Received: 30 April 2023 | Accepted: 6 October 2023

DOI: 10.1111/phpe.12186

ORIGINAL ARTICLE

PHILOSOPHICAL PERSPECTIVES WILEY

The function of perceptual learning

Zoe Jenkin

Rutgers University

Correspondence
Zoe Jenkins, Department of Philosophy, School of Arts and Sciences Rutgers, The State University of New Jersey, 106 Somerset Street, New Brunswick, NJ 08901-4800.
Email: zoe.jenkin@rutgers.edu

Abstract

Our perceptual systems are not stagnant but can learn from experience. Why is this so? That is, what is the function of perceptual learning? I consider two answers to this question: The Offloading View, which says that the function of perceptual learning is to offload tasks from cognition onto perception, thereby freeing up cognitive resources (Connolly, 2019) and the Perceptual View, which says that the function of perceptual learning is to improve the functioning of perception. I argue that the Perceptual View better explains data from infants and animals, and better accounts for learned tasks that only perception could perform.

1 | INTRODUCTION

A remarkable feature of our perceptual systems is that they can learn. With experience or training, we can learn to see, hear, smell, and taste in new ways. For example, we can learn to hear musical patterns such as chords (Sarasso et al., 2021) or even the styles of different composers (Bufford et al., 2016). We can also learn to see differences between colors that previously appeared the same (Goldstone, 1994, 1995). Why do perceptual systems learn in these ways, rather than remaining stagnant? This is the focal question of this paper.

This question is about the function of perceptual learning. A function is what something is *for*.[1] For example, the function of the stomach is to break down food. Breaking down food is the role the stomach is supposed to play in the digestive system. This function serves the digestive system locally and the organism globally. In philosophy of mind, functions are often theorized in the service of teleological theories of mental content (e.g., Cummins, 1975; Godfrey-Smith, 1994;

Griffiths, 1993; Millikan, 1989b; Neander, 2017; Papineau, 1987; Shea, 2018). Theorizing about functions also help us understand why we have the mental systems and processes we do, and the roles they play in cognition and behavior more broadly.

What is the function of perceptual learning? One initially appealing answer is the Offloading View, which says that the function of perceptual learning is to offload tasks from cognition to perception, thereby freeing up cognitive resources for other tasks (Connolly, 2019). For example, learning to visually perceive configurations of letters as whole words (Baron, 2014; O'Hara, 1980) offloads the cognitive task of inferring which word is present from the shapes of the individual letters. This frees up cognition to spend its resources instead on other tasks such as evaluating the truth of the sentence or formulating one's response. The Offloading View has been most extensively defended in philosophy by Connolly (2019), but also has roots in the work of several psychologists, including Kellman (e.g., Kellman, 2002; Kellman & Garrigan, 2009; Kellman & Massey, 2013) and Goldstone (e.g., Goldstone, de Leeuw, & Landy, 2015).[2] Offloading is not a concept unique to perceptual learning. We offload tasks from memory to external resources when we write down our to-do list or create a calendar reminder.[3]

Connolly argues for the Offloading View by surveying a broad range of examples in which perceptual learning frees up cognitive resources (Connolly, 2019). These examples range from bird watching to sensory substitution devices. I agree that perceptual learning can free up cognitive resources. However, I argue here that offloading tasks from cognition cannot be the function of perceptual learning. Instead, the function of perceptual learning is to directly improve perception's own functioning. I call this the Perceptual View. Offloading, when it occurs, is a convenient bonus, rather than what perceptual learning is for.

In §2, I describe the Offloading View and the Perceptual View in more detail. In §3, I argue that evidence of perceptual learning in infants and nonhuman animals supports the Perceptual View over the Offloading View. In these creatures, cognition is underdeveloped relative to perception, so offloading cognitive tasks is unhelpful at best and impossible at worst. Instead, perceptual learning seems to support the basic functions of the perceptual system. In §4, I argue that the function of perceptual learning in infants and nonhuman animals is continuous with the function of perceptual learning in human adults. In §5, I consider whether the function of perception itself might be to offload resources from cognition, providing an alternative argumentative route to the Offloading View. I argue that this argumentative route fails, because on all plausible views of the function of perception, perception serves to connect us to the environment rather than to offload resources from cognition. The picture we are left with is one on which neither perceptual learning nor perception is subservient to cognition, but instead serve their own independent purposes.

2 | THE OFFLOADING VIEW AND THE PERCEPTUAL VIEW

My target in this section is the Offloading View:

> **Offloading View**: The function of perceptual learning is to offload tasks from cognition onto perception, thereby freeing up cognitive resources (Connolly, 2019, p. 12).

