Can We Understand Nonhuman Minds Without Folk Psychology?

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Abstract

One central commitment of comparative psychology is the prohibition against using folk-psychological concepts to explain nonhuman animal behavior, which requires us to disavow "the attribution of human qualities to other animals, usually with the implication it is done without sound justification" (Shettleworth 2010). Many scientists and philosophers believe attributing human folk-psychological concepts to nonhuman minds constitutes an egregious violation of the anti-anthropomorphism principle. Penn and Povinelli (2007) describe the practice as "insidious" and stemming from our "folk-psychological imagination." Alternatively, others believe the prohibition against folk psychology is misguided and unnecessary. Andrews (2020) suggests "folk psychology plays an essential role in comparative psychology as the starting point, but not the end point, of our research." I adjudicate this debate by examining our use of folk psychological concepts in comparative psychological research. Andrews may be correct in her assertion that folk psychology is essential to studying nonhuman minds, but I argue this view is not mutually exclusive with the anti-folk psychologists' – folk psychology could be both necessary to doing comparative psychology and damaging to the science. This highlights a tension within comparative psychology, which I suggest can be alleviated in part by taking a nonhuman animal's umwelt, or "experiential niche," as our starting point rather than our anthropocentric understanding of folk psychology. Coupling this with Andrews' (2012) concept of "folk psychologists," I offer a strategy for identifying nonhuman folk psychologists and developing uniquely nonhuman folk-psychologies based on the umwelt of the target species.

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Introduction

One central commitment of comparative psychology requires us to disavow "the attribution of human qualities to other animals" (Shettleworth 2010). Many scientists and philosophers believe our willingness to attribute these folk-psychological qualities to nonhuman minds has slowed scientific progress. Penn and Povinelli (2007) describe the practice as "insidious" and stemming from our "folk-psychological imagination." Alternatively, others believe the prohibition against folk-psychology is misguided and unnecessary. Andrews (2020) suggests "folk psychology plays an essential role in comparative psychology as the starting point, but not the end point, of our research." I hope to adjudicate this debate by examining the role of folk psychological concepts in comparative psychological research, with particular emphasis on the folk psychological concepts surrounding social cognition. Andrews may be correct in her assertion that folk psychology is essential to studying nonhuman minds, but I argue this view is not mutually exclusive with those in opposition of the practice - folk psychology could be both necessary to doing comparative psychology and damaging to the science.

This leaves us with a challenging question – how do we reconcile the necessity of folk psychology with the damage it inflicts upon the science of animal cognition? The goal of this thesis is to explore one possible way in which we may address this problem. In Section 1 I offer an overview of folk psychology and its relationship to theory of mind and explain Andrews' (2012) "pluralistic folk psychology" account in order to make it clear what the debate it about. The prohibition "avoid folk psychology" is nearly meaningless without a clear delineation of what folk psychology consists of. I also provide a brief discussion of personal level explanation. This is important because personal-level explanation is critical to understanding nonhuman minds as social agents. In Section 2 I outline the case against folk psychology, focusing on three

distinct arguments. The first is an argument by the comparative psychologist Shettleworth, who makes the point that folk psychological explanations are unlikely to be the "correct" explanation of an animal's behavior. Her concern is that the plausible competing explanations have a higher prior probability of being correct than do folk psychological ones (Shettleworth 2012).

The second argument is by the primatologists Penn and Povinelli, who defend the claim that the use of folk psychology slows scientific progress. The third argument is from Heyes (2008), who argues that "reasoning by analogy" to our anthropocentric understanding of folk psychology serves as a primary methodology of folk psychology in comparative science. She suggests that we must move away from this strategy in order to advance the science. In Section 3, I present Andrews' position that forsaking folk-psychological attributions in nonhuman animals means avoiding the concepts we use to understand human behavior at the personal level, leading to eliminativism about the mind (Andrews 2020). I claim the latter argument, along with her argument that folk psychology is necessary to organizing behavior into types so that we may study them (Andrews 2020), constitutes a strong reason to keep folk-psychological explanation in comparative psychology. With the arguments of both camps on the table, in Section 4 I offer the case of "male alliances" in bottlenose dolphins as an example of anthropomorphism in comparative psychology. I argue the problem with folk psychology is our attribution of anthropomorphic, uniquely human folk-psychological concepts to nonhuman animals, not the attribution of folk psychological concepts in general. This analysis makes it clear that there is a need for a non-anthropomorphic folk psychology that permits explanation of animal behavior at the personal level, without assuming that the animal's personal level is akin to the personal level of a human being.

In Section 5, I offer a possible path toward developing a non-anthropomorphic folk psychology. My proposal is inspired by contemporary responses to the problem of biosignature detection in astrophysics. I argue that we can use a similar methodology to that which some astrophysicists employ, known as the "agnostic biosignatures framework." Agnosticism espouses the development of general, functional patterns that do not rely on the unique, specific chemical features of a planet's biochemistry. The result is a model of life that is generalizable to extraterrestrial lifeforms (Marshall et al. 2021). I believe there may be a parallel solution for the field of comparative psychology – perhaps there are generalizable, functional patterns of certain cognitive abilities that do not presuppose human folk psychology. This proposal resolves the tension between the critics and the boosters of folk psychology, and, as I argue, is one that should be acceptable to all parties to the debate.

Section 1: Folk Psychology and Folk-Psychological Explanation

In this section I will explicate what is at issue when we are discussing folk psychology, beginning with what Andrews (2012) calls the "standard folk psychology" views and ending with the development of pluralist accounts. In later sections, I will be using the term "folk psychology" to refer to the pluralist understanding of the concept. This discussion will also introduce and explain the idea of "folk psychologists," a term Andrews (2012) coined to refer to diverse folk-psychological practitioners. Lastly, I will introduce the personal level of explanation and lay the groundwork for my later argument that the personal level is necessary to explaining many of the social-cognitive practices found within folk psychology.

Section 1.1: Folk Psychology

Folk psychology generally refers to the commonsense ways in which people understand the behaviors and mental states of the other people that comprise their social world. The debate over how to characterise folk psychology, its constituent activities, and its underlying psychological mechanisms has given rise to several theories, each with its own unique way of understanding folk psychology. The majority of these are what Andrews (2012) refers to as "standard" theories. Standard theories place enormous importance on the activities of prediction and explanation and the propositional attitudes of belief and desire - usually to the exclusion of all other considerations. Standard folk-psychological theories include theory-theory, simulation theory, hybrid views, and some model theories. Theory-theory is perhaps the most widely embraced of the standard theories. Its central thesis is that people develop theories about the causes of others' behavior - where the causes are reasons which are made up of propositional attitudes - in order to explain someone's behavior or predict how they might behave in the future (Goldman 2012). A classic version of theory-theory portrays people as scientists who construct and deploy a theory of mind. Beginning in childhood, we gather data from our interactions, make inferences about the people around us, and then test those inferences in everyday life, refining our theory of mind where its predictions fail (Gopnik and Wellman 1992).

The accuracy of our behavioral predictions is the key to our success as folk-psychological theorists. While some advocates of theory-theory include propositional attitudes beyond belief and desire in their theories, belief and desire are considered indispensably important when attributing mental states to other agents. Nowhere is this more evident than in the popularity of false belief tasks, which gained such enormous traction in developmental psychology that they often served as a litmus test for whether an individual has a theory of mind (Goldman 2012). A false-belief task usually requires participants to watch a character, e.g. Sally, hide an object and

leave the room before a second character, e.g. Anne, takes the hidden object and hides it in another location. In order to succeed at the task, the participant must accurately predict where Sally will search for the toy. Accomplishing this feat requires the participant to consider that Sally's belief about the toy's location differ from the participants' own belief because the toy was moved while Sally was out of the room. Passing the false-belief task has been used as evidence that children develop a theory of mind around two or three years old (Gopnik and Wellman 1992).

The theory-theory is not accepted by all proponents of standard folk-psychological accounts. Despite the early empirical successes of the false-belief task, psychological studies on prelinguistic children and people with autism have cast serious doubt on the veracity of theory-theory (Goldman 2012). These studies, which suggest that a developed theory of mind is not necessary to predicting and explaining behavior, opened the door for other standard folk-psychological theories. Simulation theory argues that we imagine, or simulate, the minds of others using our own mental states – not theoretical principles – to predict and explain the behavior of others (Hutto 2021). The debate between advocates of theory-theory and simulation theory has largely dominated the history of standard folk psychology. One concern about simulation theory, initially expressed by Dennett (1987), is that simulation theory collapses into theory-theory (Goldman 2012). On this view, at least some theoretical principles are required to simulate the minds of others and make inferences based on those simulations. While neuroscientific research into mirror neurons suggests that people may "mirror" the mental states of others in a way consistent with the claims of simulation theory, many of the same studies also found that participants reported consciously representing and attributing mental states, which aligns better with the predictions of theory-theory (Goldman 2012).

