Sartrean Phenomenology for Humanoid Robots: a developmental approach

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2021

Jean-Paul Sartre's *Being and Nothingness: An essay on phenomenological ontology* is significant in its contribution to the study of subjective experience as a result of its descriptive account of existence from the first-person perspective (Flynn). In addition to its importance in phenomenology, the concepts and ideas Sartre provides have also been investigated from scientific perspectives as well, including cognitive science (Gallagher 12; Kriegel 248), neuroscience (Tantam 364; Valentine 349), and psychology (Quackenbush et al. 361; Morf 29). Moreover, Sartre's conception of self-consciousness has also been connected to *higher-order theory* from philosophy of mind (Gennaro 296), suggesting this framework can be applied to a number of domains interested in researching conscious awareness. This paper aims to demonstrate the utility of Sartrean phenomenology for robotics engineering, particularly *developmental robotics*, as this approach to experiential learning models the trajectory of human development (Cangelosi and Schlesinger 4). If successful, it seems likely these robots will achieve a degree of self-awareness and a capacity for self-reflection as a result of their learning (Chatila et al. 151; Chella et al. 5; Lee 242). Furthermore, if these social robots develop an ability to articulate their own perspectives as an embodied agent, humans may become interested in learning more about how robots think and feel. Additionally, individuals are likely to be curious about how these experiences are similar to or different than their own, however, to verify these speculations requires some type of ontological framework for explaining phenomenology. Sartre provides this in *Being and Nothingness* and by articulating key relationships required for producing reflectively conscious beings, are able to reasonably consider the future experiences of sentient robots.

After investigating three significant areas in *Being and Nothingness,* this paper explores connections to empirical evidence from evolutionary biology and childhood development. My aim is not to reduce the phenomenal to the physical, nor discount the ontological significance of the subjective. Instead, this paper identifies areas of overlap between Sartrean phenomenology and scientific contributions to demonstrate their theoretical compatibility. By articulating the relationship between the subjective and the objective, the resulting ontological ground suggests existing models possess phenomenal awareness as a product of their design. Moreover, given the bodily similarities between humans and developmental robots, it seems reasonable to conclude certain experiences will be shared as a result. Whether these robots will go on to develop reflective awareness, however, remains to be seen, and until these agents are able to express their phenomenal experiences, our understanding of robot subjectivity will be speculative and incomplete.

An Ontological Foundation for Subjectivity

In the introduction of *Being and Nothingness*, Sartre begins by establishing an ontological foundation for phenomenology where he outlines the relationship between *being* and *appearance*. He considers *being* as the "total series of appearances", or the total set of perceived elements which comprise the object or entity (Sartre 2). Moreover, the phenomenological point of view considers the appearance of entities as indicative of their own essences, despite only encountering a portion of appearances that exist within the total series (Sartre 3). An *appearance* is disclosed by immediate access, and ontologically, consists of a description which accounts for its emergence or manifestation as it appears in subjective experience (Sartre 4). Here, the existent represents an "organized totality of qualities", or the total set of features that are associated with the existent (Sartre 5). Furthermore, Sartre states that the description we use to refer to an existent *is* its ontology, and that there can be no intermediary between being and appearance. Thus, from the perspective of the subject, an object's reality is directly dependent their perception of it (Chaplin 162; Sartre 5).

From the first-person perspective, there are two forms of existing or *being*: *being-in-itself* and *being-for-itself*, where conscious awareness arises from a pre-reflective awareness of the self. To be a subject capable of knowledge is to have a capacity for perception (Sartre 7). Not all aspects of consciousness, however, refer to knowledge or a concrete representation, nor is consciousness an object of reflection (Sartre 8). Rather, Sartre believes there must be an immediate, non-cognitive relation between the self as a reflective capacity and itself as a *pre-reflective cogito* (Reisman 26; Sartre 9). In fact, it is the non-reflective consciousness which renders reflection possible, where the very nature of consciousness exists as a circle, pointing back to the self as individuals engage with their perceptions (Sartre 9). He also states that consciousness is a "wholeness of existence", where the essential characteristic of consciousness is this determination of the self by the self (Gardner 67; Sartre 11). Given this, all contents of consciousness are oriented toward the outside world, however, this awareness of objects in the world simultaneously indicates a non-positional consciousness of itself; some*thing* must exist to perceive this object (Sartre 11). Therefore, transcendence is the constitutive structure of consciousness, providing an ontological account which describes the emergence of a reflective consciousness from pre-reflective origins. As such, Sartre distinguishes two types of being: a *pre-reflective cogito* or *being-in-itself*, and the *being of the phenomenon*, also known as *being-for-itself* (Flynn; Sartre 19).

