

Similarly, the simplicity of Farrar's accidental-scratching-by-play hypothesis can be interpreted as the result of an idealization about phylogenetic proximity. In both cases, the metrics of simplicity at play are not well justified, as previously argued. Yet, in both cases, idealizations are a suitable interpretation: abstractions are being made about the space of possible hypotheses, and the processes that they invoke, that are not necessarily veridical. These idealizations are being used to generate alternative hypotheses about animal behavior.

Idealizations are useful because they assist scientists in generating alternative hypotheses. There are two points to make here with respect to comparative psychology. The first is that there is good reason to think that there are many plausible empirically distinct hypotheses that could be used to explain some behavioral observations. The second is that there is evidence that hypothesis generation is difficult. By empirically distinct, I mean hypotheses that make different predictions beyond the evidence at hand (see Laudan & Leplin, 1991; for discussion of the inverse case, see Van Fraassen, 1976). By plausible, I mean the kinds of hypotheses that are congruent with existing knowledge about the natural world (see Stanford, 2006). Plausibility can be evaluated according to existing theories and background knowledge. Plausibility eliminates some potential hypotheses. For instance, we can probably disregard the hypothesis that the puffins were scratching their bodies with sticks because they had been hypnotised to do so by a malevolent cormorant. Plausibility can do the work of reducing the set of hypotheses that comparative psychologists should pursue experimentally, but what reason is there to think that behavioral observations of animals could be explained by *many* plausible alternative hypotheses? Animal behavior is very complex, driven by, *inter alia*, genetic, physiological, environmental, social, and evolutionary factors. The causal tapestry that influences behavior plays out over milliseconds and millennia, and so there is a vast space of possible mechanisms to which one could appeal to explain any one behavior (Halina, 2023; Sloman, 1984). Combining this with the dearth of precise theory (Farrar & Ostojic, 2019; Mikhalevich et al., 2017) and the difficulty of obtaining representative samples (Farrar et al., 2021) means that a high proportion of potential hypotheses are also plausible.

That there are many plausible hypotheses to explain animal behavior does not necessarily imply that those hypotheses are difficult to generate. However, the historical record indicates that hypothesis generation is a difficult and laborious process, meaning that specialised methodological tools for making it easier would be valuable. Historical evidence that the generation of plausible, empirically distinct hypotheses is difficult comes from across the sciences (e.g., Cowie, 2023; Kashyap, 2023; Stanford, 2006; although see Godfrey-Smith, 2008; Ruhmkorff, 2011, 2015) as well as disciplines such as law (Jellema, 2022, 2023). In a recent survey of 220 comparative psychologists, around half indicated that Morgan's Canon and/or the associative-cognitive distinction are useful concepts for designing control experiments, suggesting that they make it easier for them (Voudouris et al., 2025). We can also see how plausible, empirically distinct alternative hypotheses are difficult to develop by considering the pace at which such hypotheses are published. Work on episodic memory in corvids had been occurring for at least two decades before Brea et al. published their associative-learning alternative. In the literature on metacognition, researchers developed a paradigm in which participants are presented with increasingly ambiguous stimuli and asked to make a risky choice (Smith et al., 1996). If they decline to respond a significant number of times for more ambiguous stimuli, it suggests that they are monitoring their own uncertainty. However, plausible accounts in terms only of operant conditioning took several years to gain prominence (Smith et al., 2014). Similarly, it was thought that dogs were not capable of tracking occluded objects (object permanence) because they failed at a commonly used test in which a reward is placed in an opaque container which is then occluded in a new location (e.g., Doré et al., 1996). However, it was proposed several years later that dogs may be attending instead to the more salient opaque container (Müller et al., 2014). The confluence of these examples suggest that plausible alternative hypotheses are often difficult to conceive.

While hypothesis generation is difficult, it is also intrinsically necessary to the process of science. There remains a salient inductive risk of wrongfully accepting an incorrect hypothesis because the more appropriate one had not been generated (see Birch, 2018; Douglas, 2000; Jeffrey, 1956). Therefore, a strategy that improves the hypothesis generation process by making it less laborious, less difficult, and more accurate, is valuable. There is evidence that scientists have innovated strategies to do this elsewhere in science (e.g., Novick & Scholl, 2020; Spelda & Stritecky, 2021). Philosophers of science have also argued that we must promote strategies that encourage search for hypotheses across the space of plausible alternatives (e.g., Currie, 2019; Stanford, 2015).

Idealizations are useful for assisting scientists in hypothesis generation. However, there are several possible idealizations one could make. For instance, one could idealize about the human-likeness of behavioral processes (see Andrews & Huss, 2014), or about their proximity to idealized or rational models of behavior (Simon, 1990). By idealizing away from the complexities of the hypothesis space, it becomes easier to identify which properties of a plausible alternative hypothesis should be considered. Indeed, it is this feature of idealizations that make them a useful cognitive aid to scientists. Research on categorisation in human psychology suggests that innovating a framework for simplifying complex phenomena aids decision-making. Barsalou (e.g. 1983, 1985, 1991; see also Griffiths et al., 2010; Navarro & Perfors, 2011) has extensively studied how humans derive novel categories in pursuit of specific goals. These *ad hoc* categories are instrumental in cases where the goal of categorisation is important, rather than the means of categorisation itself. The study of complex animal behaviors, such as caching or tool-use, often leads to similar situations: there are hypotheses that could explain these phenomena, and they must be found.

