

Trinity College

## Trinity College Digital Repository

---

Senior Theses and Projects

Student Scholarship

---

Spring 2021

### The Three “Cs” of Animal Self-Consciousness: Complex Nervous System, Communication and Collaborative Social Play

Elena Bernewitz

[elena.bernewitz@outlook.com](mailto:elena.bernewitz@outlook.com)

Follow this and additional works at: <https://digitalrepository.trincoll.edu/theses>



Part of the [Philosophy of Mind Commons](#), and the [Philosophy of Science Commons](#)

---

#### Recommended Citation

Bernewitz, Elena, "The Three “Cs” of Animal Self-Consciousness: Complex Nervous System, Communication and Collaborative Social Play". Senior Theses, Trinity College, Hartford, CT 2021. Trinity College Digital Repository, <https://digitalrepository.trincoll.edu/theses/890>

**The Three “Cs” of Animal Self-Consciousness:**  
*Complex Nervous System, Communication and  
Collaborative Social Play*

By Elena C. Bernewitz

A thesis submitted in partial fulfillment of the  
requirements for the degree of  
Bachelor of Science with Honors in Philosophy

From  
Trinity College

May 3<sup>rd</sup>, 2021

Thesis Advisor and First Reader: Professor Kari Theurer  
Second Reader: Professor Dan Lloyd

**TABLE OF CONTENTS**

ACKNOWLEDGEMENTS	3
INTRODUCTION	4
CHAPTER 1	9
CHAPTER 2	19
CHAPTER 3	33
CHAPTER 4	45
CHAPTER 5	54
CONCLUDING REMARKS	63
BIBLIOGRAPHY	66

## ACKNOWLEDGEMENTS

Thank you, Professor Kari Theurer, for your continued insights and incredible patience without which this project could not have been finished. Thank you for sharing your passion for philosophy of science with me and helping me develop this project that combines my strange combination of interests in philosophy, neuroscience and animals. Your commitment to helping me work through the seemingly impossible days, as well as celebrating the little milestones along the way has been invaluable. I am grateful for all your support, not only on this project, but also along my entire undergraduate time as your student and advisee.

Thank you, Professor Erik Vogt and Professor Shane Ewegen, along with my fellow thesis writers for your wonderful feedback during the writing process. Thank you also for the continued moral support and opportunity to see your various projects develop.

Thank you to my friends, who have been along for the ride. Thank you supporting me through the ups and down of this project; for sharing with me in the laughs, the tears and the hard work. A special thank you to my two dearest friends in the world, Elisa and Samantha, for sticking by my side since childhood, continuously inspiring me and sharing my love for animals.

Thank you to my parents, Torsten and Katrin, for encouraging and supporting me in every one of my endeavors in life. Thank you for giving me the opportunity to realize my dreams, whether in academics, the show ring or as a person. Thank you also to my baby brother, Leon, for always reminding me to slow down and enjoy this very moment.

This project is dedicated to all my four-legged creatures, whose impact on my life undeniably is the inspiration for this thesis; thank you Alaska, Willow, Shrimp, Nikki, Fran, Robin and Blue.

## INTRODUCTION

We, as humans, are social beings who through our interactions in the world demonstrate a compulsion to attribute the richness of our own internal mental lives to others. As professor of psychology and neuroscience Michael Graziano puts it, “when [we] talk to someone, [we] have an automatic impression of thoughts, emotions and awareness emanating from that person” (Graziano, 1). This automatic impression allows us to reasonably theorize about the other’s thoughts, beliefs and feelings as mental states, and grasp the underlying motivations of their behaviors in our interactions with them (Byom and Mutlu, 2013). In philosophical discourse, the issue of *whether* we attribute mental states or minds to others is generally referred to as Theory of Mind (TOM) (Byom and Mutlu, 2013). Further, TOM also encompasses the issue of *how* we attribute mental states or minds to others (Byom and Mutlu, 2013).

When addressing those issues encompassed in TOM there are two possible explanations. One possibility is that we all have a formed universal folk psychological theory of how the mind works, which informs the way in which we attribute mental states to others. According to this possibility, we all construct a general model of the mind, as to infer from a token behavior the mental state [of the other]” (Deonna and Nanay, 2014). This assumes that a particular expression or behavior of the other equates to a mental state of our own with which we are already familiar, based on the general model, and is known as the *theory theory* (Deonna and Nanay, 2014). Another possibility is that we all have the capacity to simulate and project our own mental states onto others. That is, that we all run a simulation of our thoughts, beliefs and feelings given a set of circumstances, and project them onto others (Deonna and Nanay, 2014). Colloquially put, we are able to put ourselves in the other’s shoes. This is the *simulation theory*, and it assumes that our

imagination is accurate in simulating, predicting and projecting our own mental states onto others (Deonna and Nanay, 2014).

Both the *theory theory* and the *simulation theory* are generally accepted as longstanding separate models of TOM. More recently, however, they are no longer treated as conflicting views; instead, they are treated as “different means at our disposal to make sense of others as psychological beings” (Deonna and Nanay, 2014). Making sense of others as psychological beings requires a consideration of who the proper subjects of investigation are, when asking who or what belongs to the category of psychological beings. Psychological beings are those to whom we attribute mental states. Thus, it is evident that other humans, to whom we consistently attribute mental states, either through the *theory theory* or the *simulation theory*, are psychological beings. However, it seems a number of nonhuman animals (hereafter: animals) should not be overlooked when asking who or what are psychological beings (Vitti, 2010). Indeed, many of us extend our desire to attribute our rich internal mental life to others to a number of animals. That is, similar to how Graziano describes human-human interactions, in human-animal interactions we also seem to have an impression of thoughts, emotions and awareness emanating from animals.

The tendency to attribute mental states to animals, along with the impression of a rich internal life in animals, motivates several questions central to the literature on animal cognition:

1. Do animals have mental states or minds?
2. Are animals conscious?
  - a. If not all, are some animals conscious? (Which can also be formulated as: what is the distribution of consciousness across the animal kingdom?)
3. What is animal consciousness *like*?

Each of these questions asks whether the impression of mental states in animals is an impression of something that exists independently of us, or, alternatively, if it is a mere appearance resulting from how we understand our own minds. Furthermore, those questions specifically concerning consciousness, are both deeply scientific and philosophical in nature, and demand that theories of

consciousness provide a means of distinguishing between animals which are and are not conscious (Andrews, 52).

In the literature on animal cognition, the phenomenon of consciousness is commonly described “in terms of qualia – how things feel – awareness” (Andrews, 52). The term ‘qualia’ is derived from the Latin ‘quālis,’ meaning “of what kind,” and thereby makes reference to the *subjective* qualities or aspects of mental states (Mandik, 3). However, consciousness by its own nature is rather complex; it is understood in a variety of ways by different philosophers, and as such suffers from muddled connotations (Cartmill, 2000). The most prominent and oft-recognized definition of animal consciousness stems from Thomas Nagel’s writing, which focuses on the question of “what it is like” to be animal X (Nagel, 1974). Nagel argues “an organism or process can be said to be conscious if there is *something that it is like* to be that organism or to be undergoing that process; [and so what is] essential to consciousness is its phenomenal, experiential, or qualitative feel” (Vitti, 2010). Here, Nagel focuses purely on consciousness in the phenomenal sense, which is unsurprisingly termed ‘phenomenal consciousness,’ and thought to encompass “the qualitative nature of experience” (Andrews, 52).

Phenomenal consciousness, however, does not encompass the phenomenon of self-consciousness. Indeed, self-consciousness differs from phenomenal consciousness in an important way, as demonstrated by Kristen Andrews in the following passage:

This distinction [between phenomenal consciousness and self-consciousness] is important because it may be that one can have conscious experience without being self-conscious of that experience – individuals may experience pain without reflecting on the pain experience. (Andrews, 52)

Here, how self-consciousness is conceived of in the philosophical discourse becomes clearer. Self-consciousness is consciousness-of-consciousness, or the “ability to reflect upon [one’s] conscious experience and thoughts” (Andrews, 52). It seems this is an ability of a higher kind, such that not

all animals who are conscious are also self-conscious. Thus, the question arises: which animals are self-conscious, and which are not? Secondary to this question, another asks: what is the phylogenetic distribution of self-consciousness in the animal kingdom? To answer these questions, a theory of self-consciousness must provide a means of distinguishing between animals which are and who are not self-conscious. In this project, I aim to develop such a theory. I propose that there are three conditions which are necessary and jointly sufficient for an animal to be self-conscious, those being: (1) a complex nervous system, (2) communication, and (3) collaborative social play. Indeed, I find that these conditions are each individually necessary and jointly sufficient, such that if an animal meets all three conditions, they must be self-conscious. Likewise, if an animal is self-conscious, they necessarily meet all three conditions.

I begin this project with an extended discussion of the phenomenon of self-consciousness. In the first chapter, I carefully consider how self-consciousness ought to be defined and demonstrate the foundational aspects of the phenomenon from which the three proposed conditions arise. In the second chapter, I argue that only those animals whose nervous systems have the capacity for centralized attention meet the first condition set forth for animal self-consciousness, that being a complex nervous system. Through the investigation of the appearance and evolution of the nervous system in the animal kingdom, I find that it is only the third stage of complexity, centralized attention, which is adequately complex for self-consciousness. In the third chapter, I argue that only those animals whose communicative utterances fit the intentional account of communication meet the second condition set forth for animal self-consciousness, that being communication. Indeed, I explore three different accounts of animal communication and find that the Gricean interpretation of the intentional account points towards a sense of self, and as such the emergence of self-consciousness. Meanwhile, in the fourth chapter, I consider two forms social



play and argue that only those animals who demonstrate the self-handicapping and role-reversal, meet the third condition set forth for animal self-consciousness, that being collaborative social play. In the fifth and final chapter, I anticipate some potential objections to my proposal. I investigate some of the traditional criticisms against each of the three conditions, those being (1) a complex nervous system, (2) communication, and (3) collaborative social play, and aim to demonstrate that by treating the three conditions as necessary and jointly sufficient, my proposal overcomes those criticisms.

## CHAPTER 1

In this chapter, I provide an extended discussion of the phenomenon of self-consciousness; how it ought to be defined and the role it plays in animal cognition more generally. As seen in the introduction, self-consciousness is often characterized as consciousness-of-consciousness; yet this definition is too broad for its investigation throughout this project. Thus, I turn to the work of Bekoff and Sherman, who detail an account of the varying degrees of self-knowledge in the animal kingdom, of which self-consciousness is the highest degree (Bekoff and Sherman, 2004). According to Bekoff and Sherman, self-knowledge refers to an animal's capacity of having a sense of self, which can be mapped across a continuum ranging from self-referencing to self-awareness to self-consciousness (Bekoff and Sherman, 2004). Through the consideration of this continuum, I aim to establish the exact nature of self-consciousness with which this project concerns itself with. Furthermore, I hope to demonstrate the foundational aspects of the phenomenon from which the three necessary and jointly sufficient conditions, those being (1) a complex nervous system, (2) communication and (3) collaborative social play, arise.

### 1.1 Self-Consciousness: Dichotomy or Continuum

When exploring a means of distinguishing between which animals are and are not self-conscious, one question in particular seems to be related; should self-consciousness be conceived of as a binary phenomenon, or does the phenomenon admit degrees (Allen and Trestman, 66)? In order to answer this question about self-consciousness, specifically, it is helpful to turn to the philosophical considerations of the same question about consciousness more generally. Those who ascribe to the view that consciousness is binary embrace the idea that it is dichotomous by nature (Allen and Trestman, 66). According to this view, an animal either is or is not conscious, as an all

or nothing perspective (Allen and Trestman, 66). However, this dichotomous view immediately imposes limitations on the way in which one aims at distinguishing between which animals are and are not self-conscious. Indeed, it renders necessary the determination of *where to draw the line of consciousness*. Thus, it asks the following questions: what is the line of consciousness and how do we settle on it? These are questions which point to the issue of how one ought to operationalize consciousness. One might wonder whether the line depends entirely on the observable behaviors of an animal, or if they include neurobiological substrates? Or perhaps, could it be a combination of both? For example, what happens if the criteria for consciousness includes a necessary condition of behavior X, yet an animal does not exhibit behavior X, not because it is not conscious, but rather because the criteria is misguided. Or for example, what happens in terms of neurobiological substrates; how does one determine whether the neurobiological substrates of the animal are the same or sufficiently similar to humans to extrapolate that they are conscious. These examples highlight that any determination of the criteria for consciousness would be rather arbitrary. Moreover, they raise the question if it could ever be known whether those are the right criteria. Thus, conceiving of consciousness as binary is unconvincing. That is, if self-consciousness is binary, as an all or nothing phenomenon, then it would seem that a determination of criteria for consciousness is necessary. But this determination, as seen above, comes at a serious cost to the question of how to operationalize consciousness. So, it would be better to reject the idea of consciousness as a binary phenomenon and, instead, to conceive of it as *admitting degrees*.