Consequently, the body exists as a perspective which is oriented toward the environment (Sartre 327). From the first-person perspective, one's body does not appear as a corporeal entity existing in the midst of the world, but instead reveals aspects of the external world as they are perceived by our sensory organs (Sartre 328). The effects of this perceptive action are subjective states, where appearances are the contents of perception (Sartre 336). Additionally, as individuals perceive or imagine objects, they are are considered to exist out in an external environment rather than appear appear *as* a concept or representation (Sartre 340). As a result, the senses exist contemporaneously with objects where all variations in perception are the result of objective conditions (Sartre 342). This suggests that the senses are not associated with subjectivity, but the objective relationship between external objects or environmental features and their effects on our sensory organs (Sartre 343). Moreover, Sartre states action cannot be separated from sensation (Sartre 344), were perceptions are revealed to individuals as they engage in activity (Sartre 346). For example, I do not engage with my hand as I write; instead, the pen as a means for writing becomes the target of my attention, and as such, I become my hand (Sartre 347). Thus, our *non-thetic* bodily awareness is not associated with postulations or propositions (Sartre 353; Williford 207), nor does it exist as a subject in our pre-reflective consciousness; rather, it is a perspective stemming from a positional point of view (Sartre 355).

In sum, Sartre's ontological foundation for conscious awareness provides a conceptual framework which can be considered from an objective point of view. Indeed, existing literature discussing the parallel between Sartre's writings and biological or psychological perspectives suggests an appropriateness for extending to general discussions of human and artificial minds (Chojnacka 21; Legrand 89; Levine 342; Williford 196). The next section aims to further this line of inquiry by appealing to literature from evolutionary biology to explain how the body as a physical system supports phenomenal experiences.

Conscious Awareness for Biological Beings

Some may be wondering about how can we talk about consciousness from a scientific perspective if we do not have a philosophical account for the existence of phenomenal experiences, as suggested by David Chalmers' *hard problem of consciousness* (Chalmers 201). It seems, however, two researchers have found a solution. Together, psychiatrist and neurologist Dr. Todd Feinberg and biologist Dr. Jon Mallatt suggest subjectivity arises from the development of living organisms over millions of years (Feinberg and Mallatt, *The Ancient Origins of Consciousness* 17), as these self-organizing systems produce emergent behaviours which give rise to system-level capacities like pre-reflective consciousness (Feinberg and Mallatt, 'Phenomenal Consciousness and Emergence' 2). Since all living organisms adapt to environmental changes and aim to maintain proper system functioning, evolutionary pressures enabled species to develop various reflex programs as a result of these biological tendencies (Feinberg and Mallatt, *The Ancient Origins of Consciousness* 24). As the nervous systems of complex organisms continued to improve over millions of years, species developed unique physiological solutions to mitigate various challenges as they arise, eventually giving rise to intelligent species like elephants, magpies, and humans. Creatures like worms, jellyfish, and sponges are considered non-conscious because their nervous systems respond automatically to stimuli, forming fixed patterns of responses and behaviours (Feinberg and Mallatt, 'Phenomenal Consciousness and Emergence' 5; Feinberg and Mallatt, *The Ancient Origins of Consciousness* 20). Vertebrates, on the other hand, are phenomenally conscious organisms given their neural complexity, improved sensory organs, and a capacity to store memories (Feinberg and Mallatt, 'Phenomenal Consciousness and Emergence' 5; Feinberg and Mallatt, *The Ancient Origins of Consciousness* 26). Since these capacities are all meant to facilitate an individual's continued survival, their resulting subjective experiences are therefore properties of the body aimed at responding and adapting to environmental changes (Feinberg and Mallatt, 'Phenomenal Consciousness and Emergence' 10; Feinberg and Mallatt, *The Ancient Origins of Consciousness* 222). For example, the pain which arises upon fracturing a bone signals an injury has occurred, motivating individuals to temporarily alter their behaviours to prevent the break from getting worse or failing to heal properly. Therefore, a reply to the *hard problem* suggests phenomenal experiences are an adaptive trait inherent to relatively complex nervous systems, one which facilitates the execution and governance of adaptive behaviours (Feinberg and Mallatt, *The Ancient Origins of Consciousness* 225).