Debates over whether theory-theory and simulation theory are truly distinct supported the creation of "hybrid theories," or theories that try to capture the upshots of each while jettisoning at least some of the problems inherent to one or the other. One such evolution is the model theory, a view that traces its history to Giere (1996), Maibom (2003), and Godfrey-Smith (2005). Model theories generally claim that our folk-psychological capacity is akin to a capacity for applying models to our everyday social interactions (Godfrey-Smith 2005). Godfrey-Smith argues that we construct "model psychological profiles" of the minds around us and use those as the basis for mental state attribution. As with other standard theories, these attributions support our explanations of and predictions about the behavior of others. Although I have offered only a rough sketch of the various standard folk-psychological theories, it is hopefully sufficient to highlight several commonalities pointed out by Andrews (2012). These commonalities are what unite theory-theory, simulation theory, model theories, and hybrid views under the "standard theory" umbrella.

First, standard theories generally view our behavior as the product of propositional attitudes, with belief and desire considered indispensably important. While this is most clear with theory-theory, simulation and model theories still understand other minds in terms of propositional attitudes – although the method used to understand those attitudes may differ somewhat across theories. Second, if an agent does not view others as "acting from their propositional attitudes," standard theorists typically disqualify them altogether as folk psychologists (an agent who possesses and can use folk-psychological capacities) (Andrews 2012). Nowhere is this clearer than with the exclusion of autistic people and nonhuman primates mentioned earlier in this section. Third, one cannot engage in the typical folk-psychological activities of predicting and explaining without being a folk psychologist (Andrews 2012). The

false-belief task illustrates this point for the theory-theorist – children who supposedly lack a theory of mind cannot accurately predict where the character will search for the hidden toy. Lastly, a consequence of the commitments of the various standard theories is that agents use the same strategies to both predict and explain behavior (Andrews 2012). There is no proposed "prediction mechanism" that is separate from some other "explanation mechanism." Instead, each theory's chosen method for propositional attitude attribution underpins both activities.

Andrews identifies problems with every commitment of the standard theory except the third, which she takes to be central to all views of folk psychology. She argues against the first commitment, which takes propositional attitudes as the cause of our behavior, by examining empirical research that suggests other cognitive abilities (such as moods, hormonal mechanisms, etc.) can also cause behavior (Andrews 2012). The second commitment, on her view, is equally flawed. She argues that what makes someone a folk psychologist is not whether they are able to make propositional attitude attributions, but whether they recognize the people in their social environments as agents. The fourth commitment, which states that we use the same strategies to both predict and explain behavior, is the last contentious principle of standard folk psychology. Andrews's argument against it is twofold: first, the possible aims of folk psychology are much broader than simply predicting and explaining, and second, research suggests that we often use diverse folk-psychological capacities to accomplish different goals (Andrews 2012). Andrews endorses the third commitment – one must be a folk psychologist in order to successfully accomplish the myriad goals of folk psychology (such as predicting, interpreting, coordinating, cooperating, etc.). I will revisit Andrews' endorsement of the third commitment in the upcoming discussion of her solution to the problems inherent to the standard view – what she calls "pluralistic folk psychology."

These concerns about the narrow scope of standard theories, especially those that focus on agents' propositional attitudes to the exclusion of other mental states, prompted Andrews to develop "pluralistic folk psychology" (PFP). This view, which seeks to expand folk psychology beyond the propositional attitudes, is founded on "the idea that social understanding and interaction is a complex phenomenon that involves a diverse array of psychological processes" (Andrews et al. 2021). The pluralist view emphasizes that folk psychology is a social practice whose practitioners can be more or less skilled with the various strategies involved in navigating everyday social encounters. Andrews explains the principles of pluralistic folk psychology in the following way:

> (PFP1) "One needs to be a folk psychologist to have robust success in predicting, explaining, and interpreting behavior"
>
> (PFP2) "Folk psychology is a social competence, which includes the ability to identify behavior, predict behavior, explain behavior, justify behavior, normalize behavior, and so on"
>
> (PFP3) "The social competences of folk psychology are supported by a number of different cognitive mechanisms, and one's degree of success as a folk psychologist is a function of the number of competences mastered and the degree of facility with the different competences"
>
> (PFP 4) "Intentional behavior is seen as sometimes caused by any number of factors, such as moods, propositional attitudes, emotions, and so on, and sometimes influenced by other factors such as personality traits, dispositions, or historical facts"
>
> (PFP 5) "The requirement for being a folk psychologist is the ability to recognize that intentional agents exist, and to fare well in discriminating intentional from nonintentional agents" (Andrews 2012, pg. 240).

(PFP 2), (PFP 3), and (PFP 4) make the pluralistic folk psychological framework inclusive of nonhuman folk psychologists in a way that is inaccessible to standard theories. By embracing the potential for a range of cognitive mechanisms, causes for behavior, and social competencies, Andrews encourages us to think about what folk psychology might look like for

diverse practitioners. Andrews (2012) refers to these practitioners as "folk psychologists." (PFP 5) serves as the limit for who counts as a folk psychologist – one must be capable of picking out the intentional agents in their environment, and likewise understand when something is not an agent. The most familiar example of a folk psychologist is a human. We navigate our social worlds by recognizing and engaging with others as fellow persons and intentional agents – we respond to others' emotions, make judgements based on their personalities, consider their wellbeing, form and maintain interpersonal relationships, etcetera. The PFP view expands who might count as a folk psychologist to nonhuman animals, whom Andrews (2012) calls "critter psychologists." On her view, we might consider various primates, cetaceans, or other nonhuman minds to be folk psychologists should they meet the criteria of (PFP 5). Now that I have laid out what I mean by "folk psychology" and "folk psychologist," I will pivot to the equally foundational question of explanation.

Section 1.2: Personal Level Explanation

In this section, I offer a rough sketch of a type of higher-level explanation called "personal level explanation" (PLE) and argue that folk-psychological explanations are the same as personal-level explanations. On my view, when we make folk-psychological explanations, we are giving personal-level explanations. Understanding PLEs will be important to my argument later in the thesis that the personal level is necessary to capturing (at least some) folk-psychological phenomena. Dennett, perhaps the first to make the distinction between personal and sub-personal levels of explanation, defines personal-level explanation as "the explanatory level of people and their sensations and activities" (Dennett 1987). Drayson (2014) adds that the personal level, as its name might suggest, is the level at which we attribute mental states to whole persons, while the subpersonal level consists of a person's psychological capacities and

subsystems. Personal-level explanations are useful simply because we require them to attribute mental states to whole agents. If we want to explain primate behavior in terms of "chimpanzee x didn't take the fruit because she noticed that her competitor chimpanzee y looked agitated," then we need to offer an explanation at the level that attributes mental activities (noticing) and emotions (agitation) to agents (chimpanzees). If we wish to investigate whether chimpanzees evaluate, predict, explain, justify, normalize, etc. each others' behavior as folk psychologists, then we must be open to explaining their folk-psychologizing at the personal level should we find sufficient evidence for it.

I stated earlier that Dennett defines personal-level explanation as "the explanatory level of people and their sensations and activities" (Dennett 1987). His explanation is richer than this, however, and certainly not the only way of understanding the personal level. In his thorough overview of various accounts of personal-level explanation, Williams (2020) outlines definitions offered by myriad philosophers including Dennett (1987), Drayson (2014), and others. While Williams characterizes Dennett's account as the most "expansive" of those available – in the sense that it is the most inclusive regarding what constitutes a personal-level explanation - it is also the most problematic for any attempt to tease personal-level explanation and folk psychology apart. This is because Dennett argues that the personal level is, more or less, the folk-psychological level; "it is only on the personal level that explanations proceed in terms of the needs, desires, intentions, and beliefs of an *actor* in the environment" (Dennett 1987). There clearly exists a deeply interconnected – perhaps even inseparable – relationship between folk psychology and the personal level of explanation.