As before, it is helpful to turn to the considerations of consciousness more generally when exploring whether self-consciousness admits degrees. One of the first philosophers to express that consciousness might be best conceived of in terms of degrees was Charles Darwin. In *The Descent of Man*, Darwin claims:

The difference in mind between man and the higher animals, great as it is, certainly is one of degree and not of kind. We have seen that the senses and intuitions, the various emotions and faculties, such as love, memory, attention, curiosity, imitation, reason, &c., of which man boasts, may be found in an incipient, or even sometimes in a well-developed condition (Darwin, 1889).

In this passage, Darwin states the differences in minds are ‘of degree and not of kind,’ such that the Darwinian approach suggests that an animal either is or is not conscious, and that different animals likely exhibit varying degrees of consciousness. Thus, this approach is inconsistent with the binary view, and supports the view which finds that the conception of consciousness as admitting degrees provides a better an explanation for the observed range of behaviors, senses, intuitions, emotions and faculties across the animal kingdom.

Contemporary philosophers, such as William Lycan and Daniel Dennett, follow suit from Darwin and also subscribe to the view that consciousness admits degrees. They embrace the view that, across the animal kingdom, consciousness occurs on a spectrum (Allen and Trestman, 66). For example, Lycan provides a functionalist account of the mind, in which “consciousness is internal monitoring... [and] consists in the operation of inner sense” (Gertler, 1998). This ‘inner sense’ view, as Brie Gertler calls it, allows Lycan to defend his near paradoxical account, in which “there is a meaningful sense in which a system with a minimal degree of consciousness is not ‘really’ conscious” (Allen and Trestman, 66). This view emphasizes the notion of the phenomenon occurring on a spectrum, in which different animals might possess different degrees of consciousness. Similarly, Dennett, who believes consciousness is merely an illusion, argues that consciousness must admit degrees on the basis that any claim to the contrary would depend on an outdated assumption of a dividing line; one that distinguishes arbitrarily between animals who are and who are not conscious (Dennett, 1995). Through Dennett’s argument it is evident that the view claiming consciousness admits degrees overcomes the limitations seen above in the binary view; namely the arbitrary nature of criteria which would decide where to draw the line of consciousness.

It seems, then, that the phenomenon of self-consciousness might best be conceived of as admitting degrees.

However, it is probable that self-consciousness itself does not admit degrees, and that instead, it itself is the highest degree of some conscious capacity. Indeed, this is the view taken by Bekoff and Sherman in their article entitled “Consciousness and Self in Animals: Some Reflections.” Bekoff and Sherman argue that self-consciousness is the highest degree of an animal’s capacity of having a sense of self, a capacity to which they refer to as self-knowledge (Bekoff and Sherman, 2004). The central hypothesis put forward in their text is “that species [of animals] exhibit different degrees of self-cognizance [or self-knowledge], which reflect variations in their social environments and life histories” (Bekoff and Sherman, 2004). Thus, Bekoff and Sherman propose that self-knowledge admits degrees, and can be mapped across a continuum ranging from self-referencing to self-awareness to self-consciousness (Bekoff and Sherman, 2004). The point on the continuum at which an animal is located, and as such the level of self-knowledge it exhibits, is determined by the extent to which they “benefit from reflecting on their own behaviors in light of the previous responses of conspecifics, and dynamically and adaptively adjusting their future behaviors accordingly” (Bekoff and Sherman, 2004). This can otherwise be understood as the extent to which they are consciously involved in reflecting on the outcomes of their behaviors in their interactions with others, and the probability that they will adjust that behavior to their benefit in the future. A close examination of the proposed continuum demonstrates the subtle differences in the degrees of self-knowledge and highlights why self-consciousness is the highest degree an animal can exhibit. In what follows I will discuss each degree of self-knowledge outlined by Bekoff and Sherman, to establish a concrete definition of self-consciousness to be used throughout this project.

## 1.2 The Continuum of Self-Knowledge

### *1.2.1 Self-Referencing*

According to Bekoff and Sherman, the first and lowest degree on the continuum of self-knowledge is self-referencing. Self-referencing refers to a perceptual capacity or recognition process in which the discriminating agent (animal) compares phenotypic characteristics of a target to itself, the discriminator (Bekoff and Sherman, 2004; Hauber and Sherman, 2001). These phenotypic characteristics, also known as labels, include odor or appearance, and are learned by the discriminator at a young age (Bekoff and Sherman, 2004 and Hauber and Sherman, 2001). The discriminator then uses these labels in order to determine the similarity of the target to itself; if it is similar, the target “is recognized and accepted based on the degree of similarity” (Bekoff and Sherman, 2004). If it is not similar and not recognized by the discriminator, the target is rejected (Bekoff and Sherman, 2004). One of the most common forms of self-referencing in the animal kingdom is known as kin recognition (Mateo, 2010). Kin recognition allows for an animal to successfully recognize and accept their kin; parents, siblings and half-siblings, by “an internal process of assessing genetic relatedness” inferred from its own phenotypic characteristics (Mateo, 2004). For example, evidence suggests after hibernation, ground squirrels are able to recognize and accept their mothers and littermates, “but not previously familiar nonkin” (Mateo, 2010). Thus, kin recognition demonstrates the robustness of the capacity for self-referencing; however, it seems, that self-referencing “can be reflexive and noncognitive, even occurring in the immune system and in creatures without brains” (Bekoff and Sherman, 2004). As a reflexive and noncognitive capacity, which seemingly operates at an unconscious level, self-referencing is the lowest degree of self-knowledge, that is not limited to the animal kingdom.

### *1.2.2 Self-Awareness*

The second degree on the continuum of self-knowledge mapped by Bekoff and Sherman is self-awareness, the capacity by which an animal is able to distinguish its own body from the bodies of others. Self-awareness is also otherwise referred to as a ‘perceptual consciousness’, ‘body-ness’ or ‘mine-ness’ (Bekoff and Sherman, 2004). Bekoff and Sherman claim that this degree of self-knowledge is necessary for an animal to successfully exist in a social context with others, “to find mates, to evade predators, or to avoid bumping into each other” (Bekoff and Sherman, 2004). This is the degree of self-knowledge most of us would automatically attribute to our house pets. For example, it certainly seems that a dog has a sense of mine-ness when he is protective of *his* bone or *his* territory when he relentlessly barks at the neighbor’s dog walking by. In addition to the distinctive notion of ‘body-ness’ or ‘mine-ness’ that characterizes self-awareness, Bekoff and Sherman argue this degree of self-knowledge is dependent on the existence of a brain (Bekoff and Sherman, 2004). Their argument, here, is that the discrimination of possessions as ‘mine’ which occurs in self-awareness, either consciously or unconsciously, requires a perceptual and integrative processor. This perceptual and integrative processor, thereby, must be the brain, which integrates and mediates inputs and outputs. Still, this is not the highest degree on the continuum of self-knowledge, nor the degree with which this project concerns itself with.

### *1.2.3 Self-Consciousness*

According to Bekoff and Sherman, self-consciousness is the highest degree of self-knowledge observed in the animal kingdom. They find the term self-consciousness synonymous with ‘reflective consciousness,’ ‘I-ness’ and the ‘I-self’ (Bekoff and Sherman, 2004). Further,

Bekoff and Sherman define self-consciousness as the sense of a named self to which one's own body belongs (Bekoff and Sherman, 2004). That is, "knowing that 'this body is me' and thinking about one's self and one's own behavior in relation to the actions of others" (Bekoff and Sherman, 2004). Therefore, self-consciousness differs from self-referencing and self-awareness because the product or effect of the phenomenon is an animal's understanding of its own self. Other philosophers have defined self-consciousness in a similar way, as the "awareness of one's self narrative" (Andrews, 70), as "consciousness of one's existence as a continuous agent who moves through the world in time" (Andrews, 70), or as "an awareness of (some of) one's own mental states such as feelings, desires and beliefs" (DeGrazia, 2009). Taken together, it seems that the phenomenon of self-consciousness not only requires that an animal has mental states, but also the awareness of those mental states (DeGrazia, 2009).

Bekoff and Sherman provide an outline of both the requirements for and effects of self-consciousness, on animal cognition more generally. The outline of those requirements is the following:

A brain is required, and the underlying processes are conscious... We hypothesize that self-consciousness evolves when individuals benefit from analyzing and revising their own behavior in light of how specific members of their social group responded to their behavior in the past. Self-consciousness leads to dynamic and finely graded behavioral outputs" (Bekoff and Sherman, 2004).

Although this conception of self-consciousness is well conceived, it lacks a means for self-consciousness to be operationalized. One oft-recognized attempt at quantifying self-consciousness was proposed by psychologist Gordon G. Gallup, about thirty years ago (Bekoff and Sherman, 2004). He developed the mirror test for self-recognition, but recently philosophers and scientists alike have criticized inferences made by the test (Bekoff and Sherman, 2004). In what follows I will discuss the mirror test proposed by Gallup and its shortcomings. I will then discuss the



foundational aspects of self-consciousness found in Bekoff and Sherman's outline seen above and demonstrate how my proposal of the three conditions for animal self-consciousness thereby arise.

### 1.3 The Mirror Test and its Shortcomings in Quantifying Self-Consciousness

#### *1.3.1 The Mirror Test*

Gallup's proposal for the mirror test stems from the idea that if an animal is able to recognize itself in a mirror, then it must be the case that it is self-conscious. Here, Gallup differs slightly from Bekoff and Sherman's definition of self-consciousness. Gallup's notion is based on the belief that self-recognition is an indicator for self-consciousness, such that it "requires the individual to become the object of [their] own attention, and that involves a concept of self" (Andrews, 71) where "a concept of self entails being able to introspect" (Gallup, 1998). To assess the validity of this idea, Gallup designed the mirror test as a measurement for the capacity of self-consciousness through the observation of self-recognition. In the mirror test, the animal of interest is marked with a symbol above one eye and the top half of the opposite ear (Gallup, 1998). A mirror is then introduced into the animal's environment; the animal is said to demonstrate self-recognition, and therefore be self-conscious, if it is able to identify the mark as an affliction of the self by touching it on their own face, rather than in the reflected image in the mirror (Gallup, 1998). The first successful response to the mirror test was observed in chimpanzees, who were anesthetized and marked with a nonodorous and nonirritating red dye (Gallup, 1998). Prior to the introduction of the mirror in their environment the chimpanzees did not seem to be aware of the mark, but when the mirror was introduced they "guided their fingers to the marks on their faces... [and after] touching the marks repeatedly and looking at their fingers, some even smelled their fingers" (Gallup, 1998). Thus, chimpanzees were believed to demonstrate self-recognition and it

was inferred that they are self-conscious. Following this first success, the mirror test became the paradigmatic method of determining which animals are self-conscious (Bekoff and Sherman, 2004).

### *1.3.2 The Shortcomings of the Mirror Test*

However, recently philosophers and scientists alike have highlighted methodological issues with the mirror test (Andrews, 70; Bekoff and Sherman, 2004). They criticize the methods of interpreting results, such that “it can yield false negatives: if an individual fails the test, it does not necessarily mean that the animal is not self-conscious” (Bekoff and Sherman, 2004). A number of circumstances can be cited in support of this criticism: if the animal’s primary sensory modality is a sense other than vision, if the animal exhibits a different behavioral response during self-recognition and if the animal does not look in the mirror to avoid eye contact (Bekoff and Sherman, 2004). Under these circumstances the animal may fail the mirror test, but ought not be dismissed as lacking self-consciousness. For example, according to the mirror test’s standards, bottlenose dolphins fail the self-recognition task. Yet dolphins do not have hands with which they can touch the mark. Thus, some have pointed out that dolphins might demonstrate self-recognition through a different behavioral response. Indeed, “dolphins were observed to spend more time in front of the mirror when they had a mark on that side, and would wiggle to position their body so that they could see the mark” (Andrews, 71). Similarly, for gorillas making eye contact is an aversive behavior, so they might not look into the mirror directly and might not notice the mark. Given these examples, it seems that failing the mirror test cannot be treated as evidence that an animal is not self-conscious. Therefore, another means of determining whether an animal is self-conscious is required.

#### 1.4 Conclusion and Foundation of New Proposal for Determining Self-Consciousness

In this project I aim to overcome the shortcomings of the mirror test and propose a new set of criteria to determine which animals exhibit the highest degree of self-knowledge, namely self-consciousness. To establish the foundational aspects of this new theory I return to the definition of self-consciousness provided by Bekoff and Sherman. According to Bekoff and Sherman, self-consciousness is an animal's sense of having a self to which their own body belongs (Bekoff and Sherman, 2004). Further, self-consciousness requires a brain, benefits the animal in their reflection of experiences in the social context and allows for dynamic and finely graded outputs (Bekoff and Sherman, 2004). These are the foundational aspects from which my proposal arises; that self-consciousness is dependent on the simultaneous occurrence of three conditions: (1) a complex nervous system, (2) communication, and (3) collaborative social play. Insofar, I believe these three conditions are necessary and jointly sufficient for animal self-consciousness. The first condition is based in Bekoff and Sherman's claim that the phenomenon requires a brain. I aim to elaborate on this and establish at which stage in evolution of the nervous system it is adequately complex for the emergence of self-consciousness. The second condition is based in the notion that communication, specifically intentional communication, is seminal for the emergence of self-consciousness. Finally, the third condition is based in the idea that collaborative social play, is the result of dynamic and finely grained outputs resulting in self-consciousness. Throughout the next three chapters I closely investigate each condition proposed for animal self-consciousness.