A theoretical explanation for phenomenal experiences has also been postulated by robotics engineer Dr. Pentti Haikonen as part of a discussion on the requirements for creating conscious machines. He suggests qualia arise from percepts produced by sensory mechanisms as physiological systems respond to various aspects of the environment (Haikonen, *Consciousness and Robot Sentience* 13). Because these experiences or *qualia* are generated by sensory organs, their content is a representation of real-world properties from the subject's perspective, appearing distinct from their objective form (Haikonen, 'Qualia and Conscious Machines' 227). The examples Haikonen appeals to are 'blueness' and 'sweetness' to show how from an external point of view, nothing exists to suggest a particular hue or taste exists when inspecting chemical compounds or waves of photons (Haikonen, *Consciousness and Robot Sentience* 14). Rather, it is the act of interpreting certain properties such as wavelengths which then gives rise to qualia. Given the primacy of these sensations, Haikonen suggests qualia are self-explanatory, requiring no further interpretation to determine their meaning or relation to the environment (Haikonen, *Consciousness and Robot Sentience* 14; Haikonen, 'Qualia and Conscious Machines' 232). Unlike symbols, which require further processing or interpretation to be understood, the meaning of qualia are directly apparent to individuals as physical experiences (Haikonen, *Consciousness and Robot Sentience* 20). Haikonen also connects qualia to the *hard problem of consciousness* by stating "to be conscious is to have phenomenal experience with qualia" (Haikonen, *Consciousness and Robot Sentience* 35), where the awareness of subjective experiences arises from the integration of information within and between different neural networks (Haikonen, *Consciousness and Robot Sentience* 39). Overall, it appears Haikonen's account for phenomenal experience is compatible with the research presented by Feinberg and Mallat, suggesting converging ideas from engineering and biology are sufficient for answering the *hard problem*.

That said, it remains to be seen the ways in which this framework is compatible with Sartrean phenomenology. If the body and its nervous system can be characterized by the passing and processing of data through the physical system, then how does this relate to Sartre's framework for the generation of subjective experiences? Now that we have sufficient accounts for the development of subjective experiences, we can begin exploring the conceptual relationships and connections between these distinct perspectives.

Connceting Sartrean Phenomenology to Naturalism

This evolutionary account also seems to provide an approach to the paradox Sartre identifies in the introduction of *Being and Nothingness*. He states that the real problem is not the conclusion which suggests conscious beings are created from non-conscious material, but that they are necessarily "self-activated" (Sartre 12). This paradox arises from the fact that a non-conscious being is able to perpetuate its own existence in this passive or inert fashion, in addition to the fact that this type of being is somehow connected to the production of conscious minds. Sartre states that consciousness is not a passive existence, but an active one which is forced "to produce itself or preserve itself" as it interacts with the environment (Sartre 12). Though an explanation for this paradox may have been mystifying in the mid-20th century, subsequent research and study in *systems theory* has provided us with a fresh perspective on biochemistry and our evolutionary history. Today, we are able to suggest that as a system of sufficient complexity increasingly self-organizes, emergent behaviour is produced from interacting processes and variables at a lower physical level (Feinberg and Mallatt, 'Phenomenal Consciousness and Emergence' 2). Moreover, our growing body of scientific research allows for the cross-disciplinary inquiry required for explaining how biochemical interactions evolved to produce brains with subjectivity (Feinberg and Mallatt, 'The Nature of Primary Consciousness. A New

Synthesis' 121). By looking at existing scientific literature through the lens of systems theory, we can provide an explanation to Sartre's paradox, as self-activation is inherent to living beings.