My view on folk psychology, which embraces the principles of Andrews' pluralistic folk psychology, understands the personal level as deeply intertwined with explaining folk

psychologists and their activities. If we find sufficient evidence that some nonhuman species are folk psychologists, and therefore act as intentional agents that can discriminate between other intentional agents and non-agents, then we must explain their folk-psychological capacities and activities at the level of intentional agents. As I have argued in this section, the personal level of explanation is the correct level for explaining intentional agents and their activities. I have thus previewed a prima facie reason for requiring folk psychology if we wish to provide personal level explanations of nonhuman animal behavior. The value of personal level explanation to this thesis cannot be understated – it is the level at which we can speak of the rich intersection between the social and the psychological in terms of beliefs, emotions, motivations, welfare, and so on. In this way, PFP makes room for nonhuman folk psychologies which do not simply reduce animals to being unfeeling propositional attitude machines. Moreover, it is the level we need if we are going to form relationships with nonhuman animals. If we do not view other animals as potential agents, it is harder to form the right kind of collaborative relationships we need to work effectively with them in a lab environment (Andrews 2021). The personal level is also important to understanding animals as potential cultural participants. The personal level, as a level of analysis, is richly social and without it we may fail to see animals as intentional agents and as persons.

Section 2: The Case Against Folk Psychology

In this section, I will elaborate further on the anti-folk psychology position that is prevalent in both the fields of philosophy and psychology. In doing so, I highlight the potential harms of including folk-psychological concepts in comparative explanations of nonhuman animal minds. For the purposes of this paper, I will focus on three criticisms of folk psychology and attributing human folk-psychological concepts to nonhuman minds. The first, offered by

Shettleworth, suggests that "Folk-psychological explanations are rarely the only plausible explanation, given alternatives." (Shettleworth 2012, pg. 3). I argue that this criticism can be resolved by viewing folk-psychological and associative explanations as different levels of explanation that are not mutually exclusive. The second, an objection raised by Penn and Povinelli (2007), argues that folk psychology impedes scientific progress within the discipline of comparative psychology. They identify a methodology called "reasoning by analogy" as a major factor in this slowing of progress. Coupling Penn and Povinelli's argument with a similar argument from Heyes (2008), I explain why this strategy presents a problem that should be addressed.

Next, I outline the third criticism, which I call "capturing distinctiveness." This is my own worry that using our understanding of human folk psychology as the starting point for our inquiry causes us to miss uniquely nonhuman folk psychologies. I then attempt to sketch a solution to the latter two concerns. In doing so, I take inspiration from Penn and Povinelli's agnosticism as to whether nonhuman mental states "bear any resemblance to the mental state concepts putatively posited by our commonsense folk psychology" (Penn and Povinelli 2007). This idea underpins my suggestion that only a *uniquely human* understanding of folk psychology is plagued by the methodological concerns inherent to "reasoning by analogy." I show how this realization pushes us to construct a non-anthropomorphic approach to folk psychology.

Section 2.1: Shettleworth's "Implausibility" Criticism

Shettleworth maintains that even if we can plausibly explain a nonhuman animal's behavior in terms of folk psychology, there is *almost always* an equally-plausible alternative explanation that does not make such attributions (Shettleworth 2012). Her view, which I refer to

as the "implausibility" criticism, goes as follows: It is extremely unlikely that a plausible folk-psychological explanation could be the best explanation because various kinds of mechanistic or other explanations (behavioral, developmental, or evolutionary) will always be equally as plausible as our best folk-psychological ones. The alternatives to explaining animal minds in terms of folk psychology – via behavioral, developmental, or evolutionary mechanisms – rely on associations between behaviors and outcomes, never requiring us to understand nonhuman minds as folk psychologists.

Shettleworth offers several reasons why a plausible folk-psychological explanation would rarely (if ever) be considered the correct explanation of a nonhuman animal's cognition. To begin, she identifies anthropomorphizing as a strategy that is usually employed when confronted with a specific anecdote or limited set of non-experimental observations (Shettleworth 2012). Shettleworth suggests that any anecdotal folk-psychological interpretations "demand experimental tests" – in other words, we must test them against competing hypotheses (Shettleworth 2010). The goal of the experimental tests we design should be to generate alternative hypotheses that predict different outcomes (Shettleworth 2010). She uses the following example of a crow dropping walnuts:

> "Crows crack walnuts by dropping them from heights of 5-10 meters or more onto sidewalks, roads, and parking lots. Occasionally they drop walnuts in front of approaching cars, as it using the cars to crush the nuts for them. Do crows intentionally use cars as nutcrackers?" (Shettleworth 2010, pg. 3).

The folk-psychological explanation might posit that the behavior is "an expression of clever crows' ability to reason and plan" (Shettleworth 2012). Alternatively, the behavior can be explained in terms of purely associative, sub-personal processes that do not require crows engaging in folk psychology or possessing a theory of mind. This example highlights what

Shettleworth considers one major challenge of offering folk-psychological explanations – without testing alternative hypotheses that predict different outcomes, there is often no clear way to decide between folk-psychological and associative causes of behavior. She relies in part on a principle known as "Morgan's Canon" to make this claim. Morgan's Canon states, "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale" (Shettleworth 2010). Morgan's Canon implores us to choose the simpler "lower" explanation – in the chimpanzee case, the associative one – rather than the "higher" folk-psychological one which requires the attribution of complex, humanlike cognition. Shettleworth agrees that these "lower" explanations will usually be more plausible than the "higher" ones.

Ultimately, I think Shettleworth's critique does not present a major obstacle to including folk psychology in comparative explanations. Rather, I think there exists a simpler response to Shettleworth's claims. If there are folk-psychological phenomena that we wish to explain, we must do so using personal-level explanations. Giving a higher-level folk-psychological explanation is not mutually exclusive with giving a lower-level associative explanation. The two can coexist within a larger multi-level explanation of an animal's behavior. Moreover, there are some behaviors for which we need a personal-level (folk-psychological) explanation. When we are explaining the behaviors and capacities relevant to an animal's activities as a folk-psychologist, we need to explain them at the level of intentional agents. Dennett's argument that I introduced in the last section does work here. He states that "it is only on the personal level that explanations proceed in terms of the needs, desires, intentions, and beliefs of an *actor* in the environment." (Dennett 1987). These intentions, desires, needs, beliefs, and so on are all folk-psychological concepts. So long as there are at least some phenomena that require personal-level

explanations, we should leave room for them in comparative psychology and prefer them in at least some cases over purely associative claims.

Section 2.2: Penn & Povinelli's "Scientific Progress" Criticism

Penn & Povinelli offer their criticism of attributing human folk-psychological mental states to nonhuman animals from within the context of their theory of mind research in primates. Theory of mind is deeply intertwined with folk psychology. Penn &Povinelli introduce their paper with the question "Are humans alone in their capacity to reason about unobservable mental states, such as perceptions, intentions, emotions, desires, and beliefs?" (Penn and Povinelli 2007). This question, which they take to be a question about theory of mind, involves reasoning about the unobservable mental states of other minds. These unobservable mental states align with those central to standard definitions of folk psychology. When we ask whether some nonhuman animal possesses a theory of mind, it seems like what we are really asking is "does this nonhuman animal 'describe, interpret, and predict' others by attributing 'familiar mental states' to them?" We can get a better understanding of theory of mind from Premack and Woodruff, who conducted the landmark chimpanzee theory of mind study that sparked an entire research program. Theory of mind occurs when "the individual imputes mental states to himself and to others (either conspecifics or to other species as well)" (Premack and Woodruff 1978). The attribution of mental states to other agents is a core tenant of all standard theories of folk psychology.

Penn and Povinelli blame the prevalence of folk psychology within comparative research for our failure to resolve the theory of mind debate. They lament that scientific progress on questions of theory of mind over the last decade has been slow, perhaps nonexistent, labelling it

an especially "intractable debate" (Penn and Povinelli 2007)[1]. This is the main harm they believe folk psychology inflicts on the science of comparative cognition – it impedes, even halts, scientific progress. They claim "the major impediment that has stood in the way of understanding whether or not other species employ a ToM (theory of mind) has been our species' inveterate intuitions about how our own ToM works." (Penn and Povinelli 2007). They suggest that by applying our own ideas about how theory of mind works in humans to nonhuman animals, we adopt an anthropocentric bias which stifles progress. This is also due to the close relationship between theory of mind and anthropomorphic, folk-psychological explanations, which may plausibly impact all aspects of the scientific process. The main mechanism by which folk-psychological attributions poison the science, on their account, is the methodological strategy of making "appeals to folk psychological assumptions and reasoning by analogy to introspective intuitions" (Penn and Povinelli 2007). Here, Penn and Povinelli identify reasoning by analogy as a cause of slowed scientific progress in comparative psychology. I believe that we should take this worry seriously. My proposal, which I expand upon in the next several sections, is that we find a non-anthropocentric starting point for understanding nonhuman minds. Adopting this new starting point would hopefully progress the science and alleviate Penn and Povinelli's worry.