## CHAPTER 2

In this chapter, I explore the first condition proposed for animal self-consciousness, namely a complex nervous system. I begin with an evolutionary discussion of the nervous system more generally, and address what I mean when I refer to complexity. Indeed, the notion of complexity I employ here refers to a functional organization between neurons. I go on to identify three stages in the evolution of the nervous system, each of which can be understood as increasing levels of complexity. The first stage in the evolution of the nervous system I identify is widespread signal transmission which occurs in nerve nets, the second is signal boosting and the third is centralized attention. Through the consideration of each stage, I find that for self-consciousness the nervous system process signals in a meaningful way. Using Giorgio Marchetti's understanding of the relationship between meaning and the self, I demonstrate that self-consciousness is dependent on meaning. I find that it is only the third stage in the evolution of the nervous system, centralized attention, which is adequately complex to process signals in a meaningful way. Thus, any animal whose nervous system has the capacity for centralized attention, meets the first necessary condition set forth for animal self-consciousness.

### 2.1 Neurons: The Building Blocks of the Nervous System

Neurons are the cellular building blocks of the nervous system. They comprise the majority of the system, and themselves possess an unusual shape allowing for specialized cell-to-cell signaling (Graziano, 9 and Godfrey-Smith, 22-23). A neuron consists of four microdomains; a cell body or soma with multiple branches called dendrites, as well as a long protrusion or axon ending at its terminal. This shape results in the possibility of creating an elaborate maze of connections between the terminal of one neuron and the dendrites of other neurons (Godfrey-Smith, 22). When

one neuron becomes electrically excited, an action potential is propagated along the axon at a rate of two-hundred feet per second (Graziano, 9). Here, the action potential can be thought of as a “wave of electrochemical energy [that] sweeps across the membrane of the cell from one end to the other” (Graziano, 9). Following the arrival of the action potential at the terminal, the neuron releases a small amount of neurotransmitter across the synaptic cleft between the terminal of the releasing neuron and the dendrite of the receiving neuron. The neurotransmitter then binds to receptors on the receiving neuron and either triggers or suppresses a subsequent action potential in that neuron (Godfrey-Smith, 23). This, in short, is how neurons transmit signals to one another. However, cell-to-cell signaling via action potentials is not tied to the appearance of neurons; action potentials “existed in cells before animals evolved and exist today outside of them” (Godfrey-Smith, 23). Similarly, cell-to-cell signaling itself is commonly observed in the biological realm outside of the animal kingdom. Thus, one might wonder, what is unique about the cell-to-cell signaling that occurs between neurons?

There are two principles which are most commonly cited for the particular quality of the cell-to-cell signaling that occurs between neurons (Godfrey-Smith, 23). First, signal transmission in between neurons is incredibly fast. As stated before, an action potential travels along the axon of a single neuron at a rate of two-hundred feet per second. This means that the influences of one neuron on another can occur seemingly instantaneously. For example, consider what happens when one accidentally steps on a dog’s paws when hectically moving around. One observes a reflex in which the dog pulls away his paw almost immediately: sensory neurons in the paw send information from the paw to the spinal cord, and motor neurons in the spinal cord send information back to the paw in a matter of milliseconds. This illustrates that the speed at which neurons are able to transmit signals allows for an animal to seamlessly interact with its environment. Second,

signal transmission between neurons is targeted. For example, neurons are able to act upon specific cells involved in the desired output. Indeed, some neurons release or respond only to a select number of neurotransmitters, while others have extended axons that “reach some distance through the brain or body and affect just a few distant cells” (Godfrey-Smith, 23). Similarly, neurons are able to respond to specific signals involved in the desired input, as demonstrated in the visual cortex where neurons selectively respond to lines of light at various orientations. In accordance with the principles of fast and targeted signaling, neurons set the stage for a demarcation in which cell-to-cell signaling is transformed from “an activity in which cells simply broadcast their signals to whoever is close enough and listening into something different: an organized network” (Godfrey-Smith, 23). The emergence of this organized network can be thought of as the appearance of the nervous system in the animal kingdom.

## 2.2 The Appearance of the Nervous System in the Animal Kingdom

The appearance of the nervous system in the animal kingdom seems to correspond with the advent of multicellular organisms, occurring between 600 and 700 million years ago (Graziano, 8). Indeed, sea sponges, the earliest of all multicellular animals to arise about 700 million years ago, share 25 of the genes involved in the development of the nervous system in humans today (Sakarya et al., 2007). However, in lacking a specified body plan, sea sponges show no evidence of an actualized nervous system, thus placing them at its “evolutionary threshold” (Graziano, 9). Genetic analyses from sea jellies point towards the arrival of the first actualized nervous system a mere 50 million years later (Erwin et al., 2004). One might conceive of sea jellies as “something soft, with no shell or skeleton, probably hovering in the water... a filmy lightbulb in which the rhythms of nervous activity first began” (Godfrey-Smith, 27). This suggests that an organized

network of neurons, and as such the nervous system, first appeared in the animal kingdom between the arrival of sea sponges and sea jellies, some 650 to 700 million years ago (Graziano, 9). However, the beginnings of a nervous system described in sea jellies is not nearly as complex as those which have evolved and are observed later, with the arrival of mammals, cephalopods and reptiles.

### 2.3 The Levels of Complexity in the Evolution of the Nervous System

Below I outline three stages in the evolution of the nervous system, which ought to be understood as stages of increasing levels of complexity within the nervous system itself. Recall that in this chapter I aim to establish at which stage in the evolution of the nervous system, it is adequately complex for animal self-consciousness. Prior to the investigation of those stages, there are two aspects to my argument which must be clarified; the first being what I mean when I refer to a level of complexity and second being why I choose to highlight the following three stages in the evolution of the nervous system in particular. First, the term “complexity” points to a number of different possible interpretations, such as the level of organization, the connectivity between parts, or the sophistication of function. Each of these interpretations would impact my argument, that a particular level of complexity of the nervous system is required for self-consciousness, in a different way. For the purpose of this chapter and project more generally, the interpretation of complexity I employ is level of organization. Specifically, the level of organization between neurons, where a nervous system with a high level of complexity demonstrates a high level of organization between neurons. I believe this is a functional organization, without which there is merely chaos, such that it exists for the purpose of doing *something* (more on what that something is later, hint: to process signals in a meaningful way). Thus, in this project, complexity does not

imply more connections. In fact, evidence from the development of the human nervous system, indicates that organization results from an important process of pruning, in which unused connections between neurons are lost.

The second aspect of my argument which must be clarified is that the three stages in the evolution of the nervous system highlighted below seem to have evolved in a particular order, such that each level of complexity follows from the other. Further, these stages are important to the emergence of animal self-consciousness in particular. Here, it is important to make clear that the evolutionary history of the nervous system can be mapped in a number of different ways. That is, the interpretation of which moments in the evolution of the nervous system are important is significantly informed by the investigator's perspective. For example, one perspective might focus on the nervous system's structural evolution through the consideration of changes in neuroanatomy, while another perspective might focus on its functional evolution through the consideration of changes in the biological processes. Thus, depending on the investigator's perspective, the moments mapped in the evolutionary history might vary, although underlying phylogenetic relationships of those moments, which are independent of the investigator, do not. In addition to the investigator's perspective, the focal point of the project also informs the interpretation of which moments in the evolution of the nervous system are important. In this project, dependent on my perspective, the three stages in the evolution of the nervous system which I highlight, reflect its functional evolution, as each stage is understood as an increasing level of complexity. Recall, that increased levels of complexity are characterized by increased levels of organization between neurons. Moreover, dependent on the focal point of this project, in which I aim to establish a new set of conditions for animal self-consciousness, the three stages highlighted in what follows are those which are integral leading up to the emergence of self-consciousness.



### *2.3.1 The First Stage in the Evolution of the Nervous System*

The first stage or level of complexity I identify in the evolution of the nervous system is widespread signal transmission which occurs in nerve nets (Graziano, 9). Nerve nets are commonly understood as networks of neurons forming mesh-like structures that span across the body of an animal and form connections between the animal's muscles (Hejnol and Rentzsch, 2015; Graziano, 9). These mesh-like structures lend themselves to a number of unique qualities in relation to the functional aspects of widespread signal transmission, which characterize this first stage in the evolution of the nervous system. The first of these qualities is that signal transmission occurs in any direction across the nerve net itself (Hejnol and Rentzsch, 2015). By allowing for signal transmission to occur in any direction, nerve nets overcome the potential limitations of a simple organization, and as such are "sufficient to form the integrative part between reception of the environment of an organism and its ability to react to changes in these environmental cues" (Hejnol and Rentzsch, 2015). Thus, the widespread signal transmission occurring in nerve nets provide the animal with the capacity to receive and respond to cues from their environment. Another unique quality of the widespread signal transmission occurring in nerve nets is that signal transmission occurs indiscriminately. This means that signals, both sensory input and motor output, spread throughout the whole nerve net, and as such the whole body of the animal. One oft-cited example of this occurs in the hydra, a small water animal similar to sea jellies. If the hydra is prodded at one point in its body (sensory input), the whole hydra twitches in response (motor output) (Graziano, 9). Thus, this widespread signal transmission in nerve nets highlight a relatively equal distribution of neurons throughout the entirety of the animal tissue at this stage in the evolution of the nervous system (Hejnol and Rentzsch, 2015). However, this widespread transmission is only

possible because, in the strict sense, nerve nets do not have “any ganglion-like accumulations of nerve cells or bundles of neurites” (Hejnol and Rentzsch, 2015).

### *2.3.2 The Second Stage in the Evolution of the Nervous System*

The second stage or level of complexity in the evolution of the nervous system quickly follows from mere signal transmission, as seen in nerve nets, to signal boosting (Graziano, 10). Signal boosting or enhancing is “the ability to enhance some signals over others... [and] is one of the most basic ways neurons manipulate information” (Graziano, 10). At the cellular level of the nervous system, this occurs via a process known as lateral inhibition, in which a signal is enhanced as a “consequence of neurons inhibiting their neighbors” (Graziano, 10). One of the most prominent examples of this principle in the animal kingdom is observed in the crab’s compound eye, which contains clusters of light detectors (Graziano, 10). Those light detectors each contain a neuron that is connected to the neurons of neighboring detectors within the cluster, such that when light hits the crab’s eye:

A neuron in one detector becomes active, [and] it tends to suppress the activity of the other neurons in the neighboring detectors, like a person in a crowd who is trying to shout the loudest while shushing the people nearest to him... The pattern of activity across the set of detectors in the eye not only signals a bright spot, but also signals a ring of darkness around it. The signal is, in this way, enhanced (Graziano, 10).

The example of lateral inhibition in the crab’s eye, however, is only one instance of the basic principle of signal boosting that occurs in the nervous system. Indeed, signal boosting seems to occur at multiple levels of signal processing, “from the eye to the highest levels of thought in the cerebral cortex” (Graziano, 11).

### *2.3.3 The Third Stage in the Evolution of the Nervous System*

Meanwhile, the third stage or level of complexity I identify in the evolution of the nervous system in the animal kingdom is centralized attention (Graziano, 11). Centralized attention allows for multimodal signal integration; the pooling and sorting of information from a number of sensory inputs, such as vision, olfaction and touch (Graziano, 12). In turn, multimodal signal integration allows for the animal to exhibit a “coordination between parts... [for] the task of generating coherent whole-organism actions” (Godfrey-Smith, 23-24). So, centralized attention as multimodal signal integration allows for the animal to identify and respond to the most important signal in its current environment. As such, it allows for a “meaningful response” (Graziano, 12). However, for this to be observed in an animal, there must be one place in the nervous system where the convergence of signals occurs. Therefore, it is proposed that this stage in the evolution of the nervous system requires a central attention processor (Graziano, 12). Such a processor is most often conceived of as a central brain or an “aggregate of neurons [or ganglion] in the head that is larger than any of the others in the body” (Graziano, 12). Given these hypotheses, one can infer that centralized attention is likely displayed by most vertebrates who have a central brain similar to our own, as well as arthropods including crabs, insects and spiders, who have a central ganglion located in their head. Furthermore, recent studies indicate that certain cephalopods, such as octopuses, squid and cuttlefish also have developed a complex central brain, and as such likely also display centralized attention (Graziano, 13).