The Offloading View is a view of perceptual learning. Perceptual learning consists in long-term changes to perception that are caused by repeated experience with a stimulus-type over time (Gibson, 1963, p. 29).[4] In broad terms, the Offloading View tells us that the purpose of perceptual learning is to aid cognition. On this view, while perceptual learning occurs within perceptual systems, it is not primarily a tool of perception but one of cognition.

The Offloading View also specifies the way in which perceptual learning aids cognition: by offloading tasks that cognition would normally perform onto perceptual systems. This is advantageous because our cognitive resources (e.g., attention and working memory) are limited. When tasks are offloaded from cognition, more cognitive resources become available for other tasks. This allows us to accomplish more tasks in total and increases cognitive efficiency.[5]

The Offloading View contrasts with the Perceptual View:

> **Perceptual View**: The function of perceptual learning is to improve the functioning of perception.

The Perceptual View says that perceptual learning is for perception, not cognition. The Perceptual View is compatible with the idea that perceptual learning aids cognition in some respects, e.g., by allowing perception to deliver more detailed information than it otherwise would have. But it is not compatible with the Offloading View unless the function of perception itself is to offload tasks from cognition. I address this possibility in §5.

How should we adjudicate between these views of the function of perceptual learning? A standard way of determining something's function is to observe what it is doing when it seems to be functioning well.[6] In the case of perceptual learning, this involves surveying a range of cases of successful perceptual learning. In the spectrum of cases of successful perceptual learning, is this learning offloading tasks from cognition or improving the functioning of perception?

In certain paradigm examples of perceptual learning, perception does offload tasks from cognition onto perception. Connolly and Kellman and Massey both describe a focal example of telegraphers who start out hearing Morse code clicks as individual letters and gradually learn to perceive whole words, and then whole phrases (Connolly, 2019, p. 33–35; Kellman & Massey 2013, p. 124, from Bryan & Harter, 1899). Here, perceptual learning seems to be offloading the task of deciphering words and phrases from cognition onto perception, thereby freeing up the telegraphers' cognitive resources to attend to the meaning of the message. Other examples of perceptual learning that offload tasks include learning to see algebraic structures (Kellman, Massey, & Son, 2009; Kellman & Massey, 2013), and categorical perception for categories such as colors, birds, and vocal consonants (Goldstone, de Leeuw, & Landy, 2015).

However, these examples are also compatible with the Perceptual View. Focusing on the example of telegraphers, when they learn to perceive whole phrases, this learning also improves the functioning of their perceptual systems, in this case their auditory systems. It increases the range of what telegraphers can auditorily discriminate from only letters to letters, words, and phrases. It allows audition to deliver information more efficiently than it did before, because it no longer needs to sequentially process each individual letter. The telegraphers' perceptual learning also expands their ability to accurately represent their environment, enabling auditory representations of words and phrases. I reserve discussion of what exactly the function of perception is for §5, but it plausibly involves just these kinds of activities: discrimination of sensory particulars (e.g., Schellenberg, 2018), acquiring information about the environment (e.g., Block, 2023; Dretske, 1981, 1995), and/or accurately representing the environment (e.g., Palmer, 1999; Burge, 2010; Graham, 2014).

3 | EVIDENCE FROM INFANTS AND ANIMALS

Given that both the Offloading View and the Perceptual View are compatible with telegrapher-type cases, we should turn to other types of perceptual learning to determine which of these views is ultimately correct. A view of the function of perceptual learning must tell us what perceptual learning in general is for, so attention to a broad spectrum of cases is warranted. Such broad attention can help us determine what is truly the function of perception and what is merely a common consequence. In the rest of this section, I argue that forms of perceptual learning in infants and nonhuman animals tell against the Offloading View and in favor of the Perceptual View.

In human infants, cognition is radically underdeveloped compared to perception. Almost immediately after birth, infants can see, smell, hear, taste, and touch. While perceptual maturation does take time, it occurs far more rapidly than cognitive maturation. For example, by six months of age infants have developed color vision (Skelton, Maule, & Franklin, 2022), stereopsis (Birch, 1993, Levi, 2022), and visual acuity close to that of an adult (Sokol, 1978; Daw, 2006). Yet children struggle to perform even the simplest deductive syllogisms at three years old (Mody & Carey, 2016).[7] Infants and children also perform poorly at simple problem-solving tasks through at least age three, due their limited executive functioning (Zelazo & Frye, 1998; Moriguchi, 2014). Infants' capacities for attention (Reynolds & Romano, 2016) and short and long-term memory are also highly limited (Rose, Feldman, & Jankowski, 2001; Káldy & Leslie, 2005; Ross-sheey, S., Oakes, L. M. & Luck, S. J., 2003). All of this is to say that in infancy, cognition is relatively undeveloped, especially in comparison to perception. Infants rely on perception as their predominant psychological system, especially in the first year of life,