Section 2.3: Heyes' Critique of "Reasoning by Analogy"

Heyes (2008) argues that "reasoning by analogy" from human folk-psychological states to nonhuman ones is a primary methodology – and vice - of anthropomorphic explanation. As mentioned in the previous section, Penn & Povinelli (2007) also suggest that this methodology

[1] Time may have proven them wrong – one decade after they published their 2007 paper, Krupenye et al. (2019) found evidence that great apes pass the false belief task, which is the gold standard for traditional theory of mind research. However, Penn at least seems unconvinced – as of 2019, he still argues that higher-order cognition across all domains is unique to humans (Penn et al. 2019).

shouldn't be used in a rigorous science of comparative psychology. Of course, it then becomes important to investigate what reasoning by analogy is and why it is an unsound methodology. This worry about reasoning by analogy, or reasoning starting with our intuitions about human folk psychology, is a serious problem that ought to be addressed. Once the problems inherent to the folk-psychological methodology have been laid bare, it becomes clear that when we use reasoning by analogy to understand nonhuman minds, we are likely failing to capture the unique phenomena which make them distinct. This concern about "capturing distinctiveness," along with Penn and Povinelli's worry that folk psychology impedes scientific progress, can be addressed by fixing the method of folk-psychological explanation.

What does it mean to reason by analogy? Penn and Povinelli suggest that reasoning by analogy occurs when we begin with our "introspective intuitions" regarding the psychological causes of human behavior and assume those same psychological causes must apply to nonhumans that behave in similar ways (Penn and Povinelli 2007). Heyes offers an excellent explanation of this strategy in the form of an example. Referring to folk-psychological explanations given in the context of mirror self-recognition experiments, she explains the process of reasoning by analogy in this way:

> "The reasoning behind these claims has never been articulated, but it seems to be roughly as follows. (1) When I (a human) use my mirror image, I understand the image to represent my 'self', and I understand my self to be an entity with thoughts and feelings. (2) This chimpanzee uses his mirror image. (3) Therefore, this chimpanzee understands his mirror image to represent his 'self', an entity with thoughts and feelings." (Heyes 2008).

Heyes' explanation of folk-psychological reasoning can be restated in the following way:

1) When humans perform behavior *X*, it is motivated by thought *Y* and feeling *Z*
2) Nonhuman animal *A* also performs behavior *X*
3) The motivations for performing behavior *X* are similar for humans and animals

4) Therefore, nonhuman animal *A's* performance of behavior *X* is also motivated by thought *Y* and feeling *Z*

It is now possible to determine why reasoning by analogy is an unsound methodology. Premise (3) is almost certainly false – the motivations for performing behavior *X* likely vary dramatically between species, especially for more complex social behaviors which may have specific, context-dependent reasons. Moreover, it is unsurprising that Penn and Povinelli worry that folk psychology is impeding scientific progress in comparative psychology. It seems that there is real cause for concern about the legitimacy of making inferences about the causes of nonhuman animals' behavior from our unique, human experiences as folk-psychologizers. For the rest of this section, I will outline my own view on why folk psychology harms our understanding of nonhuman minds before offering a sketch of what a new approach to folk psychology might look like - one that isn't burdened by an ineffective methodology.

Section 2.4: (Re)capturing Distinctiveness

When we make anthropomorphic folk-psychological explanations via reasoning by analogy we must assume Premise (3), which falsely holds that the mental states underpinning nonhuman animals' behaviors are the same as those that underpin human behavior. By assuming that the psychological causes of behavior are uniform across species, we are blinding ourselves to the incredible psychological diversity of nonhuman minds – thereby missing out on uniquely nonhuman phenomena. This argument is what I call the "capturing distinctiveness" critique. Imposing our own folk-psychological concepts onto nonhuman animals is a poor substitute for their actual mental states, which may be unlike ours. On my view, failing to capture the distinctive folk psychologies of nonhuman animals subverts the aims of comparative psychology as a discipline. If comparative psychology wants to accurately understand nonhuman cognition -

not just catalogue the ways in which the psychologies of other animals measure up to our own - then we need a new approach to folk-psychological explanation.

Now that I have argued for comparative psychology's need for a new folk-psychological approach, I will offer a potential first step. The heart of the problem with folk-psychological explanation is that it is shamelessly anthropomorphic – reasoning from analogy uses *human* folk-psychological concepts as its starting point. We can preserve folk-psychological explanation by reframing the role human cognition plays. Instead of using our own folk psychology as the starting point for reasoning about nonhuman cognition, we should take the "umvelt" - the experiential niche - of the target species as the new starting point. The term "umvelt," coined by biologist Jakob von Uexkull, can be understood as how "the world… appears to animals themselves, not as it appears to us. This we may call the *phenomenal world* or *self-world* of the animal" (von Uexkull 1957). By doing away with the anthropocentric "reasoning by analogy" strategy and replacing it with a new approach that begins with each animal's umvelt, it positions us well to reason about the unique folk psychologies of nonhuman animals.

This approach works to resolve the criticisms advanced by Heyes, and Penn and Povinelli, along with my "capturing distinctiveness" critique. By rejecting human folk psychology as the starting point of our inquiries, we remove the troublesome Premise (3) from the folk-psychological method. From here, we use our new starting point of an animal's umvelt to develop hypotheses about the possible personal-level explanations of an animal's behavior. Now that we are working with scientific hypotheses and not "our folk psychological intuitions," there is no reason that crafting personal-level explanations of nonhuman animals' behavior would impede scientific progress. Moreover, once we've committed to doing away with reasoning by analogy and replacing it with an approach that prioritizes an animal's umvelt as the

starting point, we are no longer in danger of missing out on the wide variety of uniquely nonhuman folk-psychological phenomena that likely exist. This is because we are no longer making the incorrect assumption that the psychological causes of an animal's behavior are the same as our own, freeing us to explore novel, diverse hypotheses based on the experiential niche of the nonhuman minds we are studying.

There is one last point to make in this section. My project is primarily interested in identifying potential nonhuman folk psychologists and developing a strategy for explaining the uniquely nonhuman facets of their folk-psychological practices, which lends itself nicely to the "big tent research program" envisioned by pluralistic folk psychology. Given the latter focus, it is important to note that my intent when talking about folk psychology moving forward is not to get at *all* folk-psychological concepts in other animals. There are surely some non-social folk-psychological phenomena – perhaps an ant has beliefs about where a food source is located, but does not recognize others as intentional agents. The ant in this hypothetical could correctly have "belief" attributed to her, but she is not a folk psychologist. The folk psychologies of animals such as the ant in this example are not the target of my thesis. Rather, I mean to narrow my scope to those concepts and capacities related to being a folk psychologist, such as those implicated in social cognition or theory of mind. Examples of such phenomena include not just predicting and explaining, but other activities such as cooperating, normalizing, justifying, and other fundamentally social processes.

Section 3: Why We Still (Sometimes) Require Folk Psychology

One might reasonably wonder why, if it is so deeply flawed, we bother keeping folk psychology around in the first place? Why not make the easier, simpler move and get rid of it altogether? In this section, I will address two primary arguments for why scientists and philosophers should want to keep folk psychology within comparative psychology. The first reason is what I call Andrews' "functional organization" argument, which suggests that "folk psychological concepts allow us to categorize behaviors into types and investigate the causes of those types of behavior." (Andrews 2020). The second reason, which has already been hinted at in previous sections, is that we must preserve the personal level of explanation in order to explain several kinds of nonhuman phenomena. The personal level of explanation, or "the explanatory level of people and their sensations and activities" (Dennett 1986), becomes needed when we must attribute mental states to whole agents. Lastly, I will conclude the section with an exploration of male alliances in bottlenose dolphins – a unique phenomenon that I hope highlights the need to understand nonhuman folk psychologies and concepts in non-anthropomorphic terms.