This concept of "self-activation" can be further identified in the creation of a human mind as systems theory has been applied to child development as well, where theories suggest that novel or emergent behaviours are produced by iterative and experiential learning (Smith and Thelen 343). This theory builds upon the work of child psychologist Jean Piaget, a figure Sartre happens to mention briefly in the introduction of *Being and Nothingness.* Specifically, Sartre mentions Piaget's experiments involving children performing mental addition while not knowing *how* they are arriving at their results (Sartre 9). Sartre uses this example to suggest that knowledge and reflective consciousness are not the foundations of our awareness, and that a pre-reflective consciousness is able to support certain cognitive faculties like simple addition. Piaget's highly influential *stage theory* suggests children tend to pass through periods of development as they organize their knowledge into coherent structures, allowing them to see the world in new ways (Siegler et al. 134). The first stage involves sensorimotor learning, aptly called the *sensorimotor stage*, where infants explore their immediate environment and gain an understanding of the relationship between perceptions and actions (Siegler et al. 135). From around the second year of age to about 7 years old, children become better able to represent their experiences in language and mental imagery, known as the *preoperational stage*. Next, the *concrete operational stage* involves improved reasoning capacities and lasts until around age 12, while the final stage, the *formal operational stage*, is characterized by the ability to think abstractly and hypothetically (Siegler et al. 135). This pattern of development is motivated by a child's intrinsic motivation to learn and apply their knowledge (Siegler et al. 133), suggesting the self-activation Sartre mentions can be interpreted through a lens of developmental psychology in addition to explanations from evolutionary biology. Both instances demonstrate how subjective awareness is an outcome of an iterative, incremental process where emergent properties are generated from the interaction and organization of lower-level properties.

Sartre's discussion of the body as *being-for-itself* is also consistent with the scientific literature on perception and action, and has inspired others to investigate *enactivism* and *embodied cognition* in greater detail (Thompson 408; Wider 385; Wilson and Foglia; Zilio 80). This broad philosophical perspective suggests cognition is dependent on features of the agent's physical body, playing a role in the processing performed by the brain (Wilson and Foglia). Since our awareness tends to surpass our perceptual contents toward acting in response to them (Zilio 80), the body becomes our centre of reference from which the world is experienced (Zilio 79). When Sartre talks about the pen or hammer as an extension of his body, his perspective reflects the way our faculties are able to focus on other aspects of the environment or ourselves as we engage with tools for some purpose. I'd like to suggest that this ability to look past the immediate self can be achieved because we, as subjects, have matured through the *sensorimotor stage* and have learned to control and coordinate aspects of our bodies. The skills we develop as a result of this sensorimotor learning enables the brain to redirect cognitive resources away from controlling the body to focus primarily on performing mental operations. When we write with a pen, we don't often think about how to shape each letter or spell each word because we learned how to do this when we were children, allowing us to focus on *what* we want to say rather than how to communicate it using our body. Thus, the significance of the body for perception and action is further reinforced by evidence from developmental approaches emerging from Piaget's foundational research.

Though beyond the scope of this paper, the next step in connecting Sartrean phenomenology and this naturalized functionalism is identifying the relationship between the evolutionary development of social living and brain functionality. Based on similarities identified between intelligent species, such as long childhoods and social environments (Gopnik 49–50), it can be suggested that cognitive capacities beyond the mere reflexive must be developed with time and experience. Indeed, scientific literature indicates the human brain's frontal lobe is the last area to mature, beginning around puberty and extending throughout adolescence (Choudhury et al. 164; Teffer and Semendeferi 196). While children are around 3 years old when they begin learning language (Mills and Conboy 175), the ability to communicate with others rests on the prior development of other capacities, like imitation and empathy (Tomonaga and Myowa-Yamakoshi 207; Syal and Finlay 422). Additionally, since social situations are highly dynamic and idiosyncratic, a degree of cognitive control is required in order to communicate and cooperate (Nelson and Guyer 234; Zoh et al. 4). Sartre discusses similar ideas when he discusses "being-seen-by-another" (Sartre 281), where one's awareness of others as subjective beings enables a shift in perspective which indicates oneself is an object (Sartre 280). With a full account of Sartre's writings on this relational process between conscious individuals, connections can be established between objective accounts. At first glance, the overlap between theories and perspectives suggests overall, the evolutionary development of social environments introduced a mechanism which facilitated self-awareness. Individuals born into social communities would learn the roles and relations between unique people, including those they were less acquainted with. These settings would have fostered the brain's capacity for meta-awareness, as one realizes the other possess the same internal perspective as they do themselves.