### *2.4 Levels of Complexity and the Emergence of Self-Consciousness*

Before discussing the complexity in each stage and its relation to the emergence of animal self-consciousness, here, it would be helpful to recall the aim of this project more generally.

Throughout this project, I aim to establish a new set of conditions to determine which animals are and are not self-consciousness. That is, which animals exhibit an understanding of their own self, such that they have mental states along with an awareness of those mental states (DeGrazia, 2009). In the previous chapter, I established three conditions which are necessary and jointly sufficient for animal self-consciousness. Those being: (1) a complex nervous system, (2) communication, and (3) collaborative behavior, such that animal self-consciousness is dependent on the simultaneous occurrence of all three conditions. In this chapter I explore the evolution of the necessary complexity of the nervous system, as the first of those conditions. As argued in the previous chapter, this condition is informed by Bekoff and Sherman's definition of self-consciousness, one aspect of which is its dependent on the presence of a brain or brain-like structure (Bekoff and Sherman, 2004). If one were to consider the three stages discussed above, solely in regard the presence of a brain or brain-like structure, there would be a straightforward answer concerning which stages meet this standard for the first and third stages, but not the second.

The first stage, widespread signal transmission occurring in nerve nets, would fail because in the strict sense nerve nets have no brain or brain-like structure (Hejnol and Rentzsch, 2015). The third stage, centralized attention, would meet the standard because it depends on a central attention processor, namely a brain (Graziano, 12). However, the second stage would fall somewhere in between failing and meeting the standard, because signal boosting can occur both in a non-brain structure (as in an eye), as well as in a brain (as a part of higher levels of thought mediated in the cerebral cortex) (Graziano, 11). The notion that the second stage would fall somewhere in between points to why, in this chapter, I elaborate on a necessary level of complexity. By turning to complexity, I overcome the limitations of considering the presence of a brain alone and address an aspect of the nervous system that seems crucial for the emergence of

self-consciousness. This aspect is the difference between nervous systems which merely transmit signals and nervous systems which process signals in a meaningful way, so that they are “consciously experienced” (Vitti, 2010). Thus, for an animal to meet the first condition, its nervous system must demonstrate an adequate level of complexity to process signals in a meaningful way.

#### *2.4.1 Meaningful Processing and What it has to do with Self-Consciousness*

As addressed above, for an animal to meet the first condition set forth for self-consciousness, its nervous system must be adequately complex to process signals in a meaningful way. In this way self-consciousness is dependent on meaning. But then, one might wonder: what is the sense of meaning employed here? Here, I follow a tradition in philosophy of mind, in which I employ the semantic theory of meaning. The semantic theory of meaning concerns itself with assigning semantic content to a symbol or expression. It is “a specification of the meanings of the words and sentences of some symbol system” (“Theories of Meaning,” 2010). Within the semantic theory, there are two aspects of a word which together is its meaning. The first component is that the word picks out a thing in the world, its reference, while the second component is that the word beings about concepts or ideas about a thing in the world, its sense (Frege, 1952). However, the concepts or ideas also point towards a thing in the world, such that there is a relationship between a mental state and a thing in the world. This relationship is commonly referred to as mental representation (“Theories of Meaning,” 2010). Thereby, the semantic theory indicates that to process signals in a meaningful way has something to do with mental representation, which allows for a thing in the world to be significant to the individual.

Philosopher Giorgio Marchetti claims that when an animal has the capacity to process signals in a meaningful way, the animal who “consciously experiences it, knows, what it means to

him” (Marchetti, 2017). So, Marchetti finds that meaning provides the animal with three aspects of information about his conscious experience:

(1) That his experience has a content [a phenomenal quality of “what it is like”], and what the content is... (2) that the experience he is having differs from other kinds of experiences that he already had or could potentially have... and (3) that the experience he is having is his own, that is, it belongs to him and no one else (Marchetti, 2017).

According to Marchetti, these three aspects of information about the animal’s conscious experience always already contains within itself a reference to the existence of a self (Marchetti, 2017). This self is represented in the nervous system and acts as the mechanism through which the animal is reduced to a single entity. Moreover, this self “supplies the system with the sense of being a unique, single entity, which evolutionarily culminates in the appearance of self-consciousness” (Marchetti, 2017). I use Marchetti’s work to explicate the relationship between meaning and self-consciousness, however, I differ in my understanding of the direction of dependence. Marchetti claims that meaning is dependent on self-consciousness, while I claim that self-consciousness is dependent on meaning, such that the direction of dependence is reversed.

#### *2.4.2 Meaningful Processing in Centralized Attention*

As seen above, meaning and self-consciousness are intricately interwoven, such that self-consciousness is dependent on meaning. Recall too that meaning stems from the adequate complexity of the nervous system, defined as a functional organization between neurons. In returning to the discussion about which of the three stages in the evolution of the nervous system is adequately complex to meet the first condition for self-consciousness, and in employing the notion of meaning, it is once again immediately apparent that the first stage fails to be adequately complex. The characteristic widespread signal transmission occurring in nerve nets, is not adequately complex to process signals in a meaningful way. Indeed, as established earlier, a unique

quality of nerve nets is the indiscriminate transmission of signals. The term “indiscriminate” refers to a process of doing something in a random or unsystematic manner (Merriam-Webster, 2021). Indiscriminate transmission exists in direct opposition to complexity, which invokes the notion of functional organization. Further, without adequate complexity, it seems nerve nets do not produce the kind of meaning upon which self-consciousness is dependent; and that instead, they merely transmit signals. Thus, widespread signal transmission occurring in nerve nets is not adequately complex to meet the first condition for self-consciousness.

Meanwhile, the second stage in the evolution of the nervous system, signal boosting, demonstrates increased complexity. Signal boosting demonstrates early levels of complexity or functional organization in the nervous system, as it requires neurons to systematically inhibit their neighbors to enhance their signals and respond to their environment in a targeted way. But the question remains, is signal boosting adequately complex to process signals in a meaningful way, as to meet the first condition for self-consciousness? There are several mechanisms which seemingly respond to their environment in a targeted way without processing signals in a meaningful way. For example, a thermostat receives information (or signals) about the temperature of the room and responds by adjusting the amount of hot or cold air that is blown into that room. However, it is fair to assume that the thermostat is not processing signals in a meaningful way, nor conscious of them. It seems, then, that a system which is adequately complex to respond to the environment in a targeted way, does not necessarily demonstrate adequate complexity to process signals in a meaningful way. Thus, signal booting, also does not produce meaning upon which self-consciousness is dependent and is not adequately complex to meet the first condition for self-consciousness. Nonetheless, it can be thought of as an integral stage in the evolution of the nervous system leading up to the complexity required for self-consciousness.

The third stage in the evolution of the nervous system, centralized attention, however, does demonstrate adequate complexity to process signals in a meaningful way. Centralized attention by definition is a result of the multimodal integration of inputs in a highly complex, or functionally organized system. Further, it allows for the animal to identify and respond to the most important signal in its current environment, and as such for the animal to have a “meaningful response,” (Graziano, 12) as to process signals in a meaningful way. Recall that according to Marchetti’s work, the relation between meaning and self-consciousness is that meaning already always contains within itself a reference to the existence of a self (Marchetti, 2017). Recall also that I use Marchetti’s understanding of the relationship between meaning and a sense of self to demonstrate that self-consciousness is dependent on meaning. Therefore, as centralized attention is adequately complex to process signals in a meaningful way which points to a sense of self, centralized attention meets the first condition set forth for self-consciousness.

## 2.5 Conclusion

In sum, I have demonstrated that centralized attention, the third stage in the evolution of the nervous system, is adequately complex to meet the first condition for animal self-consciousness. In this chapter, I found that complexity of the nervous system is defined by the functional organization between neurons; and that a nervous system is only adequately complex for self-consciousness if it allows for signals to be processed in a meaningful way. Indeed, using Marchetti’s claim that meaning already always contains within itself a reference to the self, I argued that self-consciousness is dependent on meaning. I found that both the first and second stages in the evolution of the nervous system, widespread signal transmission occurring nerve nets and signal boosting, lack the functional organization to process signals in a meaningful way, and



so fail to be adequately complex for animal self-consciousness. However, the third stage in the evolution of the nervous system, namely centralized attention, demonstrates the functional organization required to process signals in a meaningful way. That is, centralized attention demonstrates multimodal signal integration in a central attention processor or brain. Thus, I have demonstrated that any animal whose nervous system has the capacity for centralized attention, meets the first necessary condition set forth for animal self-consciousness, that being a complex nervous system.

### CHAPTER 3

I have argued, so far, for three necessary and jointly sufficient conditions for self-consciousness in animals. Those being: (1) a complex nervous system, (2) communication and (3) collaborative social play. In this chapter I explore the second condition. I begin with a brief overview of the suggestion that animal communication can be used as evidence of thinking, as the motivation for what follows in this chapter. I go on to consider three accounts of what communication consists in, in order to establish an account which points to the emergence of self-consciousness. The first account of communication I consider is the biological account, which I criticize on the basis that it is too permissive, and as such does not point to a sense of self. The second account is information-based, which I criticize on the basis that it is silent on the nature and content of animal minds. Here, it is helpful to note that an account's indication of the nature and content of animal minds is necessary for this project, which seeks to determine which animals have a sense of self, that is, which animals are self-conscious. Next, I consider a third account, known as the intentional account, which is largely concerned with the intention of a communicative utterance. The intentional account provides a significant body of literature relevant to how animals communicate their thoughts. With a focus on the Gricean approach to intentional accounts of animal communication, I will use Juan Gómez's interpretation to demonstrate that intentional communication is formative of a sense of self, and as such self-consciousness. Thus, any animal whose communicative utterance fits the intentional account, meets the second condition set forth for animal self-consciousness.

### 3.1 Why Animal Communication?

Philosopher Donald R. Griffin proposes that animal communication might be able to provide a number of insights about the nature and content of animal minds (Griffin, 154). He states that the mechanisms underlying animal communication exist as “a source of objective evidence about the thoughts and feelings [of animals] that have previously seemed so inaccessible” (Griffin, 154). The basis of Griffin’s claim is that if animals have subjective thoughts and feelings, these would likely be reflected in their communicative utterances (Griffin, 154). That is, if animals have thoughts and feelings, one might assume it would be in their best interest to be able to share those with others, as well as for the others to correctly understand them (Griffin, 154). So, it seems animal communication can be evaluated as an exchange of thoughts and feeling between animals, and the probability that this exchange might alter the nature or content of their minds. Given Griffin’s claims, in this chapter I explore communication as the second condition required for animal self-consciousness. I use Griffin’s notion that communication reflects the nature and content of animal minds, such that if this includes a sense of self, the communicative utterance of the animal meets the second condition for self-consciousness.

### 3.2 What is Animal Communication?

When one turns to a discussion of what animal communication is, one can observe multiple paradigmatic instances of communication, and extract from them a general definition which points to what they have in common. To start with, social insects communicate; honeybees are famous for their waggle dance, which is used to indicate to other bees in the hive the exact location of pollinating flowers (Von Frisch, 1967). Similarly, fish communicate. For example, electric fish use electrical signals in both social and predator-prey interactions (Griffin, 154). Birds also

communicate in a number of ways; chickens use a number of distinct calls and ravens “gesture with their beaks and use eye contact to coordinate interactions with nonfood items such as twigs or moss” (Andrews, 111). Finally, mammals communicate too. For example, baboons demonstrate at least 14 distinct audible expressions with different meanings, while both prairie dogs and meerkats also demonstrate “distinct alarm calls to warn group members about the appearance of various predators” (Andrews, 111).

Philosopher Kristin Andrews claims that each of these instances highlight a shared aspect of animal communication, namely that it involves the coordination of two or more animals (Andrews, 111). However, Andrews also claims that, taken together, they point to another set of questions about animal communication; “What else do they have in common? And how do they differ? Are they all instances of the same kind of communication?” (Andrews, 111). In order to answer these questions, one must establish an account of animal communication from which to proceed. According to Andrews, there are three prominent accounts of communication, the biological, the information-based and the intentional, each of which demonstrate a slightly different understanding of animal communication, and which communicative utterances ought to be encompassed in that conception. In what follows, I investigate those accounts in order to articulate an account of animal communication that illuminates the nature and content of animal minds. For the purpose of this project, I must establish an account of communication which indicates that an animal has a sense of self, and as such self-consciousness.

### 3.3 Accounts of Animal Communication

#### 3.3.1 *Biological Accounts*

One account of animal communication is biological, in which communication is generally thought of as “a relationship between two organisms such that a change in the state of one organism causes a change in the state of the other organism” (Andrews, 112). Indeed, biologist Peter James Slater claims that the very essence of communication is that the behavior of one animal influences another’s behavior (Gómez, 62). However, this unrestricted account of communication lends itself to being too permissive (Gómez, 62). For example, if animal A kicks animal B, and animal B’s behavior changes in response to the kick, according to Slater’s account, this interaction would be thought of as communicative. In order to avoid being too permissive, other biologists propose accounts of communication which adopt additional criteria to that criterion of “influencing another animal’s behavior” (Gomez, 62). For example, Richard Dawkins and John Krebs find that the essence of communication is dependent on two criteria; (1) that the communicative behavior of one animal results in a change of behavior or attitude in another animal, and (2) that this change benefits the animal who originally exhibited the communicative behavior (Andrews, 112).