Before progressing further into this section, I must clarify what I mean by "why we still *sometimes* require folk psychology." I offer this caveat because not every explanation has a personal level component – some phenomena may be fully explicable at the subpersonal level, or the level of an animal's "psychological capacities and subsystems." (Drayson 2014). Take this explanation of locomotion states in *C. elegans* as one such example:

"In each locomotion state, C. elegans animals express a characteristic set of locomotor parameters over a long-lasting, stable time period. C. elegans locomotion is comprised of just a few basic building blocks: (1) forward locomotion, (2) brief backward locomotion (aka reversals) and omega turns in which animals change their direction of movement, (3) postural

changes such as fine-scale head movements (Von Stetina et al. 2006), and (4) locomotion pauses (Steuer Costa et al. 2019). These four basic building blocks are present in every locomotion state, but their frequencies and amplitudes can vary considerably… Importantly, each locomotion state that we describe below is reliably observed under specific environmental conditions and consists of a reliable set of locomotion parameters." (Flavell, Raizen, and You 2020).

While it is possible this explanation could constitute one part of a multi-level, folk-psychological explanation of some other behavior in *C. elegans,* one does not need to offer an explanation at the personal level to adequately capture the phenomenon of *C. elegans'* locomotion states. This is for the same reason that Shettleworth (2012) offers – a lower-level, associative explanation sufficiently explains the phenomenon.[2] The locomotion states in *C. elegans* seem to be inflexible and reliably elicited by environmental cues – the behavior does not require the recognition of self or others as agents. While it's possible we might find evidence for considering *C. elegans* to be folk psychologists through studying their other behaviors, locomotion states alone do not demand a folk-psychological explanation. A complete explanation of an animal's folk psychology will likely include both personal and subpersonal-level components, but I do not wish to argue that *all* behaviors require folk-psychological explanations.

Section 3.1: Andrews' "Functional Organization" Argument

In order to study nonhuman minds in a rigorous, unbiased way, scientists must be able to organize behaviors into categories based on the behavior's function – including folk-psychological ones. In doing so, we are better able to compare the similarities and examine the differences between human and nonhuman folk psychologies. This is the heart of what I will refer to as Andrews' "functional organization" argument. She identifies "the need to organize behaviors together for study… as an important part of the methodology of comparative

[2] This does not mean that we should rule out a personal-level explanation in this case entirely, nor reject compelling evidence (should it arise) that locomotion behavior is an important part of a potential *C. elegans* folk psychology. In this case, I am arguing that the associative explanation truly seems more plausible.

psychology." (Andrews 2020). There is much research, both in human and nonhuman animals, conducted within comparative psychology on topics that require the attribution of mental states to whole agents: theory of mind, social play, social learning, social emotions such as empathy or shame, etc. In human research, we often use folk psychology to explain behaviors that require mental state attribution – for example, we might conclude that a child participating in a false-belief task thinks Sally will look for her toy in the basket because that's where Sally *believes* it is.

Andrews argues that we must be able to do the same in nonhuman animal studies; "if we cannot see functional similarities between movements of different geometries, we fail to consolidate behavioral types as objects of study." (Andrews 2020). It seems that if we want to compare human and nonhuman cognition in domains that usually require folk-psychological explanations in humans, then we must be willing to offer these folk-psychological explanations for both types of minds – not just the human ones. She argues that it is through the application of folk-psychological concepts that we are able to organize behaviors into functional types and "investigate the causes of those types of behavior." (Andrews 2020). Take the case of chimpanzee deception – without applying the folk-category of "deceptive" to chimpanzees, there would be no basis for comparison to functionally similar behaviors in humans or even other nonhuman animals. Despite the established harms of keeping folk psychology in comparative psychology, doing away with it altogether as the anti-folk psychologists suggest would also harm the science. Andrews points out that finding functional similarities across species is a key methodology of comparative psychology, and without a willingness to attribute folk-psychological concepts for this purpose, we would lose this important strategy (Andrews 2020). The functional organization argument highlights what may feel like an obvious, but deeply

important, point – if we want to study nonhuman folk psychologies (and folk psychologists), we must be willing to make folk-psychological explanations of nonhuman animals' behavior.

Section 3.2: Andrews' "Personal-Level Explanation" Argument

In order to address the worry that giving up folk psychology requires the abandonment of personal-level explanations, we must answer the question "what specifically is useful about personal level explanations of nonhuman minds?" Once we know what we need from personal-level explanations, we can then ask whether folk psychology is actually necessary to this endeavor. The usefulness of folk-psychological explanation, beyond their helpfulness in the functional organization of concepts mentioned in the previous section, is that they allow us to attribute mental states to whole agents. If we want to explain primate behavior in terms of "chimpanzee 'x' didn't take the fruit because she *believed* that her competitor chimpanzee 'y' would notice," then we need to offer an explanation at the level that attributes mental states (believing) to agents (chimpanzees). If we wish to investigate whether nonhuman animals represent and predict each others' mental states, then we cannot avoid explaining their folk-psychologizing in non-folk psychological terms.

Alternatively, we can examine what happens if we remove folk psychology from our explanations to better understand its importance to explaining nonhuman minds. Doing so reveals that the reluctance of many scientists to attribute personal-level explanations to nonhuman animals for fear of engaging in anthropomorphism is rooted in a more insidious assumption. Andrews argues that "Following the advice to avoid folk psychology in comparative psychology would lead scientists to avoid all the mental concepts associated with our lay (sometimes true and sometimes false) understanding of the causes of human behavior" (Andrews

2020). If we remove folk psychology, and therefore personal-level explanation, from the explanatory tools available to comparative scientists, the discipline commits itself to a sort of eliminativism about nonhuman minds. The stakes are elevated by the fact that adopting this view would make entire research programs in comparative psychology off limits. Take Shettleworth's suggestion that we employ rigorous alternate hypothesis testing (rather than some other method like success testing) before giving a folk-psychological explanation as one such example. If we were to commit to avoiding folk psychology completely then even modest proposals like Shettleworth's, which afford folk psychology a very minimal role in comparative psychology, would be discarded. We would be left with only a subpersonal understanding of nonhuman minds and behavior, rooted in purely associative mechanisms, should we adopt the anti-folk psychology position. This view of nonhuman animals also precludes regarding them as intentional agents or persons, which would have additional implications for related disciplines such as animal ethics.

This worry constitutes a compelling reason to preserve personal-level explanation - refusing to give folk-psychological explanations of nonhuman minds for phenomena that require them in humans, such mind reading, amounts to a prohibition against studying mind reading in nonhuman animals. If we embrace the anti-folk psychological position, a large swathe of the phenomena that scientists and philosophers find interesting would be closed off. Take the research on mind reading as a paradigmatic example. In the mind-reading case, where the target phenomenon is an animal's ability to represent the mental states of others, rejecting the null hypothesis requires us to attribute mental states such as beliefs and desires to nonhuman animal subjects. Put another way, we cannot avoid giving folk-psychological explanations of fundamentally folk-psychological phenomena. Attempting to strip folk psychology from all

explanations would harm scientific progress in comparative psychology. In the mind-reading example, scientists could only give subpersonal explanations of the neurological mechanisms that support this higher-order cognitive ability, but they could not successfully explain mind reading without invoking folk psychology.

Section 4: The Case of "Male Alliances" in Bottlenose Dolphins

I have so far argued that using human folk-psychological intuitions and concepts is harmful to the study of animal cognition, largely because it requires the use of a flawed methodology which prevents us from capturing the distinctive, uniquely nonhuman phenomena that we wish to explain. However, I have also shown that folk psychology is necessary to maintaining the personal level of explanation in comparative psychology, along with its value as a strategy for organizing behavior into functional types that researchers may study. I will now turn to an example which I hope highlights the need for personal-level explanations of nonhuman behavior while emphasizing my conclusion that imposing *human* folk-psychological characteristics on to other minds is harmful to comparative psychology. This case – an examination of "male alliances" in bottlenose dolphins – also stresses the need to shift away from anthropomorphic folk psychology and toward a new approach that uses nonhuman psychology as its starting point.

Before attempting to show how "male alliances" might constitute a uniquely nonhuman folk-psychological concept, it is important to offer an explanation of the relevant agents and their social activities. Bottlenose dolphins are highly social marine mammals that live in complex fission-fusion societies where "individual interchange among subunits" of the larger group is common. (Wursig and Pearson 2015). Likewise, male alliances constitute one such possible

subunit of a larger pod of dolphins. Male alliances are nested, multi-tiered social structures (Mann 2006). The most basic unit is the first-order alliance, which usually forms between two or three individual males whose relationship may last 15-20 years (Mann 2006). Considering the average life span of bottlenose dolphins in the wild is approximately 25 years (Jaakkola and Willis 2019), membership in a first-order alliance lasts most or all of an individual's adult life. Dolphins in first-order alliances have been observed cooperating to "maintain exclusive reproductive access to a single female" for a period known as "consortship," which usually lasts for a week (Mann 2006). Additionally, males in first-order alliances also frequently engage in male-male sexual activity with each other. First-order alliances sometimes form what are known as "second-order alliances" by allying with other first-order dyads or triads. The function of this social behavior is theorized to support reproduction – the other males in the alliance might protect the female targeted during consortship from males outside the alliance (Mann 2006). Perhaps the most interesting feature of these alliances for comparative cognition researchers is that at one site in Shark Bay, Australia, second-order alliances ally with each other to create exceptionally complex, multi-tiered social structures and alliances of this complexity had previously only been observed in humans. (Mann 2006).