Perceptual learning occurs during this developmental stage, preceding the maturation and expansion of cognitive capacities like attention, memory, and reasoning. For example, 3.5-month-old infants can learn to perceive configural information about faces during a laboratory training period (Galati, Hock, & Bhatt, 2016). In this experiment, infants were first tested on their ability to detect changes in the configural dimensions of faces—that is, the spacing between facial features. At initial test, infants were unable to discriminate configural changes. The infants were then primed with a series of faces that vary along configural dimensions. The infants were then re-tested and showed remarkable improvement in detecting configural changes. Because this study was done in a laboratory with a particular training procedure that was run over a short period of time, we can conclude that it reflects true learning rather than mere maturation.

This experiment presents a challenge to the Offloading View. The infants in this experiment are 3.5 months old, which is well within the developmental stage in which perception dominates cognition, so it does not make sense to say that this perceptual learning is functioning to free up cognitive resources. These infants cannot yet perform the most basic of cognitive tasks such as deductive syllogism (Mody & Carey, 2016; Cesana-Arlotti et al. 2018) or holding multiple items in working memory (Káldy & Leslie, 2005; Kibbe, 2015; Cowan, 2016). These infants do not need further cognitive resources to guide their actions, because their limited cognitive resources are not particularly useful to them, and their cognitive architecture is such that they do not rely on cognition much in the first place.

In contrast, the Perceptual View makes good sense of the function of perceptual learning in young infants. Here, perceptual learning functions to improve perception's own functioning, specifically its capacity for identifying faces. Infants use face perception to guide their actions (e.g., gaze-direction, reaching, imitation, crying), so this improvement in perceptual function will in turn help better direct those actions. Improving perception's function is directly useful to infants, unlike offloading cognitive resources.

One might wonder, though, whether this example of 3-5-month-old infants learning to perceive configural information is unique. If there is only one such type of process in which perceptual learning does not offload cognitive resources, we might hold onto the Offloading View and explain away the exception. However, the case of learning configural facial perception is far from unique. Perceptual learning occurs widely in infancy. In the domain of faces, experience also influences which species and races of faces infants are sensitive to. Six to nine-month-old infants who have been regularly exposed to monkey faces can recognize and discriminate between them, whereas infants who lack such experience cannot (Pascalis et al., 2005; Scott & Monesson, 2009).[8] Similarly, infants as young as six months experience the cross-race effect, which is the relative ease of recognizing faces of members of their own racial group (Hsu & Chien, 2011; Wheeler et al., 2011; Chien, Wang, & Huang, 2016). While the general capacity for face perception may be innate, an individual's particular sensitivities to certain types of faces and facial features depend on experience.

Beyond faces, infants can learn to recognize and discriminate rhythms (Bahrick & Lickliter, 2000), segment sound streams into words (Saffran, Aslin, & Newport, 1996), visually complete objects (Johnson, 2004), to organize visual patterns (Bhatt & Quinn, 2011), represent angular relations (Slater et al., 1991), and individuate and categorize objects (Wilcox & Chapa, 2004; Needham, Dueker, & Lockhead, 2005; Wilcox & Woods, 2009).[9] One particularly interesting case of infant perceptual learning involves subtle differences in phonemes. Infants start out with broad abilities to discriminate phonemes, but these abilities typically narrow to the range of phonemes used in their native language by the time they reach one year old (Werker, 1989; Kuhl et al., 1992; Cheour et al., 1998). However, infants who are exposed to a nonnative language (Kuhl et al., 1992) or who are raised in a bilingual environment (Burns et al., 2007) retain their abilities to discriminate phonemes across languages.[10] Again, for these infants perceptual learning does not seem to be functioning to free up cognitive resources. Infants are unable to engage in cognitive tasks like reasoning about the meanings of strings of phonemes or considering how to respond, because they do not yet have these cognitive abilities. Instead, perceptual learning seems to be improving the functioning of perception by increasing the accuracy and range of phoneme processing.

A similar point can be made with respect to perceptual learning in nonhuman animals. Perception is phylogenetically prior to cognition. This means that many nonhuman animals, such as insects and fish either lack cognition entirely or have cognitive systems that are underdeveloped relative to their perceptual capacities. Even if these creatures do have some minimal cognitive capacities, they pale in comparison to their perceptual capacities. These nonhuman animals rely primarily on perception, and so have no need to offload cognitive resources.