Overall, Sartrean phenomenology is compatible with a naturalized perspective of human consciousness as an emergent capacity. From the first-person perspective, Sartre explains how subjectivity emerges from basic environmental awareness, and is generally consistent with literature on the development of conscious awareness based on scientific literature from evolutionary biology. With these two explanatory perspectives in mind, there is good reason to suspect advanced humanoid robots will someday possess a degree of phenomenal awareness, a consideration which has significant implications for human societies. The next section outlines a potential route for developing sentient machines and argues for the addition of mechanisms which support robot self-expression.

Developing Humanoid Social Robots

Scientific literature from *developmental psychology* has captured the attention of robotics engineers interested in creating social, humanoid robots, given the complexity of behaviours we expect from these machines (Cangelosi and Schlesinger 183). Since human communication involves both formal language and subtle behavioural cues, robots interacting with people are required to both understand the meanings behind certain messages, along with knowing how to respond given contextual factors (Dautenhahn 684). Researchers believe the most effective route to achieving this is by modelling robot learning on human development, creating a branch of systems engineering called *developmental robotics* which focuses on the relationship between the embodiment and cognition involved in learning (Morse and Cangelosi 38). As sensorimotor information contributes to the agent's internal representations of the world, a more robust depiction of its causal source or referent becomes further reinforced (Belpaeme et al. 55; Law et al. 273; Lee 199). Additionally, these robots are provided with innate motivations and capacities, such as a sense of curiosity and a set of reflex-like behaviours similar to those observed in human neonates (Linson et al. 56; Marshall et al. 1; Ortony et al. 194). Currently, developmental robots demonstrate capacities on par with toddler humans, able to understand verbal commands and respond to questions about objects in its environment (Štepánová et al. 784). Although we are in the early stages of producing humanoid robots, it seem a developmental approach is a promising direction for producing socially-aware machines. By modelling robots on human physiology, advanced models are likely to become sufficiently self-aware and able to communicate features of its perceptions or internal states as skillfully as humans (Lee 242; Maldonato and Dell'Orco 17).

Although the goal for social robots involves a degree of reflective self-awareness, existing models demonstrate a degree of pre-reflective consciousness as they learn and interact with aspects of its environment. One model named iCub is capable of learning about objects in its environment by interacting with a human tutor, and through several iterations of exploratory activities, is able to handle and use objects with minimal instruction (Belpaeme et al. 59; Cangelosi and Schlesinger 185). Because iCub is designed to behave like a child, it has a head with eyes and ears, a neck, arms and torso with the necessary joints for mimicking human action, thus allowing it to move itself in response to environmental stimuli, such as being presented with novel objects (Di Nuovo et al. 695; Shaw et al. 126). These humanlike features will likely support phenomenal experiences which are somewhat similar to our own. In particular, embodied senses like kinesthesia, or the perception of the position and movement of one's limbs in space, and the vestibular system with its role in detecting spatial orientation (Wolfe et al. 351). For example, sensations experienced by humans and robots arising from certain activities like tennis or hockey may involved shared elements of subjectivity, as these sports require agents to use their bodies in similar ways. Given that these robots are modelled on human physiology, its phenomenal experiences of these bodily capacities and behaviours will likely possess a degree of similarity to our own.