Nonetheless, even with the adoption of the additional criteria, biological accounts provide minimal constraints on which behaviors or interactions are communicative. As a result, these minimal constraints allow for simple behaviors to be determined to be communicative (Andrews, 112). For example, according to these accounts even a number of behaviors or interactions outside of the animal kingdom would be communicative. Bean plants release an odorous substance which attracts wasps, who in turn feed on small bugs that are infesting the plant (Andrews, 112). Further, bean plants also send signals through their roots to neighboring plants, warning them of their infestation, so that those plants can proactively release the sustenance (Andrews, 113). Thus,

according to biological accounts the bean plants are communicating; the change in behavior of one influences another. In addition to the minimal constraints provided by biological accounts which “make the answer to the communication question too simple,” (Andrews, 113) these accounts also provide nothing to the discussion of the nature and content of animal minds. That is, they make no claims in regard to the notion “whether animals can communicate their thoughts,” (Andrews, 113) and as such cannot be used in the determination of which animals have a sense of self, as to be self-conscious.

### 3.3.2 Information Based Accounts

Another account of animal communication is information-based, where alternatively, communication is thought of as “the exchange of information from one party to another” (Andrews, 113). The information-based accounts of communication, first proposed by mathematician Claude Shannon, claim that the message sent by one animal is simply an encoded signal of information, which is decoded and reconstructed by another animal (Andrews, 113). However, it is important to clarify that not every signal sent by an animal contains information, such that information is defined as “a means of reducing uncertainty in the receiver” (Andrews, 113). That is, signals containing information must provide a representation of content which alters the other’s perception and/or actions. Ruth Millikan refers to the simplest form of information exchange as *pushmi-pullyu* representations (Millikan, 2006). In *pushmi-pullyu* representations, the signal sent by an animal “simultaneously gives information about the situation and information about how to respond to the situation” (Andrews, 114). For example, in the waggle dance, honeybees depend on the specificity of movements in their dance to send information to other bees in the hive the exact location of pollinating flowers, whose pollen is needed for the production of

honey (Von Frisch, 1967). However, this is the same principle upon which computer systems work. Given that “information-based accounts can include natural as well as artificial design; artifacts and artificial systems such as computer networks can communicate as well” (Andrews, 114). Thus, just like the biological account, the information-based account of animal communication provides no insight into the nature and content of animal minds and cannot be used in the investigation of animal self-consciousness.

### 3.3.3 *Intentional Accounts*

Meanwhile, a third account of animal communication is intentional, in which communication is “flexible, and requires expecting that another receives the message” (Andrews, 115). That is, according to this account, the communicative utterance of the animal is “*intended* to have a communicative effect” (Gómez, 64). Here, intention is used in the sense that when the animal sends a signal containing information, the animal is aware both of that information and the effect sharing that information will have; “indeed this is why he or she uses the signal” (Gómez, 64). When distinguishing intentional from unintentional communication, it seems intentional communication must always be partially referential and not simply emotive (Andrews, 123). Biologist Peter Marler suggests that functionally referential utterances are those in which, “(1) the production of the signal must be caused by the same kind of stimuli, and (2) hearing or seeing the signal must cause the same effect as does hearing or seeing the object the signal refers to” (Andrews, 124). For example, bantam chickens give two distinct alarm calls, one for aerial predators and another for ground predators (Andrews, 124). Similarly, they exhibit two distinct escape actions, one for aerial predators such as hawks, and another for ground predators such as foxes. Yet, bantam chickens demonstrate the same escape action in response to a hawk, regardless

of whether they saw the hawk themselves or if another chicken gave the aerial predator alarm call (Andrews, 124).

Referential utterances, however, are not limited to alarm calls; in some cases, food calls, social calls and contact calls meet Marler's criteria as well. Contact calls, specifically, are referential as they are representative of a particular individual (Andrews, 124). For example, bottlenose dolphins "develop individually distinctive signature whistles that they use to maintain group cohesion... [such that] signature whistles can facilitate continued contact between individuals" (Janik et al., 2016). Dolphins within the pod learn to identify the signature whistle and recognize it as representing that particular individual (Andrews, 125). Interestingly, dolphins develop their signature whistle within the first few months of their lives, and while female dolphins maintain a stable signature whistle, it seems males are able to modify theirs (Tyack, 1997; Andrews, 125). Moreover, dolphins seem to have an incredible capacity for imitation, such that they sometimes imitate another dolphin's signature whistle to gain a response from the named individual (Tyack, 1997; Andrews, 125). These features of the bottlenose dolphin signature whistles point to referential properties, which are central to intentional accounts of animal communication. Further, they indicate that intentional communication does, indeed, have something to say about the nature and content of animal minds, and as such about the thoughts and feelings of animals. Thus, the intentional account is an articulation of communication which can be used in the investigation of which communicative utterances of an animal meet the second condition set forth for self-consciousness. I elaborate on intentional accounts of animal communication in what follows and aim to demonstrate how it is that intentional communication results in a sense of self and meets the second condition for self-consciousness.



### 3.4 Intentional Accounts: The Gricean Approach

Different approaches have been taken in the discussion of intentional communication, the most influential of which is the Gricean approach. The Gricean approach stems from philosopher H.P. Grice's suggestion that when animals intentionally communicate with one another, they think about what the other is thinking (Andrews, 115 and Gómez, 64). For example, if animal A communicates X to animal B, animal A intends X to provoke a reaction in animal B, because animal A believes animal B will understand X. Indeed, this brief example demonstrates the Gricean approach to intentional communication, in which the signal of one animal is intended to produce a response in another animal, such that the other animal recognizes the intention of the signal, and this recognition of intention accounts for the other animal's response to the signal (Andrews, 115). Thus, the Gricean approach seems to depend on a sophisticated theory of mind (TOM) (Andrews, 115). Indeed, philosopher Daniel Dennett claims that the Gricean approach to intentional accounts of animal communication requires the animal to have a third-order intentional system (Andrews, 116).

This stems from Dennett's discussion of the different orders of intentional systems and the way in which they ought to be conceived of, where:

A *first-order* intentional system has beliefs and desires (etc.) but no beliefs and desires about beliefs and desires. Thus, all the attributions we make to a merely first-order intentional system have the logical form of

7. x believes that p

8. y wants that q

where "p" and "q" are clauses that themselves contain no intentional idioms.

A *second-order* intentional system is more sophisticated; it has beliefs and desires (and no doubt other intentional states) about beliefs and desires (and other intentional states) - both those of others and its own. For instance

9. x wants y to believe that x is hungry

10. x believes y expects x to jump left

11. x fears that y will discover that x has a food cache

A *third-order* intentional system is one that is capable of such states as

12. x wants y to believe that x believes he is all alone. (Dennett, 1983)

To summarize Dennett's discussion above, a first-order intentional system has beliefs and desires, a second-order intentional system has beliefs and desires about those beliefs and desires, while a third-order intentional account has beliefs and desires about the second order beliefs and desires. Through the consideration of those conceptions, it becomes evident why, according to Dennett, the Gricean approach to communication requires a third-order intentional system. Recall that in the Gricean approach when animals intentionally communicate with one another, they think about what the other is thinking (Andrews, 115; Gómez, 64). Animals with first-order intentional systems have no beliefs about beliefs, and so lack the ability to think about what the other is thinking; while animals with second-order intentional systems lack the ability think about their desire for the other to think about their intention. So, only animals with third-order intentional systems have "the ability to think about the beliefs others have about one's own beliefs," (Andrews, 116) as to fit the standard of the Gricean approach to intentional communication.

### 3.5 The Gricean Approach to Intentional Communication and Mutual Awareness in Animals

One interpretation of the Gricean approach, which follows from the belief that it requires a third-order intentional system, is that intentional communication involves mutual awareness, occurring between the speaker and the listener (Gómez, 68). It is important to note, that this mutual awareness is an awareness of the other's mental processes, not merely the other's presence during the communicative interaction (Gómez, 68). As such, it is "an awareness of the other's awareness" (Gómez, 68). Gómez claims that this mutual awareness stems from *attention* contact, which can be understood as the mutual recognition of the other's signs of attention (Gómez, 73-76). Accordingly, attention contact consists of animal A attending to the signs of attention of animal B, while animal B is attending to the signs of attention of animal A at the same time. Gómez notes

this follows a peculiar Gricean structure (Gómez, 72). One compelling way to show attention contact is through eye contact, in which one animal attends the other's eyes, checks their attention and becomes aware of the object or being that is the focus of the other's attention (Gómez, 72). However, attention contact is not reducible to eye contact, such that there are other signs of attention including mirroring, mimicry, etc. Thus, "insofar as we admit that the signs of attention are signs of awareness, they can be said to be aware of each other's awareness" (Gómez, 76).

Gómez goes on to state that when two animals are intentionally communicating, they not only "think of each other thinking of each other; they perceive each other attending to each other" (Gómez, 76). That is, when two animals are in attention contact, they perceive each other's attention rather than merely thinking of each other's attention; such that the mutual awareness which occurs is perceptual, not intellectual (Gómez, 76). This indicates that the attention of one animal can be mediated through its perception of the focus of attention of the other. For example, chimpanzees are able to discover hidden food through their perception of the focus of attention of a leader, who knows where the food is hidden (Gómez, 76). The result of this interpretation is a particularly interesting one, such that if the focus of attention of the other is on an animal's own attention, the other's attention points to an animal's own attentional activity (Gómez, 76). This is what occurs in attention contact, thereby "the structure of attentional contact seems to lead to a first version of self-awareness (both as a physical and as an "aware" or "attending" entity)" (Gómez, 76). Ultimately, Gómez claims that the Gricean approach to intentional communication, which involves attention contact, implies "a sophisticated combination of self- and other-awareness" (Gómez, 68).

### 3.6 The Gricean Approach to Intentional Communication and Self-Consciousness

The above claim, that attention contact might allow for the emergence of more complex versions of self- and other- awareness, follows the structure of G.H. Mead's and Vygotsky's ideas (Gómez, 77). The structure of their ideas is that a sense of self is mediated through the other, but of course Gómez takes it a step further, that a sense of self is mediated through the awareness of the other's attention (Gómez, 77). That is, "the ability to understand the other's attention or awareness would lead to the ability to understand one's own awareness" (Gómez, 77). Thus, it is through the mutual awareness that occurs in intentional communication, that this mediation of a sense of self through the awareness of the other arises. Recall that this mutual awareness stems from attention contact, (Gómez, 76) which is the mutual recognition of the other's signs of attention (Gómez, 73). Indeed, Gómez himself claims that "when we analyze the implications of attention contact, it seems that many important later developments are embedded in its structure [including] self-consciousness" (Gómez, 77). However, Gómez is also careful to point out that one should not succumb to developmental fallacy, the assumption that the identification of a simple situation whose structure implies a later situation provides an explanation for the emergence of the latter (Gómez, 77). So, as to avoid developmental fallacy, one cannot claim that because attention contact implies self-consciousness, this accounts for the mechanism of realization for self-consciousness (Gómez, 77). One can, however, claim that attention contact "seems to be the key to the Gricean structure of intentional communication ... moreover, attention contact seems to be a seminal situation for the development of self-consciousness" (Gómez, 78). Thereby, intentional communication points to the emergence of a sense of self, and as such self-consciousness.

### 3.7 Conclusion

In sum, I have demonstrated that the intentional account of communication provides an understanding of the communicative utterances of animals that points to a sense of self, and as such self-consciousness. In this chapter, I found that animal communication can be used as evidence of thinking; and that any account of communication which is employed in the investigation animal self-consciousness must indicate that the nature and content of animal minds includes a sense of self. I found that both the biological and information-based accounts fail to do so: the biological account is too permissive, while the information-based account is silent on the nature and content of animal minds more generally. However, I found the intentional account does point to a sense of self, as it is largely concerned with the intention of a communicative utterance and how animals communicate their thoughts. Indeed, according to the Gricean approach to intentional communication, when animals intentionally communicate with one another they think about what the other is thinking. Thus, using Gómez's claim that intentional communication is formative of a sense of self, I argued that intentional communication points to animal self-consciousness. Thus, I have demonstrated that any animal whose communicative utterance fits the intentional account, meets the second condition set forth for animal self-consciousness.