These arguments establish that idealizations in general are useful for hypothesis generation. There are several reasons why idealizations about cognitive simplicity have taken such prominence in contemporary comparative psychology. From a practical standpoint, simplicity features prominently in science, and especially in comparative psychology due to the widespread influence of Morgan's Canon (de Waal, 2008; Dewsbury, 1984). Comparative psychologists are, in general, familiar with the notion of simplicity, and of considering the several ways in which it can be defined, because simplicity has featured so prominently in the history of the discipline. More broadly, thinking in terms of simplicity can be fruitful for the practice of comparative psychology at large. Idealizations about cognitive simplicity, in their diversity, are a key facilitator of a more expansive search for alternative hypotheses. Rather than systematically generating several similar hypotheses (such as different versions of mental time-travel), these idealizations encourage different scientists to generate radically different hypotheses (such as Plastic Caching).

These reasons characterise why idealizations about cognitive simplicity are useful to comparative psychologists right now. But there are also normative considerations at play which come intrinsically with the common-sense conception of simplicity. Consider a candidate measure of simplicity which allows us to compare the simplicities of different hypotheses; this could be, for instance, the metabolic cost of the overall behavioral process (biological process simplicity) or the amount of experience required for the behavioral process to output the expected behavior (minimal experience simplicity). It seems clear that generally for measures of simplicity, there would be a minimum value, corresponding to the very simplest hypothesis. For the previous examples, this minimum value might correspond to the process that has physiologically minimal metabolic requirements, or that the process requires no learning or experience to produce the expected behavior (i.e., it is innate and inflexible). However, it is not clear that, in general, measures of simplicity would have a maximum value. What is the maximum metabolic cost of a behavioral process? What is the maximum amount of experience for, e.g., associative learning, to give rise to the expected behavior? Given a candidate hypothesis, there is therefore a definable bounded region within which to search for simpler hypotheses, but there is an unbounded region within which to search for more complex hypotheses.[4] At the very least, the simplest process is more straightforward to define than the most complex.[5] Idealizations about simplicity compress and compartmentalise the space of hypotheses within which comparative psychologists must search, assisting them to generate plausible alternatives. Of course, by using different and incompatible measures of simplicity, different hypotheses occupy the bounded region that is the focus for hypothesis generation. Given this argument, idealizations about complexity would be less helpful than idealizations about simplicity. However, this is not to say that there are not similarly useful idealizations out there. As mentioned, one might consider generating hypotheses to explain non-human animal behavior that are similar to those used to explain human behavior. Since similarity also has a lower bound (identity), the search space for hypothesis generation is reduced. Indeed, such a hypothesis generation mechanism might be at play in cases of apparent anthropomorphism in contemporary comparative psychology, where hypotheses from human psychology are adapted to explain non-human animal behavior.

Viewing cognitive simplicity as a family of idealizations about hypotheses and the processes they invoke has at least two normative consequences. The first is that comparative psychologists should be diverse in the specific kind of idealizations they use to help them sample the space of plausible, empirically distinct alternative hypotheses. If everyone uses the same idealization, then coverage of that space is not achieved across the scientific

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[4] This argument is owed to how simplicity is discussed in the literature on algorithmic information theory (see Chater & Vitányi, 2003; Sterkenburg, 2016 and references therein).

[5] The reader may note that for some interpretations of cognitive simplicity, such as Ubiquity simplicity or Recency simplicity, the theoretically most complex hypothesis is more straightforward to define, as either the most common process or the most recent evolutionary innovation. While this may be true for these special cases, it does not apply to all interpretations of simplicity. In contrast, the theoretically most simple hypothesis is definable for all interpretations.

community. Indeed, it is because of the diversity of definitions of cognitive simplicity at play in many debates about animal behavior that such a diversity of interesting and innovative alternative hypotheses is generated to subsequently test. Moreover, the idealization view encourages the development of further strategies, not necessarily linked to the notion of simplicity, that can hasten the generation of alternative hypotheses (see Heesen et al., 2019; Kummerfeld & Zollman, 2016; Zollman, 2010). Second, the idealization view allows us to clarify and delimit its role in comparative psychology. Idealizations about cognitive simplicity are founded upon as-yet unjustified assumptions. This is forgivable in the context of hypothesis generation, but not in the context of hypothesis selection. Therefore, recognising the idealized quality of claims about cognitive simplicity naturally blocks them from being used to privilege some hypotheses over others, which aligns with recent arguments in the philosophy of comparative psychology. Moreover, this view encourages caution around the attribution of simplicity to certain hypotheses, and the rhetorical role that it can play. While *simpler explanation* is often seen as synonymous with *better explanation* both within and outside of science, this does not apply, at least in comparative psychology, when the attribution of simplicity derives from an idealization.

Conclusion

I have argued that cognitive simplicity is often used during hypothesis generation, a descriptive claim about the science of comparative psychology. This role of cognitive simplicity is distinct from its well-discussed role in privileging certain hypotheses over others. In the latter case, there are several compelling arguments that cognitive simplicity is unjustified, because there are multiple jointly contradictory and individually problematic ways to define simplicity as it applies to cognitive processes in animal behavior. However, those same arguments do not necessarily undermine appeals to cognitive simplicity for hypothesis generation. To resolve this, I propose that we interpret the many manifestations of cognitive simplicity as idealizations over the space of hypotheses and the behavioral processes they invoke, that are useful for generating alternative hypotheses. This interpretation permits appeals to cognitive simplicity during hypothesis generation, but not during hypothesis selection. Idealizations about cognitive simplicity facilitate researchers to tackle the difficult problem of hypothesis generation, faced with the vast possibilities that could explain a set of behavioral observations. Idealizations about cognitive simplicity offer a route for comparative psychologists to overcome this methodological challenge; and innovate creative alternatives that can be empirically tested. Moreover, this view delimits the role of cognitive simplicity, blocking it from involvement in inferences about the selection of some hypotheses over others. That problem remains difficult, but it is not one that idealizations about simplicity can help with.

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Conflict of Interest

The author declares that there are no conflicts of interest with the publication of this manuscript.

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