While this complex social behavior is hypothesized to serve reproductive purposes, male alliances are unique in that only a few males within the alliance successfully reproduce (Wisniewski, Brown, and Moller 2012). For this reason, male alliances are somewhat difficult to explain in terms of human social concepts - why would male dolphins spend most of their lives forming close social and sexual relationships with other males as a primary reproductive strategy? Of course, the phenomenon has been scooped up by popular science media, where journalists have engaged in wild speculation as to how this question should be answered. One

headline reads “Bros for life! Dolphin males can form life-long relationships with one another” (Remili 2022), while another claims “More Gay Dolphins Observed Off Coast of Western Australia” (Osborne 2017). In perhaps the most outlandish example of anthropomorphism on this subject, the former article even describes male alliances as “bromances” and suggests individual dolphins act as “wingmen” for each other. From what we know about male alliances, there is nothing that suggests the individuals involved are “bros,” wingmen, or lovers. We know nothing about gender or sexuality in bottlenose dolphins, nor anything about their thoughts or feelings toward their allies. Our confusion at witnessing a social structure that does not exist in humans produces humorous attempts at mapping them on to narrower (but still inaccurate) human folk-psychological categories such as “bromance.”

One might think this tendency to anthropomorphize nonhuman animal behavior is restricted to popular science journalism – sadly, one would be mistaken. In fact, the way scientists talk about male alliances highlights how using our own folk-psychological concepts to explain nonhuman animals means that we, knowingly or not, import the moral attitudes and judgements our community attaches to these concepts. This could arise in the form of wrongfully attributing a human folk-psychological concept (per the journalism examples), or in refusing to recognize a functional similarity between human and nonhuman behavior (per the scientific case to follow). Moreover, our anthropocentric biases prevent what I argue are fairly obvious interpretations of the data on male alliances. Consider the following claims about the nature of dolphin mating systems:

“Our study shows that strategic, intergroup male alliances can arise directly from a chimpanzee-like promiscuous mating system without one-male units, pair bonds, or male parental care.” (Connor et al. 2022)

It is unclear why first-order alliances would not meet the criteria for "pair bonding." Pair bonds are typically defined as "a selective association that exists between two adult individuals of the same species" (Bales et al. 2021). Definitions of pair bonding often include a requirement for mutual sexual activity, shared territory, proximity maintenance (time spent attending exclusively to the bonded partner), and affiliation behaviors such as mutual grooming and preening (Bales et al. 2021). Given that evidence suggests first-order dyads and triads are intentionally selected based on "social homophily" (cultural, behavioral, genetic, or material similarity) between partners (Connor et al. 2022), that partners engage in sexual activity (Mann 2006), that they spend considerable time in mutual affiliative behaviors (Mann 2006), and that they share territory (Connor et al. 2021), it seems like an obvious case of pair-bonding for many male alliance members. Connor et al. do not offer an explanation for the basis of their pair-bonding judgement, but it is likely because male alliance pair bonds arise in a context where we might not expect to humans to pair bond. For example, because the authors might look for pair bonding between males and females, but overlook it between males because of morality judgements inherent to their folk-psychological concepts.

Researchers, despite their formal scientific training, are no more insulated from cultural biases than the popular journalists. Scientists have clearly struggled to describe "how such intense, prolonged male-male bonds are formed and maintained" within the context of male alliances (Mann 2006). Because many of the males within alliances do not reproduce, some scientists have theorized that these individuals constitute a prime example of "reciprocal altruism" within the animal kingdom (Wisniewski, Brown, and Moller 2012), rather than posit that there may be some non-reproductive value to the allied individuals. One more, this seems like another example of imposing our own understanding of human social behavior onto a

species for whom it may not apply. Wursig and Pearson remind us that "we do not really understand dolphins' social nature. This includes all aspects of their lives – resting, travelling, foraging, feeding, and social and sexual behavior – within the prevalent mating system of a dolphin species or community (Wursig and Pearson 2015). For various cultural and institutional reasons, very little research has been done on homosexual relationships and behaviors in nonhuman animal communities (Mann 2006). The disappointing reality is that we don't understand how this unique cetacean social structure functions, what purposes it might serve within cetacean communities, or how its members think of each other as other minds and agents.

What does this example of anthropomorphizing a nonhuman social concept teach us about comparative psychology? First, it highlights how scientists and non-scientists alike often impose socially loaded, rich human categories onto nonhuman animals. Anthropomorphizing in this manner also impedes scientific progress and fails to capture distinctively nonhuman phenomena. The former seems to be the case on the basis that, as Mann (2006) pointed out, very little research is done on nonhuman phenomena that may include homosexual relationships. If scientists used nonhuman concepts as their starting point rather than their own biases and intuitions, then perhaps more research would be done on the role of homosexual relationships within male alliance formation. The latter criticism is made evident by the lack of a coherent or compelling personal-level explanation of male alliances. While there are descriptions of the phenomenon and plenty of speculation regarding its social function, there are no personal-level explanations that are not simply misattributed human concepts – and, as I've shown, those range from the simply misguided to the outlandish and bigoted.

However, there is a reason that "male alliances" have proven to be a popular and controversial subject within both academia and science journalism. It does appear to be a

uniquely nonhuman, complex social phenomenon that demands a personal-level explanation.[3] Male alliances share little in common with our own social structures and concepts, and as a result they highlight the shortcomings of reasoning by analogy as a strategy for explaining nonhuman minds. As I argued in Section 3, we need folk psychology in our explanations, but the arguments against folk psychology offer compelling reasons for abandoning the practice. I have argued that we need to construct a new, non-anthropomorphic approach to explaining nonhuman cognition at the personal level that takes the nonhuman umvelt as its starting point. In the next section, I begin to address the challenging question of what such an approach might look like and how we might begin building one.

Section 5: Developing a Nonhuman Folk Psychology

How do we craft a new approach that separates anthropomorphism from folk psychology? This would constitute a large change in the way we study nonhuman minds. I should note again that I am narrowing the scope from folk psychology broadly understood to a focus on understanding agents as folk psychologists, and the relevant socio-cognitive capacities, activities, and concepts. On the view I will develop in this section, a new approach requires two things. The first part of the section is dedicated to this first feature - we need a method for determining whether a nonhuman species might be "folk psychologizers" in Andrews' sense of the term. I will propose a methodology for detecting nonhuman folk psychologies through an analogy to astrobiology's search for extraterrestrial life. The solution to the astrobiological problem that some scientists have endorsed, called "agnostic biosignatures," could be adapted to

[3] There are interesting implications and intersections between this thesis and cross-cultural psychology. While outside the scope of this thesis, whether one result of my proposal is that we make changes to the way we approach diverse human folk psychologies is an open question.

help comparative psychologists discover nonhuman communities with folk psychologies. In the second part of the section, I introduce the second feature this new approach requires - we need the ability to construct non-anthropomorphic explanations of nonhuman folk-psychological concepts. While it has thus far been sufficient to suggest that we replace "reasoning by analogy" with a methodology that takes the umvelt of the target species as its starting point, I have not yet offered much guidance on how such a method might be constructed, or what it would look like.

This second part poses a significantly larger challenge. When humans want to learn about each others' mental states, they can communicate with language and form close relationships with those they wish to better understand. One major – and perhaps glaringly obvious – obstacle is that we presently lack the ability to communicate with nonhuman animals in this way. Even if we recognized a species as potential folk-psychologizers, it would be difficult, even impossible, to understand their unique folk psychology given these limitations. For the same reasons that nobody knows what it's like to be a bat, we lack the ability to grasp how bats might understand each other as minds and social agents. Despite these obstacles, I argue that we can make progress toward an approach that takes an animal's umvelt as its starting point. This goal could be realized through future advances in technology, specifically those that help us make sense of nonhuman animal communication. I will draw on examples from contemporary cetacean research to show how we might begin such a daunting project.