## CHAPTER 4

Throughout this project, I have argued for three necessary and jointly sufficient conditions for self-consciousness in animals. Those being: (1) a complex nervous system, (2) communication and (3) collaborative social play. In this chapter I explore the third condition. I begin with a reference to the notion that animal social play can be used to investigate the nature and content of animal minds. Specifically, I focus on the notion that animal social play can be used to make inferences about an animals' sense of self, and as such the emergence of self-consciousness. Next, I investigate how animal social play ought to be defined and focus on Bekoff and Beyer's (1981) definition which makes no reference to functionality. Using this definition, I go on to consider how social play can be systematically studied through Colin Allen's proposal for the attribution of concepts to animal and consider animals' use of play signals to differentiate instances of play from instances of non-play. I then investigate two different forms of animal social play, those being self-handicapping and role reversal, both of which have traditionally been approached as indications of an understanding of self. Thus, any animal who exhibits self-handicapping and role-reversal, meets the third condition set forth for animal self-consciousness.

### 4.1 Why Animal Social Play?

Philosophers Colin Allen and Marc Bekoff propose that although there are a number of collaborative behaviors in the animal kingdom that can be examined, collaborative social play, in particular, might be useful in gaining insight into animal minds (Allen and Bekoff, 88-89). Allen and Bekoff claim that the empirical investigation of collaborative social play [hereafter: social play] yields more significant evidence about the nature and content of animal minds than other behaviors. This is because investigation of social play primarily focuses on behavioral patterns,

such as cooperation and role-playing, which indicate what is going on “in there” (Allen and Bekoff, 88). Allen and Bekoff also suggest that behavioral patterns of social play occur across a number of animal species, and as such lend themselves to the extension of investigation “beyond the narrow focus on primates that often dominates discussions of nonhuman cognition” (Allen and Bekoff, 88). They state, “it would be premature to rule out the possibility that the performance of these behavior patterns might also be important in the evolution of self-conception in non-primates” (Allen and Bekoff, 89). That is, social play seems to point to behavioral patterns from which inferences about the emergence of consciousness and self-consciousness can be made (Allen and Bekoff, 89; Bekoff, 1999). Given Allen and Bekoff’s claims, in this chapter I explore social play as the third condition required for animal self-consciousness.

#### 4.2 What is Animal Social Play?

When one turns to a discussion of what social play is, it seems there is no simple or unique definition. Social play refers to a number of behavioral patterns across animal species, and as such is similar to feeding and mating. However, “unlike play, feeding and mating correspond to easily identified biological functions” (Allen and Bekoff, 89). Thus, what is unique about social play is that it does not have a distinct biological function. Some propose that social play might contribute to the improvement of the general skill set of young animals, such that play might contribute to the development of motor and cognitive capabilities (Allen and Bekoff, 90). Others propose that social play might result in improving hunting, foraging and social abilities, all of which are beneficial to the animal across its lifespan (Allen and Bekoff, 90). Furthermore, there are other who propose that play “may have different evolved functions in different species and it may have different consequences for individuals of different ages and sexes” (Allen and Bekoff, 90). Thus,

functional definitions of play “are difficult to formulate ... [and some] authors have been tempted into defining it as a functionless behavior” (Allen and Bekoff, 89-90).

Indeed, in an attempt to provide a definition that makes no reference to functionality, Bekoff and Beyers conceive of play in the following way:

Play is all motor activity performed postnatally that appears to be purposeless, in which motor patterns from other contexts may often be used in modified forms and altered temporal sequencing. If the activity is directed toward another living being is called *social play*. (Bekoff and Beyers, 1981).

Bekoff claims this definition “centers on the structure of play sequences – what animals do when they play – and not on possible functions of play” (Bekoff, 1999). The structure of play sequences varies greatly within and between species of animals, such that the next action in play sequences can rarely be accurately predicted; although, “the degree of variability can be affected by the ages of participants, their sexes, their social ranks, their social experience, etc.” (Allen and Bekoff, 91). This flexibility and variability among play sequences allows for the study of social play to be particularly interesting.

#### 4.3 Studying Animal Social Play

Bekoff suggests that the study of social play or play sequences is suitable to Allen’s proposal for the attribution of concepts to animals (Bekoff, 1999). According to Allen’s proposal:

An organism O may reasonably be attributed a concept of X whenever: (1) O systematically discriminates some instances of X from some non-Xs; (2) O is capable of detecting some of its own discrimination errors between Xs and non-Xs; and (3) O is capable of learning to better discriminate Xs from non-Xs as a consequence of its capacity. (Bekoff, 1999)

For the purpose of this project, the concept X of interest, which can be attributed to an organism O, is *play*. Bekoff suggests that canids, especially coyotes, might be used to demonstrate Allen’s proposal. In regard to the first point, coyotes seem to be able to systematically discriminate some



instances of play from some instances of non-play by the kind of bites involved in the play sequence (Bekoff, 1999). During social play, “bites directed toward the tail, a flank, a leg, the abdomen, or the back lasted a significantly shorter time and were more stereotyped... than during aggression” (Allen and Bekoff, 98). Coyotes are able to recognize the subtle differences in bite timing in order to discriminate instances of play from instances of non-play. With respect to the second point, many animals, such as coyotes, are able to identify when they have misidentified an instance of play as non-play and vice versa, as exemplified by their use of the play bow which will be explored further in the next section (Bekoff, 1999). Finally, in regard to the third point, animals seem to become better at discriminating between play and non-play through previous mistakes of discrimination (Bekoff, 1999). Through the consideration of Allen’s proposal, it seems the next question which must be addressed in relation to animal social play is: how do animals agree to play? This question is particularly significant within the context of this project, as the agreement to play points to a sense of self. That is, the agreement is dependent on an animal’s ability to distinguish between self and other, as well as grasp what the relationship is between self and other during the interaction.

#### 4.4 Play Signals: How do Animals Agree to Play?

As seen above with coyotes and the discrimination of bites in play and non-play, when animals engage in social play, they use behavioral patterns within the play sequence which are also used across other contexts (Bekoff, 1999). If the behavioral patterns within the play sequence are not intrinsically different from predatory, antipredatory or mating contexts, then how do animals agree to play (Allen and Bekoff, 99)? Many animals have evolved play signals, or play markers, which are used to reach an agreement to play and to maintain a playful mood throughout

the interaction (Allen and Bekoff, 99; Bekoff, 1999). Bekoff claims “play-soliciting signals appear to foster some sort of cooperation between players so that each responds to the other in a way consistent with play” (Allen and Bekoff, 99). Here, coyotes can be used once again as an example. Coyotes react differently to threatening gestures, such as biting and standing over, following a play signal compared to in the absence of a play signal (Allen and Bekoff, 99).

#### *4.4.1 Play Bows*

One oft cited and extensively studied example of a play signal is the canid play bow, which is “a highly ritualized and stereotyped movement that seems to function to stimulate recipients to engage (or to continue to engage) in social play” (Allen and Bekoff, 99). The notion that play bows are stereotyped implies that the way in which they are performed is highly uniform, however, it does not imply that play bows are not versatile (Allen and Bekoff, 100). This uniformity is important for the purpose of play bows, such that in this way they are less likely to be misidentified (Allen and Bekoff, 100). During a play bow, “an individual crouches on its forelimbs, remains standing on its hind legs, and may wag its tail and bark... [this] places the head of the bower below the head of another animal in an unthreatening position” (Allen and Bekoff, 100). Play bows “occur almost exclusively during social play” (Bekoff, 1999) and can occur at any point in the play sequence, although they most commonly occur at the beginning of the sequence (Bekoff, 1999). While the form of play bows is highly uniform, dependent on when they occur in the play sequence, their duration is quite versatile. Allen and Bekoff claim this can be attributed to three explanations, (1) that fatigue occurs during play; (2) the performance of preceding postures; and (3) that there is less necessity to signal the continuation of play than the initiation of play (Allen and Bekoff, 100). One should note that they do not believe these explanations are mutually exclusive (Allen and

Bekoff, 100). Regardless of the explanations for the versatility of play bows during play sequences, it does seem that play bows in general reinforce and maintain the play mood of the interaction (Allen and Bekoff, 103). That is, play bows signal to the other “I want to play... what follows is play... [and] this is still play” (Bekoff, 1999), thus allowing for the cooperation between animals during social play.

#### 4.5 Forms of Animal Social Play

##### 4.5.1 *Self-Handicapping*

One behavior pattern which is commonly identified during animal social play is self-handicapping (Bekoff, 1999). Self-handicapping is a behavior in which one animal purposefully inhibits itself during the interaction in order to foster the play mood (Bekoff, 1999; Essler et al., 2016). Interestingly, self-handicapping does not take into account the “the relative ranks of the partners outside of the play context” (Essler et al., 2016); both the dominant and subordinate animals might demonstrate self-handicapping during social play. In general, there are three kinds of self-handicapping observed in the animal kingdom, “*social* self-handicapping, when a stronger partner takes a disadvantageous position, *kinematic* self-handicapping, when a partner exhibits a physically demanding position, and *sensory* self-handicapping, when a partner closes its eyes while acting” (Essler et al., 2016). Once again, coyotes can be used to demonstrate self-handicapping behavior. During social play, “a coyote might not bite her play partner as hard as she can, or she might not play as vigorously as she can” (Bekoff, 1999). Here, when the coyote does not bite with all of its force, or does not play as vigorously as possible, it demonstrates self-handicapping by taking a disadvantageous position. This, in turn, encourages the play partner to continue the interaction in the play mood. Similarly, red neck wallabies seem to demonstrate self-

handicapping, such that they adjust the way in which they play depending on their play partner's age (Bekoff, 1999). For example, "when a partner was younger, the older animal adopted a defensive, flat-footed posture... [and] was more tolerant of its partners tactics" (Bekoff, 1999).

#### *4.5.2 Role Reversal and Self-Handicapping/Role Reversal Combinations*

Another behavior pattern which is commonly identified during animal social play is role reversal (Bekoff, 1999). In role reversal, "a dominant animal performs an action during play that would not normally occur during real aggression" (Bekoff, 1999). A good example of role reversal can be observed when companion dogs play with one another. The role reversal occurs when the dominant dog rolls over to expose its belly voluntarily, which it would not do outside of the context of play (Bekoff, 1999; Smuts, 2014). Indeed, for dogs, rolling over belly up is one of the most vulnerable positions they can be in; by doing so voluntarily, the dominant dog demonstrates their subordinate position to the play partner (Smuts, 2014). Similarly, in coyote pups rolling over is demonstrated as role reversal, where rolling over of the dominant coyote pup occurs exclusively in social play contexts (Bekoff, 1999). Yet role reversal and self-handicapping are not entirely exclusive; there are some instances in which they occur within the same play sequence (Bekoff, 1999). For example, the dominant animal might roll over to expose its belly voluntarily, as well as not bite their play partner with all of its force (Bekoff, 1999).

Together, these forms of animal social play occur "as not to allow the interaction to escalate into a real fight" (Bekoff, 1999). Recall, that the behavior patterns in play sequences are not unique to play contexts, therefore "play sequences are punctuated with behaviors patterns that indicate an individual is willing to either handicap himself or engage in role playing" (Bekoff, 1999). This willingness points towards the animals' wish to play, and as such might provide insight into the

nature and content of its mind (Bekoff, 1999). Indeed, Bekoff finds “the performance of self-handicapping and role reversal suggests that an individual is able to make an assessment of himself and others and manage or regulate how she plays” (Bekoff, 1999). If Bekoff’s interpretation is correct, then the performance of these two forms of social play require that the animal has a sense of self and is able to distinguish itself from other. Similarly, Maxeen Biben suggests that collaborative social play is used by individuals to “learn strategies of social interaction that are related to self-competence and self-preservation” (Bekoff, 1999). Again, here, it becomes evident that there is a distinct relationship between social play and a sense of self.

#### 4.6 Conclusion

In sum, I have demonstrated that self-handicapping and role-reversal in animal play sequences point towards a sense of self, and as such self-consciousness. In this chapter, I found that collaborative social play [again hereafter: social play] might be useful in gaining insight into animal minds; and that social play points to behavioral patterns from which inferences about animal self-consciousness can be made. Indeed, social play is a particularly interesting behavior because it is not directly tied to a biological function. Using Bekoff’s notion that play signals, specifically play bows, allow for animals to agree or continue to agree to play, I argued that there are two forms of social play of particular interest when investigating animal self-consciousness, those being self-handicapping and role-reversal. Recall, that in self-handicapping one animal purposefully inhibits itself during the interaction in order to foster the play mood, while role-reversal the dominant animal performs an action it would not usually perform in an aggressive encounter. I found that both of these forms of social play require than an animal have a sense of self, and as such self-consciousness, because they presume an ability to distinguish between self

and other. Thus, I have demonstrated that any animal who exhibits self-handicapping and role-reversal, meets the third condition set forth for animal self-consciousness.