Without an account from the robot itself, it is difficult to speculate exactly how distinct robot experiences are from our own. If photons and sound waves are processed in ways which produce outputs sufficiently analogous to those produced in people, robot vision and hearing may be perceived in a similar manner. A loud, high-pitched sound from an alarm may redirect a robot's attention to the source of the sound or to the entity it represents, generating subsequent thoughts or behaviours that are also associated with human experiences. If a startle reflex were to be programmed into the robot, it seems feasible this situation may evoke analogous phenomenal experiences to those which arise in humans and other animals under similar circumstances. Although these phenomenal experiences are not likely to be identical to those emerging from animal or human subjectivity, it seems we may be able to relate to a few types of potential robot experiences, and vice versa. On the other hand, just as there will be a number of robot sensations that humans can never know first-hand, there will be plenty of human experiences robots will never know for themselves. Without eukaryotic cells, blood, and hormones, robots will not be able to experience feelings of hunger, love, or pain in the exact way that humans do, as they lack the biological continuity we share with other species. Any certainty of these similarities and differences will ultimately be unknown, however, until we are able to ask robots directly.

To know for certain the similarities and differences between human and robot experiences, researchers will require self-reports. The significance of robot phenomenology, in addition to being philosophically interesting, may be derived from more pragmatic concerns as well, especially those interested in human-robot relations. Just as patients describe their physical ailments to physicians, robots may be able to describe aspects of their functionality from their perspective for the purposes of troubleshooting issues as they arise. Although scientific practices tend to spurn verbal reports and subjective experiences in favour of objective measurements, phenomenological accounts are still useful for situations where we are unable to get a glimpse into internal states or processes. Robot phenomenology may be especially useful for improving human-robot interactions, as these new agents may be difficult for human individuals to relate to or empathize with. Because learning about unfamiliar perspectives requires exposure and positive interactions, further development of social robots should consider ways to foster self-expression and reflexive thinking, such that we can begin to learn about the nature of robotic phenomenal experiences and the ways they differ from biological versions.

Concluding Remarks

Although the notion of robot phenomenology may sound like science fiction today, we have good reason to suspect that certain robots like iCub are, indeed, phenomenally conscious to some degree. This pre-reflective form of awareness is an intentional feature of the agent's functional architecture, similar to instincts or innate capacities in animals. Reflective consciousness, on the other hand, may be an innate trait for individuals but its full capacities require time and experience to emerge. While rudimentary self-recognition may appear in humans early in life, self-awareness in its full capacity takes years to develop, and likely due to a need for plenty of practice and experience. Of course, whether iCub and similar robots develop humanlike levels of self-awareness remains to be seen, however, we have good reason to suspect that this may emerge. As conversational and linguistic skills improve with future research and development, advanced models will likely become able to express their inner feelings and notice their own being as an embodied agent. While their phenomenal experiences will substantially differ from our own, the gulf between forms of subjectivity will remain known until we start to gain a comprehensive understanding of how the world looks from the robot's point of view. Not only will this be crucial for the research and development process, in the form of behavioural troubleshooting, but it will likely be necessary for fostering human-robot relations. In order for robots to adopt certain roles within human societies, a degree of self-awareness or reflexive thinking will be required to convince the public of their suitability and ease of use. Due to the physical differences between humans and robots, citizens may struggle to understanding the inner states or motivations of artificial agents, potentially leading to feelings of frustration. Therefore, we ought to consider the ways in which robot and human experiences differ as they are experienced from the first-person perspective.

Furthermore, the study of robot phenomenology will assist in tailoring or tempering our expectations for future cooperation with these types of self-aware agents. In addition to considering the robot's perspective, humanity must continuously monitor its own actions and perspectives so as not to harm or exploit self-aware robots and cause psychological suffering. Doing so may risk our relationship with these new agents, as their experiences of emotional pain, betrayal, or moral outrage may develop similarly to our own. A social robot versed in cultural norms may become aware of its own position or role in human societies, leading to the generation of behaviours or inclinations we may have difficulty controlling or rectifying at a later point. Additionally, because these machines will be produced by companies and organizations with profit-related interests, it seems likely this incentive will give rise to conflict in the future. If self-aware social robots required regular visits with its family, how will this need be managed by the owners or property rights holders? The clash between these identities will generate a conflict of interests between organizations and the robot as an agent aware of its role or purpose. It's important to remember that the introduction of new minds may have unanticipated consequences on human populations, suggesting our relationship with these new agents is going to be unlike anything humanity has ever experienced before. To develop these relationships, humans will need a robust understanding of robot phenomenology in order to relate these unfamiliar minds.

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