Section 5.1: Using "Agnostic Biosignatures" to Find Nonhuman Folk-Psychologizers

I argue that we should look to how other sciences have made progress overcoming similar obstacles to address the question of how to spot nonhuman folk-psychologizers without privileging our own folk psychology, with its inherently human mechanisms and concepts. In

order to do this, I will first discuss a concern regarding the detection of extraterrestrial biosignatures, or biochemical "signs of life" (Duner 2018) within the field of astrophysics – called the "*N*=1" problem - that resembles the structure of our own issue in comparative psychology. I then explore one potential solution – some astrophysicists have adopted "agnosticism" as a theoretical commitment in the search for biosignatures. Agnosticism's aim is to determine general, functional patterns that do not rely on the unique, specific chemical features of a planet's biochemistry (Marshall et al. 2021). I suggest there may be a parallel solution for the field of comparative psychology – perhaps there are generalizable, functional patterns of certain social-cognitive abilities that do not presuppose human folk psychology.

Section 5.1.1: The "N=1" Problem

What is the *N*=1 problem? To paint an oversimplified view of statistics, it is typically the case that the larger the sample size – referred to using the variable *N* – a dataset can claim, the more accurate and generalizable the results of an analysis using this data set will be (Biau 2008). For example, take some hypothetical study that tests whether rats prefer Food A over Food B. Assuming the sample is also representative, we would feel more confident in results drawn from the preferences of 150 rats than results drawn from 5. When the sample size is this low, it becomes challenging to identify confounding variables, such as whether the 5 rats have anomalous food preferences that wouldn't apply to the broader rat population. Furthermore, we would be unjustified in using this study as the basis for deciding which type of food to offer our new pet rat. In a truly disastrous scenario, there could be some large defect with Food B that causes it to be tasty but also mildly poisonous, and it just so happens that our 5 sample rats were unaffected. If we fed Food B to our new pet rat, we may end up making her sick or worse, highlighting the risks of generalizing from a low sample size.

This example captures the heart of what is commonly referred to as the *N*=1 problem in the search for extraterrestrial biosignatures. Scholarship on the *N*=1 problem in astrophysics stems from the relatively new need to design methods and tools for detecting biochemical signatures in the atmospheres of exoplanets. The existence of life on Earth shapes the chemistry of Earth's atmosphere in significant ways through "processes such as photosynthesis, carbon and nitrogen fixation, replication, chiral enrichment, and morphogenesis" that are detectable "via isotopic and atmospheric analysis." (Marshall et al. 2021). The astrophysics debate is centered on how we should apply these analyses to exoplanets – extrasolar worlds that, due to their potentially non-Earthlike chemistries, are unlikely to support life that undergoes the sorts of biochemical processes that would give rise to recognizable biosignatures. While there is a chance that life on other worlds would share the same biochemistry as Earth life, it seems unlikely – the types and amounts of chemicals available on extrasolar planets is incredibly diverse, which would shape the evolution of life on these worlds. Moreover, because our sample size of planets that support life is just one – Earth – the accuracy and generalizability of our models of the characteristics of Earth-life are in serious doubt. In other words, "knowing what signatures can be assigned to living systems is difficult as alien life has never been seen before." (Marshall et al. 2021).

Astrophysics is not the only science with an N=1 problem. My concern that we only understand one folk psychology – our own – and that it is inherently anthropomorphic, presents a similar problem. How would we know if we encountered other folk-psychologizers?[4] Our anthropomorphic methodology of reasoning by analogy likely fails to detect most novel,

[4] I offer this analogy not with the intent of getting at all folk-psychological concepts in other animals. Rather, I mean to narrow my scope to those that are of great interest to my thesis, namely the concepts and capacities related to social cognition or theory of mind.

nonhuman folk-psychological phenomena, just as astrobiologists' methods for detecting biosignatures are formed completely around Earth's biological and chemical features. The pair of problems may be stated as follows:

Astrophysics: we have not discovered any non-Earth biosignatures, and do not know enough about "life" as a category to be certain we would recognize extraterrestrial biosignatures.

*Folk Psychology***:** we have not discovered any nonhuman folk-psychological concepts, and do not know enough about "folk psychology" as a category to be certain we would recognize nonhuman folk-psychologies.

There are several ways the analogy can help us understand the "N=1" problem within folk psychology. While one could argue that we understand enough about life on earth to suggest a robust concept of "life," this falls apart if we wish to expand our concept to include potential extra-terrestrial life. The same applies to folk psychology – while we understand human folk psychology fairly well, we cannot generalize the concept to nonhuman folk-psychological concepts. Because our concept of folk psychology cannot be justifiably generalized, we cannot rely on our understanding of human folk psychology to assess whether some nonhuman behavior *x* is evidence for some previously unknown, uniquely nonhuman folk-psychological concept.

Section 5.1.2: The "Agnostic Biosignatures" Solution

The N=1 problem, intractable as it may seem, has not impeded progress much in the field of astrophysics. Some astrophysicists have addressed the N=1 problem by constructing a model known as the "agnostic model of life" (Smith 2021). The purpose of the agnostic biosignatures model is to remain "agnostic" about the specific chemistry of a living system, and therefore the biosignatures the system would produce, in favor of creating a universal model of life using general, functional patterns (Marshall et al. 2021). Moreover, the aim of employing this model in astrophysics research is to determine what these general, functional patterns might be and how

they might expand the range of potential biosignatures, and then apply the findings to the hunt for extrasolar biosignatures. Research efforts using this model have been fruitful. Adoption of the agnostic biosignatures model has launched a new, productive research program that has been largely successful in identifying possible candidates for universal patterns of life, or "candidate signatures." These include molecular complexity (Marshall et al. 2021), system complexity (Marshall et al. 2017), system elemental ratio (Kempes 2021), and energy transfer (Walker 2018). Of course, despite the productivity of the research program we have yet to meet E.T., but through the use of a model that does not presuppose any specific biochemistry, we are much closer to understanding the universal patterns that characterize life everywhere.

It seems possible that comparative psychologists could resolve their own N=1 problem by constructing a parallel, similarly agnostic model, but with folk psychology rather than life as the explanandum. The purpose of this model would be the identification of generalizable, functional patterns of certain social-cognitive abilities – those requiring the attribution of mental states to whole agents - that do not presuppose a specifically human folk psychology. Astrophysicists have proposed a few of these general, functional patterns, what I referred to previously as "candidate signatures." The presence of these candidate signatures might help us decide if there is life on some non-Earth planet. One key difference is that while astrophysicists examine non-Earth planets, comparative psychologists would survey nonhuman animal communities. Below I have selected two astrobiological candidate signatures that, on my view, have clear counterpart folk-psychological candidate signatures.

Candidate Signature #1: Information Flow

Biosignature Detection: matter and energy transfer in molecular networks (National Academies of Sciences, Engineering, and Medicine 2018)

Folk Psychology: information flow within social networks; communication behaviors like calling, gesturing, attention, and joint action (Johnson 2015).

One possible "universal feature" of life is information or energy transfer within a molecular network. Matter and energy transfer within a network of molecules is one possible measure of complexity (National Academies of Sciences, Engineering, and Medicine 2018), which could "apply to any kind of life, even if it is based on a radically different biochemistry." (Walker 2018). There is also information flow within social networks, which could point to a "universal feature" common to all communities of folk-psychologizers. Markers of information flow within social groups include, but are not limited to, the various communication behaviors listed by Johnson (2015). The threshold for how frequent, or how much, information would need to flow in a system before we would determine the community as possible folk-psychologizers would likely be an empirical question – one that has not yet been tackled.

Candidate Signature #2: Network Complexity

Biosignature Detection: measures of atmospheric chemical complexity (Walker 2018)

Folk Psychology: social complexity measures such as group size, social roles, relationship differentiation, levels of structure, and social uncertainty (Hobson et al. 2019)

A second possible "universal feature" of life might be found in the chemical complexity of a planet's atmosphere. Planets that do not support life - such as Mars, Venus, Titan, and the Jovian planets (Jupiter, Saturn, Uranus, and Neptune) – possess atmospheres whose chemical structures resemble random networks (Walker 2018). A planet that supports life would likely have an atmosphere whose chemical structure resembles a non-random, complex network (Walker 2018). Just as planetary atmospheres possess chemical networks, animal communities form social networks. Folk-psychologizers may have complex, non-random social structures.