## CHAPTER 5

In this project, I have demonstrated why (1) a complex nervous system, (2) communication and (3) collaborative social play, are each individually necessary for animal self-consciousness. In this chapter, I aim to demonstrate that together they are sufficient, such that the three conditions must be understood as necessary and jointly sufficient for self-consciousness. To do so, I investigate some of the traditional criticisms against each of the conditions individually. I then find that by treating them as jointly sufficient, my proposal overcomes these criticisms; thereby providing a new set of conditions which are successful in determining which animals are and are not self-conscious. In anticipation of possible objections to my proposal more generally, I turn to philosopher Valerie Hardcastle's response to explanatory gap arguments and view of scientific explanations. Hardcastle claims it is not fair to demand that scientific explanations demonstrate why an identification or identity statement holds. Indeed, Hardcastle finds that demonstration of the identification is explanation enough for scientific theory, a notion I embrace to address the following questions:

1. What is the connection between these three conditions and self-consciousness?
2. Why is it that these three conditions give rise to self-consciousness?
3. Why are these three conditions necessary and jointly sufficient for self-consciousness?

Finally, I provide a demonstration of how my proposal can be implemented through the consideration of dolphins as a case example of an animal which meets all three conditions set forth in my proposal and is self-conscious.

### 5.1 Criticisms Against the First Condition: A Complex Nervous System

As seen in the second chapter, I argue that centralized attention, the third stage in the evolution of the nervous system, is adequately complex for the emergence of animal self-consciousness. Recall this is because centralized attention demonstrates the functional

organization between neurons required to process signals in a meaningful way; and that self-consciousness is dependent on this meaning. In short, to demonstrate that centralized attention meets the first condition for animal self-consciousness, I employ the complexity argument. However, in his book *Rethinking Consciousness*, neuroscientist Michael Graziano discusses the traditional criticism of the complexity argument. Graziano states:

Scholars who write about the evolution of consciousness tend to emphasize a gradual increase in the complexity of the brain. It is intuitively tempting to think that complexity makes consciousness. In that view, somewhere in the process of evolution, the nervous system became so complex that it crossed a threshold, woke up, and gained subjectivity. If that is true, then the question of consciousness turns into a matter of finding the threshold – always a slippery slope. (Graziano, 36)

In this passage, Graziano elegantly describes the complexity argument: the argument claims that at some stage in the evolution of the nervous system there is a threshold at which consciousness, or self-consciousness, arises as a result of an adequate complexity of the nervous system (again, this is the argument I make in the second chapter). He also describes the traditional criticism of this argument: finding this threshold for consciousness, or self-consciousness, is always problematic (Graziano, 36).

Graziano attributes the problematic nature of finding this threshold to human emotional biases (Graziano, 37). For example, if one rules out fish as being conscious because one assumes their nervous system lacks complexity, perhaps an expert in the realm of fish nervous systems would find that this assumption is mistaken; that fish do have the necessary complexity, and so that they are indeed conscious (Graziano, 36-37). Thus, Graziano claims that the threshold for consciousness, and self-consciousness, is always “subject to human whim” (Graziano, 37).

Following this, Graziano states:

Once you start with the intuition that consciousness arises naturally from complex information processing, it's hard not to slip into panpsychism, the belief that everything in the universe is conscious at least to some degree. By replacing consciousness with information and complexity, properties that are literally



everywhere and in everything, we are left to slide up and down the slippery scale.  
(Graziano, 37)

Given this criticism, one might wonder why I maintain that a complex nervous system is the first condition for animal self-consciousness. I believe that a complex nervous system is nonetheless necessary, although not sufficient for self-consciousness, such that the other two conditions prevent the slip into panpsychism Graziano is concerned about. Indeed, a complex nervous system is necessary for self-consciousness for a very simple reason. It provides an internal control system which “depicts the self as containing an amorphous, non-physical, internal power, an ability to know, to experience, and to respond” (Graziano, 43). Furthermore, it provides an animal with the “requisite information to lay claim to a subjective experience, [and so self-consciousness] finally becomes relevant” (Graziano, 44). Thus, for self-consciousness to become relevant, it seems a complex nervous system certainly is necessary, although only sufficient in the simultaneous occurrence with the other two conditions, communication and collaborative social play.

## 5.2 Criticisms Against the Second and Third Conditions: Communication and Social Play

As seen in the third chapter, I argue that communication as described by the intentional account is seminal to the emergence of self-consciousness. Recall that the Gricean approach to intentional communication finds that when animals intentionally communicate with one another, they think about what the other is thinking. Indeed, Gómez’s interpretation of the Gricean approach emphasizes a mutual awareness and attention contact which points to a sense of self, and as such self-consciousness. In short, to demonstrate that intentional communication meets the second condition for animal self-consciousness, I argue that communicative utterances can be used to make inferences about a sense of self. However, the notion of depending on the nature of communicative utterances as a means of inference for animal self-consciousness has traditionally

met certain criticisms and is often discouraged by cognitive ethologists. Cognitive ethologists follow a tradition in which there is a “conviction that all animal communication is a direct result of internal physiological states that are not under any sort of conscious control” (Griffin, 155). That is, they do not believe communication provides insight into the nature and content of animal minds, and so they claim it cannot be used to infer animal self-consciousness. Another related criticism stems from the view that the communicative utterances of animals might merely be “predictive information that leads to an appropriate response on the part of the animal” (Griffin, 155). This criticism supposes that animals communicate in a manner that does not indicate whether they are or are not conscious of their utterance; and that instead, they communicate in a manner that suggests they are merely simple, behaviorist organisms (Griffin, 155).

The above criticisms against using communicative utterances to make inferences about self-consciousness, are quite similar to the criticisms against using collaborative social play for the same purpose. Recall that in the fourth chapter, I argue the two most commonly observed forms of animal social play, self-handicapping and role reversal, can be used to infer self-consciousness. That is, self-handicapping and role reversal reflect an animal’s ability to monitor its own sense of self, as well as the ability to distinguish self from other. Oft-cited criticisms against this inference focus on the following question: how can one be certain that animals are in any way aware of the meaning of the play sequence or “are they simply conditioned to respond” (Bekoff, 1999)? Thus, given these criticisms, one might again wonder why I maintain that communication and collaborative social play are the second and third conditions for animal self-consciousness. Just as in the discussion of the first condition, I believe that communication and social play are necessary, although individually not sufficient for self-consciousness. Indeed, the presence of an audience in communication and the presence of a play partner in social play show that animals are not merely

conditioned to respond (Griffin, 155); and instead, that the communication and social play of animals operates from an ability to distinguish self from other. Thus, for self-consciousness to become relevant, it seems communication and collaborative social play are necessary and sufficient in the simultaneous occurrence with the first condition, a complex nervous system.

### 5.3 Three Conditions: Necessary and Jointly Sufficient

In the two preceding sections, I have addressed several potential criticisms against each of the three conditions proposed for self-consciousness. I have also offered an argument against each of the potential criticisms to demonstrate that each condition individually is necessary for self-consciousness. However, each condition alone is not sufficient. That is, these conditions must occur for the emergence of self-consciousness, but their occurrence alone does not guarantee self-consciousness; they are only sufficient when they occur simultaneously. As jointly sufficient conditions, if an animal meets all three conditions, one may conclude that the animal is self-consciousness. Likewise, if an animal is assumed to be self-conscious, one may conclude that it meets all three conditions. To demonstrate the necessary and jointly sufficient nature of the conditions, it might be helpful to consider what form this would take. Let N represent the first condition – a complex nervous system. Let C represent the second condition – communication. And let P represent the third condition – collaborative social play. If animal X exhibits N alone, although N is necessary for self-consciousness, one may conclude that animal X is not self-conscious. Similarly, if animal X exhibits C and P, although both C and P are individually necessary for self-consciousness, one may conclude that animal X is still not self-conscious. However, if animal X exhibits N, C and P, because these three conditions are individually necessary and jointly sufficient, one may conclude that animal X is self-conscious. In the same

way, if animal X is self-conscious, then one may conclude that it meets N, C and P; animal X would not exhibit only a subset of those conditions. Thus, I arrive at an identity statement in my proposal for self-consciousness, namely *self-consciousness is N + C + P*, and *N + C + P is self-consciousness*.

#### 5.4 Hardcastle and Explanatory Gap Arguments

In this project, I have taken recourse to a highly empirical approach in developing a theory of animal self-consciousness, culminating in the following identity statement: *self-consciousness = a complex nervous system + communication + collaborative social play*. In this way, I follow philosopher Valerie Hardcastle who is a committed materialist in the study of consciousness (Hardcastle, 1996). Hardcastle believes “that consciousness is part of the natural world, but surely is completely mysterious” (Hardcastle, 1996). Hardcastle also believes that the best approach to the study of consciousness is an empirical one, “to isolate the causal influences or components with respect to consciousness and model them” (Hardcastle, 1996). This is what I have done in this project; I have isolated the three conditions or components of self-consciousness, those being (1) a complex nervous system, (2) communication and (3) collaborative social play. Indeed, this is how I arrived at the identity statement that *self-consciousness = a complex nervous system + communication + collaborative social play*, or *self-consciousness = N + C + P*. However, a philosopher who demands more out of a theory of consciousness might find that my theory is incomplete; while I have successfully identified the components of self-consciousness, I have not explained why it is that N + C + P give rise to self-consciousness or why this identity holds (Hardcastle, 1996). That is, I have not bridged the explanatory gap that exists between mind and body. Hardcastle states the following:

[This] is, of course, exactly right: scientific theories of consciousness won't explain the weirdness of consciousness to those who find the identity weird... To put it bluntly: their failure to appreciate the world as it really is cuts no ice with science. Their ideas are at fault, not the scientific method. Materialists presume that there is some sort of identity statement for consciousness. (Hardcastle, 1996).

Given that the scientific method is not at fault, Hardcastle claims it would be a mistake to require that scientific explanation, or theory of self-consciousness for the purpose of this project, is able to explain why the identity statement holds. For example, other identity statements in science, such as *water* =  $H_2O$ , are not required to provide explanation, they are simply accepted (Hardcastle, 1996). Thus, I follow Hardcastle's idea and claim that it would be unfair to require an explanation of why *self-consciousness* =  $N + C + P$ , it is simply so. All one can propose to explain is that the "understanding of consciousness [and as such self-consciousness] will someday be embedded in some larger mind-brain framework" (Hardcastle, 1996).

### 5.5 Application of the Three Conditions

Here, it would be helpful to demonstrate how my proposal can be applied to determine whether an animal is or is not self-conscious. For this purpose, I turn to dolphins as an example of an animal which meets all three conditions set forth in my proposal for animal self-consciousness. In the second chapter, I demonstrated that any animal whose nervous system has the capacity for centralized attention, meets the first condition for self-consciousness: a complex nervous system. Recall that centralized attention is characterized by multimodal signal integration. The dolphin brain has two cerebral hemispheres which are connected by the corpus collosum, a bundle of nerves that transmit signals across hemispheres for central integration (Leatherwood and Reeves, 1990). Furthermore, much like the human brain, the dolphin brain is made up of various lobes with specialized functions: the sensory cortex maps physiological stimuli, while different layers in the visual cortex map different kinds of visual stimuli (light, orientation, color, etc.) (Leatherwood and

Reeves, 1990). The stimuli mapped in each hemisphere and lobe are then centrally integrated, as is characteristic of centralized attention. Thus, I find that dolphins meet the first condition, as their nervous system has the capacity for centralized attention.

Meanwhile, in the third chapter, I demonstrated that any animal whose communicative utterance fits the intentional account of communication, meets the second condition for self-consciousness: communication. Although I already examined the communicative utterances of dolphins in the third chapter, it is worth reiterating, here, why they fit the intentional account. At an early age, dolphins develop a signature whistle, which other dolphins in the pod learn to identify and recognize as representing that individual (Andrews, 125). Dolphins use these signature whistles along with other clicks and whistles to maintain group cohesion, and to communicate important information to others about their location, or the location of food or a threat (Tyack, 1997). As the communicative utterances of dolphins contain referential properties, are intended to have an effect and are about something, these utterances fit the intentional account. Therefore, I find that dolphins meet the second condition for self-consciousness, such that their communicative utterances are intentional.

Finally, in the fourth chapter, I demonstrated that any animal who exhibits self-handicapping and role-reversal, meets the third condition set forth: collaborative social play. Dolphins often exemplify self-handicapping and role-reversal in various play sequences, such play fights or chases, play feeding and wave riding (Janik, 2015). Indeed, in the article *Why do Dolphins Play*, Stand Kuczaj and Holli Eskelinen observe the following:

During social play, an older and/or more adept animal [dolphin] may opt to handicap itself to both encourage playful interactions with a younger animal and to avoid injuring the youngster. If the dolphins are playing a social game, such as playfighting or play-mating, the more dominant animal may play a subordinate role, such role reversals being rarely observed outside of the play context. (Kuczaj and Eskelinen, 2014)

Self-handicapping is particularly common during play fights and chases, in which dolphins charge through the water at one another without harming one another (Janik, 2015). Meanwhile, during play feeding, older and younger dolphins alternate hunting positions as an example of role-reversal (Janik, 2015). I again find that dolphins meet the third condition set forth, such that they demonstrate both self-handicapping and role-reversal during social play. Ultimately, because dolphins meet all three conditions set forth, I conclude that they are self-conscious.

## CONCLUDING REMARKS

In this project, I have developed a theory of animal self-consciousness which provides a means of distinguishing between animals which are and are not self-conscious. I have proposed that there are three conditions which are necessary and jointly sufficient for animal self-consciousness, those being: (1) a complex nervous system, (2) communication, and (3) collaborative social play. I have found that these conditions are each individually necessary and jointly sufficient, such that if an animal meets all three conditions, they are self-conscious. Likewise, if an animal is self-conscious, they necessarily meet all three conditions. But one might wonder, does it really matter whether any animal is self-conscious? Similarly, does it matter which animals are self-conscious and under which conditions (Griffin, 234)? In an important sense I believe the answer to those questions is yes. Indeed, there are three reasons why I believe one ought to concern oneself with animal self-consciousness.

The first reason stems from philosophical curiosity, where “an understanding of animal minds [and self-consciousness], presumably would inform the understanding of our own” (Vitti, 2010). In this way, the philosophical importance of animal self-consciousness “lies in its relevance to the general question of other minds and difficult questions of how to define and identify consciousness” (Griffin, 233). Indeed, questions about consciousness and self-consciousness often stem from philosophical attempts to locate humans in nature (“Animal Consciousness,” 2016), and are rooted in the notion that humans are distinct from other animals (Vitti, 2010). In the traditional philosophical sense, at least in the West, that which distinguishes humans from other animals is the uniquely human endowment of consciousness and self-consciousness (“Animal Consciousness,” 2016). However, my proposal expands the endowment of self-consciousness to other animals. Thus, through the careful consideration of animal self-consciousness and the



reasonable conditions for its emergence, this project contributes to philosophical discourse about consciousness and other minds more generally.

The second reason why one ought to concern oneself with animal self-consciousness stems from ethical concerns that surround animal suffering. For example, “hardly anyone denies that there is a large ethical difference between torturing a dog or monkey and mutilating even the most elaborate and efficient machine” (Griffin, 245). This is rooted in the belief that animals consciously suffer in a way that machines do not, that is, *this is painful to me*. So, it seems we frequently make value judgements about animal suffering that inform our decisions about trade-offs concerning welfare (Griffin, 246). Take two extreme cases: one in which a promising medical procedure is tested on an anesthetized rat and to another in which an elephant is left crippled because it is hunted for ivory (Griffin, 251). While the former trade-off seems warranted because human benefit is greater than animal suffering (although that itself is debatable too), the latter is certainly an “unwarranted indulgence in minor human satisfaction at the expense of considerable suffering” (Griffin, 251). Yet most cases do not necessarily align with either extreme. Thus, the question remains: “how should we actually implement change to accommodate conscious [or self-conscious] animals” (Vitti, 2010). Although I cannot hope to resolve this rather complex, but immensely important issue here; this project, in its expansion of the endowment of self-consciousness to other animals, contributes to ethical considerations of animal suffering.

Meanwhile, the third and final reason why I believe one ought to concern oneself with animal self-consciousness stems from its scientific significance. Within the animal kingdom there are millions of species of non-human animals, indeed:

For this alone it is important to understand animals as fully as possible; for without such understanding we will remain blind to an important aspect of reality. We cannot understand animal fully without know what their subjective experience are

like... In its own right, [this is] an important reason to inquire as deeply and critically as we can into the subjects discussed [animals]. (Griffin, 252)

Within the passage the relevance of scientific curiosity into animal self-consciousness becomes evident, such that non-human animals comprise the majority of animal kingdom and ought to be fully understood. Further, “much of twentieth-century science has gradually slipped into an attitude that belittles nonhuman animals” (Griffin, 252). Through its expansion of the endowment of self-consciousness to other animals, this project actively functions to counteract this slip in scientific literature.

Ultimately, I am confident that my proposal of the three necessary and jointly sufficient conditions for animal self-consciousness, those being (1) a complex nervous system, (2) communication and (3) collaborative social play, contributes to philosophical, ethical and scientific investigations of consciousness more generally. Indeed, I believe in its expansion of the endowment of self-consciousness beyond humans to other animals, it is a continuation of a long-term learning and change in perspective away from a human-centric view to something much more diverse and inclusive. In this way, this project moves away from a perspective of human singularity and exceptionalism, and lays the groundwork for an inclusive investigation into questions including the following: what it is like to be animal X and how one ought to go about animal welfare with the knowledge that animal X is self-conscious?

**BIBLIOGRAPHY**

- Allen, Colin, and Marc Bekoff. *Species of Mind: The Philosophy and Biology of Cognitive Ethology*. First Edition, The MIT Press, 1997.
- Allen, Colin, and Michael Trestman. “Animal Consciousness.” *The Blackwell Companion to Consciousness*, edited by Susan Schneider and Max Velmans, Wiley Blackwell, 2017, pp. 63–72.
- Andrews, Kristin. *The Animal Mind: An Introduction to the Philosophy of Animal Cognition*. 1st ed., Routledge, 2014.
- Bekoff, Marc. “Social Cognition: Exchanging and Sharing Information on the Run.” *Erkenntnis* (1975-), vol. 51, no. 1, 1999, pp. 113–128. JSTOR, [www.jstor.org/stable/20012943](http://www.jstor.org/stable/20012943).
- Bekoff, Marc, and Sherman, Paul. “Reflections on Animal Selves.” *Trends in Ecology & Evolution*, vol. 19, no. 4, 2004, pp. 176–80. *Crossref*, doi:10.1016/j.tree.2004.12.010.
- Byom, Lindsey J., and Bilge Mutlu. “Theory of Mind: Mechanisms, Methods, and New Directions.” *Frontiers in Human Neuroscience*, vol. 7, 2013. *Crossref*, doi:10.3389/fnhum.2013.00413.
- Cartmill, Matt. “Animal Consciousness: Some Philosophical, Methodological, and Evolutionary Problems.” *American Zoologist*, vol. 40, no. 6, 2000, pp. 835–46. *Crossref*, doi:10.1093/icb/40.6.835.
- Darwin, Charles, Leonard Keble, and Joseph Meredith Toner Collection. *The Descent of Man: And Selection in Relation to Sex*. London: J. Murray, 1889.
- DeGrazia, David. “Self-Awareness in Animals.” *The Philosophy of Animal Minds*, edited by Robert W. Lurz, Cambridge University Press, Cambridge, 2009, pp. 201–217.

- Dennett, Daniel. "Animal Consciousness: What Matters and Why." *Social Research*, vol. 62, no. 3, 1995, pp. 691–710. JSTOR, [www.jstor.org/stable/40971115](http://www.jstor.org/stable/40971115).
- Deonna J., Nanay B. (2014) "Simulation Versus Theory-Theory: A Plea for an Epistemological Turn." In: Reboul A. (eds) *Mind, Values, and Metaphysics*. Springer, Cham. [https://doi.org/10.1007/978-3-319-05146-8\\_20](https://doi.org/10.1007/978-3-319-05146-8_20)
- Erwin, D. H., et al. "The Cambrian Conundrum: Early Divergence and Later Ecological Success in the Early History of Animals." *Science*, vol. 334, no. 6059, 2011, pp. 1091–97. *Crossref*, doi:10.1126/science.1206375.
- Essler, Jennifer L et al. "Play Behavior in Wolves: Using the '50:50' Rule to Test for Egalitarian Play Styles." *PloS one* vol. 11,5 e0154150. 11 May. 2016, doi:10.1371/journal.pone.0154150
- Frege, Gottlob. "Sense and Reference." *The Philosophical Review*, vol. 57, no. 3, 1948, pp. 209-230., [www.jstor.org/stable/2181485](http://www.jstor.org/stable/2181485).
- Gallup, G.G. *Can animals empathize? Yes*. *Sci. Am.*, 1998, 9, pp. 66 – 71
- Gertler, Brie. *Mind*, vol. 107, no. 427, 1998, pp. 676–679. JSTOR, [www.jstor.org/stable/2660124](http://www.jstor.org/stable/2660124)
- Graziano, Michael. *Rethinking Consciousness: A Scientific Theory of Subjective Experience*. 1<sup>st</sup> ed., W. W. Norton & Company, 2019.
- Griffin, Donald. *Animal Minds*. New Ed, University Of Chicago Press, 1994.
- Godfrey-Smith, Peter. *Other Minds: The Octopus, the Sea, and the Deep Origins of Consciousness*. Reprint, Farrar, Straus and Giroux, 2017.
- Gómez, Juan Carlos. "Mutual Awareness in Primate Communication: A Gricean Approach." *Self-Awareness in Animals and Humans*, edited by Sue Taylor Parker et al., Cambridge: Harvard University Press, 1994, pp. 61–80.

- Hardcastle, Valerie. "THE WHY OF CONSCIOUSNESS: A NON-ISSUE FOR MATERIALISTS." *Journal of Consciousness Studies*, 3, No.1, 1996, pp. 7-13
- Hauber, Mark E., and Paul W. Sherman. "Self-Referent Phenotype Matching: Theoretical Considerations and Empirical Evidence." *Trends in Neurosciences*, vol. 24, no. 10, 2001, pp. 609–16. *Crossref*, doi:10.1016/s0166-2236(00)01916-0.
- Hejnal A, Rentzsch F. "Neural nets". *Curr Biol*. 2015, Sep 21;25(18): R782-6. doi:10.1016/j.cub.2015.08.001. PMID: 26394095.
- "Indiscriminate." Merriam-Webster.com. 2011. <https://www.merriam-webster.com>.
- Janik, Vincent M. "Play in Dolphins." *Current Biology*, vol. 25, no. 1, 2015, pp. R7–8. *Crossref*, doi:10.1016/j.cub.2014.09.010.
- Janik, V. M., et al. "Signature Whistle Shape Conveys Identity Information to Bottlenose Dolphins." *Proceedings of the National Academy of Sciences*, vol. 103, no. 21, 2006, pp. 8293–97. *Crossref*, doi:10.1073/pnas.0509918103.
- Kuczaj, S. A. II, Yeater, D., & Highfill, L. "How selective is social learning in dolphins?" *International Journal Of Comparative Psychology*, 2012, 25(3), 221-236. Retrieved from <https://escholarship.org/uc/item/9z25m1rq>
- Leatherwood, Stephen, and Randall Reeves. *The Bottlenose Dolphin*. Elsevier, 1990.
- Mandik, Pete. *This Is Philosophy of Mind: An Introduction*. 1st ed., Wiley-Blackwell, 2013.
- Marchetti, Giorgio. "Consciousness: A Unique Way of Processing Information." *Cognitive Processing*, vol. 19, no. 3, 2018, pp. 435–64. *Crossref*, doi:10.1007/s10339-018-0855-8.
- Mateo, Jill M. "Self-Referent Phenotype Matching and Long-Term Maintenance of Kin Recognition." *Animal Behaviour*, vol. 80, no. 5, 2010, pp. 929–35. *Crossref*, doi:10.1016/j.anbehav.2010.08.019.

- Mateo, Jill M. "Recognition Systems and Biological Organization: The Perception Component of Social Recognition." *Annales Zoologici Fennici*, vol. 41, no. 6, 2004, pp. 729–745. JSTOR, [www.jstor.org/stable/23736140](http://www.jstor.org/stable/23736140).
- Millikan, Ruth. "Styles of Rationality." *In Rational Animals*, ed Susan Hurley and Matthew Nudds, 117-126. Oxford: Oxford University Press, 2006.
- Nagel, Thomas. "What Is It Like to Be a Bat?" *Philosophical Review*, 1974, 83: 435-450.
- Sakarya, Onur, et al. "A Post-Synaptic Scaffold at the Origin of the Animal Kingdom." *PLoS ONE*, edited by Leslie Vosshall, vol. 2, no. 6, 2007, p. e506. *Crossref*, doi:10.1371/journal.pone.0000506.
- Smuts, Barbara. "Chapter 4 - Social Behaviour among Companion Dogs with an Emphasis on Play" ed Juliane Kaminski, Sarah Marshall-Pescini, *The Social Dog*, Academic Press, 2014, pp 105-130, ISBN 9780124078185, <https://doi.org/10.1016/B978-0-12-407818-5.00004-8>.
- "Theories of Meaning", The Stanford Encyclopedia of Philosophy (Spring 2021 Edition), Edward N. Zalta (ed.), <<https://plato.stanford.edu/archives/spr2021/entries/meaning/>>.
- Tyack, P. L. "Development and social functions of signature whistles in bottlenose dolphins *Tursiops truncatus*." *Bioacoustics*, 1997 8(1-2), 21–46
- Vitti, Joseph. *The Distribution and Evolution of Animal Consciousness*. Harvard University, 2010.
- Von Frisch, Karl. *The Dance Language and Orientation of Bees*. 1st edition, Harvard University Press, 1976.