Hobson et. al offer a brief elaboration on each measure of social complexity: "(1) group size, the number of individuals in the society, (2) social roles, the number, types, and diversity of roles individuals take on in groups, (3) levels of structure, the extent to which groups are organized across different social scales, (4) relationship differentiation, the extent to which relationships are individualized and differentiated, and (5) social uncertainty, the degree to which social situations and interaction outcomes are predictable or uncertain" (Hobson et. al 2019). As with the previous candidate signature, the list of potential measures of social network complexity are not limited to the ones offered here. The degree to which the various measures will be exemplified in a population before we would consider that population potential folk-psychologizers would also be an empirical question.

Now that I've offered a sketch of one possible way to determine whether a species might have their own folk psychology, or be their own unique kind of folk psychologist, I will briefly recall the cetacean example from the previous section to show how employing the "agnostic folk psychology" strategy might look. Cetaceans, it turns out, are possibly one of the best candidates for potential nonhuman folk-psychologizers. First, there is excellent evidence of information flow – they utilize diverse communication behaviors. Dolphins use a wide variety of whistles, burst pulses, physical touch, and other ways to communicate (Lammers and Oswald 2015). Second, their societies would score high on any measure of network complexity. Their communities have varied, flexible group sizes, where "dolphins in riverine and nearshore areas tend to occur in small groups of a few to several dozen, while many open-ocean groups occur in hundreds to thousands" of individuals (Wursig and Pearson 2015). Moreover, group size measures usually ignore that "dolphins some distance apart may be in acoustic contact with each other," which may increase the size of an individual's community (Wursig and Pearson 2015).

There is also evidence that dolphins have diverse social roles, multi-tiered fission-fusion social structures, high differentiation in their relationships, and a high degree of uncertainty within their social interactions. In one population of dolphins around 5 percent adopted the foraging strategy of "sponging," or using a sea sponge for protection, a specialized role which is transmitted socially from mother to offspring (Mann and Patterson 2013). Their social structures are also multi-tiered. Within a larger pod "there are sex- and age-mixed units, nursery units, mating units, and perhaps subadult units as well" (Norris and Dohl 1979). Relationships in dolphin communities are highly differentiated as well, where "dolphins must sort out their partnerships and perhaps subtle dominance/subservience relationships" (Wursig and Pearson 2015). Not to mention the various mechanisms of partner choice from the male alliance example, which include preferences for specific individuals (Mann 2006). Lastly, the flexible group sizes and fission-fusion nature of dolphin societies introduces high social uncertainty.

Section 5.2: Approaching Non-Anthropomorphic Explanation

Once we've identified an appropriate target species, how do we come to understand nonhuman folk psychological concepts, especially those that are radically different from ours? In this section, I argue that communication is vital to understanding nonhuman folk psychologies, which will allow us to replace human folk psychology as the starting point of our inquiries. Humans form relationships and communicate with language to learn about others' mental states. We presently lack the ability to communicate with nonhuman animals in this way, making it difficult to understand their folk psychologies. However, it could be possible with future advances in technology, specifically those that help us make sense of nonhuman communication. I will conclude by offering examples of current research that is progressing comparative

psychology toward the goal of being able to offer non-anthropomorphic folk-psychological explanations.

Linguistic communication is important because it is the primary way that humans learn about each others' mental states – the thoughts, feelings, beliefs, desires, motivations, etcetera that we use to understand those in our communities as social agents. While there may be other strategies we can use – such as body language or other cues – these are less direct ways of knowing, as they involve making inferences about the possible meanings of various behaviors. That animals lack humanlike language (as far as we know) is already a well-known problem. While human language could be a unique feature of our species, any system of communication – whether it truly counts as language or is "language-like" - with syntax and semantics should be enough for humans to work with. It is important to point out that I do not think language is necessary for a species to have a folk psychology – only that, as we begin our search for other folk-psychologists, it would be strategic to begin with those that communicate in ways that are potentially intelligible to humans.

These are what I call the "easy cases," and they can potentially help us develop our methods and technology to potentially address more challenging cases in the future. One more feature of an "easy case" is that the target nonhuman community is cooperative and communicative with humans. Perhaps we identify a species or community that we believe are likely folk-psychologists, and they also seem to have language-like communication. If they have no interest in forming cooperative relationships with humans, the task becomes more challenging. Here we can once more turn to the example species of bottlenose dolphins. Research has shown that they are strong candidates for possessing language-like communication in addition to being cooperative communicators with humans. One semantic feature of dolphin

communication is “signature whistling,” or self-referential whistles that are unique to each individual and are used to “broadcast their identity and location to other members of their social group” (Lammers and Oswald 2015), and “as a label when addressing conspecifics” (King and Janik 2013). Moreover, bottlenose dolphins both in captivity and the wild are known to actively cooperate with humans. In one case off the coast of Brazil, “dolphins have been observed driving schools of mullet into fisherman’s nets and then capturing fish for themselves as some escape from the nets” (Wursig and Pearson 2015, pg. 90).

This brings us back to the question of what sort of research program benefits a non-anthropocentric approach to folk psychology. On my view, efforts should be focused on decoding nonhuman animal communication (such as the aforementioned research on signature whistles and other features of cetacean communication), along with developing artificial intelligence and other “translation” technologies that aid in communication research. While communication with nonhuman animals might seem farfetched, development of communication technologies is starting to gain traction. One excellent example of this research is the CHAT (Cetacean Hearing and Telemetry) project, which is an underwater computer that is meant to aid in communicating with cetaceans and decoding cetacean communication (Herzing 2014). CHAT accomplishes this by receiving and producing sound underwater – so far, the team working on this project has generated artificial sounds that resemble dolphin whistles (Herzing 2014). The generated sounds refer to simple, familiar objects in the dolphins’ environment (Herzing 2014). The plan is to have CHAT produce these created whistles and see if the dolphins can learn how to use them, or even incorporate them into their own communications with researchers (Herzing 2014). Perhaps even more exciting is the project’s longer-term purpose – to utilize “pattern discovery techniques in an attempt to uncover fundamental units of dolphin vocalizations” (Herzing 2014). By adopting a

new approach to understanding nonhuman minds that uses an animal's umvelt - rather than human cognition - as its starting point, we can progress toward achieving truly non-anthropomorphic folk-psychological explanations.

Section 6: Conclusion

Is there a way to give non-anthropomorphic folk-psychological explanations of nonhuman animal social behavior? While the question is broad and no doubt requires an interdisciplinary solution, my hope is that the proposal offered in this thesis shows that giving such explanations is both possible and worthwhile. This question is important because I worry that using our anthropocentric understanding of folk psychology to make attributions to other animals causes us to miss out on the incredible psychological diversity of nonhuman minds. My strategy for addressing this question was to argue that if we want to understand nonhuman cognition - not just catalogue the ways in which the psychologies of other animals measure up to our own - then we need a new, non-anthropocentric approach to folk-psychological explanation. I then sketched a path forward for this new approach, starting with an explanation in Section 1 of how I understand folk psychology and its practitioners, who Andrews (2012) calls "folk psychologists." Next, I explore why we need the personal level to explain nonhuman folk psychologists. In Section 2, I outlined three arguments against using folk psychology in comparative psychology – Shettleworth's (2012) "implausibility" criticism, Penn and Povinelli's (2007) "scientific progress" criticism, which is grouped with Heyes' (2008) critique of reasoning by analogy, and my own argument for "capturing distinctiveness." In Section 3 I explained two arguments offered by Andrews (2020) for why folk psychology should be used in comparative psychology, the "functional organization" argument and the "personal-level explanation" argument."

In Section 4 I drew on the example of male alliances in bottlenose dolphins to highlight why we need a new, non-anthropomorphic approach to folk-psychological explanation of nonhuman folk psychologists and their social activities. In Section 5 I drew an analogy between our search for folk psychology and astrophysicists' search for biosignatures to show one avenue that comparative psychology might take toward a non-anthropocentric, or "agnostic," approach. I conclude that constructing such an approach is absolutely possible, and that current efforts to decode cetacean communication are the first steps toward this goal. Projects such as CHAT may give us a unique understanding of cetacean social behavior, and how cetaceans engage with each other as intentional agents and folk psychologists. This knowledge could give us the unique insight necessary to using their umwelt, and not our own, as the starting point for our inquiries into nonhuman folk psychology. There are many limitations to the project outlined in my thesis. Most importantly, this is an inherently interdisciplinary project. Its success relies on the present and future efforts of comparative psychologists, ethologists, and others who study nonhuman animal communities. This thesis can, at most, offer suggestions for how these research programs should proceed, and argue that the end goal should be a non-anthropocentric understanding of folk psychology. Moving forward, scientists and philosophers each have a role to play in shaping the future of comparative psychology – one which should aspire to understanding the unique, diverse folk psychologies of nonhuman animal communities.

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