Yet there is ample evidence that such nonhuman animals undergo perceptual learning. Guppies can learn color and shape discrimination (Lucon-Xiccato, Manabe, & Bisazza, 2018). Homing pigeons and bees can learn to represent the direction of the sun by gradually combining information from their circadian clocks and the position of the sun relative to the horizon (Gallistel, 1990). Zebra finches can learn to recognize songs of their conspecifics (Gallistel et al., 1991). Pigeons and mice can learn to visually discriminate artistic styles (Watanabe, 2011, 2013). Dogs can learn to smell low blood sugar (Rooney et al., 2019). Rats can learn to discriminate novel flavors (Symonds & Hall, 1995; Blair & Hall, 2003). These examples reflect just a small sampling of the literature on animal perceptual learning.[11]

The animals in the above studies rely primarily on perception to guide their actions and navigate their environments. If they have cognitive systems at all, they are far less developed than their perceptual systems. It would not make sense for perceptual learning in these creatures to function to free up resources for cognition, as the Offloading View states, given that cognition plays a relatively minor role in their psychology. The Offloading View makes the most sense for adult humans, who regularly engage in sophisticated reasoning processes, and hence need all the cognitive resources they can get. But perceptual learning is much more widespread than just adult humans. It occurs in minds that are very unlike ours, especially with respect to their degree of reliance on cognition. The Perceptual View makes good sense of the function of perceptual learning across human and nonhuman animals of all ages.

4 | DIFFERENT FUNCTIONS?

At this point, a proponent of the Offloading View might object that perceptual learning may have a different function in infants and nonhuman animals than it does in adult humans. The psychological evidence I have used to argue against the Offloading View and in favor of the Perceptual View involves infants, honeybees, guppies, pigeons, and rats. One might think that even if such evidence shows that the Perceptual View is correct about these creatures, it does not show that the Perceptual View is correct about adult humans.

In reply, there is good reason to want our theory of the function of perceptual learning to be unified across the animal kingdom and across developmental stages. Perceptual learning in infants and animals shares many of the same signatures as perceptual learning in adults. For example, adults can increase their perceptual sensitivity to facial configural information (e.g., Carey & Diamond, 1994; Carey, De Schoen, & Ellis, 1992; Maurer et al., 2002; McKone & Robbins, 2011; Mondloch & Thomason, 2008)[12] and subtle distinctions in phonemes (e.g., Lively, Logan, & Pisoni, 1993; Bradlow et al., 1999; Norris, McQueen, & Cutler, 2003) just as infants can. Adults and infants not only share the ability to learn to better recognize and discriminate faces and phonemes, but they acquire this ability in the same way: through repeated exposure to stimuli that vary along configural and acoustic dimensions. Adults and infants also use these learned abilities in similar ways. They both use facial configural representations to determine how to interact with the people around them, and they both use phonemic representations to extract meaning (or begin to extract meaning, in the case of infants) from sound streams.

There are also robust continuities across human and nonhuman animal perceptual learning. Like guppies, human adults can learn to better discriminate colors (Goldstone, 1994, 1995). Like Zebra finches, we can learn to recognize and categorize music (Burns & Ward, 1978; Szpunar, Schellenberg, & Plino, 2004; Sarasso et al., 2021). Like pigeons and mice, we can learn to discriminate artistic styles (Rush & Sabers, 1981; Hess & Wallsten, 1987). Like rats, we can learn to discriminate flavors (Mundy, Dwyer, & Honey, 2006; Ishii et al., 2007). While there may be some forms of perceptual learning that only certain species can achieve (e.g., perhaps only creatures with sufficiently sensitive olfactory systems, such as dogs, can smell low blood sugar), but for the most part animal perceptual learning is continuous with human perceptual learning.[13]

One might further press the worry that perceptual learning in adults has a different function from perceptual learning in infants and animals by typing functions of perceptual learning according to consciousness. We can know from subjective reports that adult human perceptual learning is often driven by their conscious experiences and results in changes to their conscious experiences, but we have no such evidence for infants and animals. This leaves open the possibility that perceptual learning in infants and animals only involves unconscious perception and not conscious experience, and hence is of a different type.[14]

A first reply is that even in adults, perceptual learning can both be caused by unconscious perception and lead to changes in unconscious perception.[15] For example, in a study by Carmel and Carassco, subjects underwent training sessions in which images of textures were presented but suppressed from awareness using continuous flash suppression (Carmel & Carassco, 2013). Subjects nonetheless improved their texture discrimination when tested after training. Other examples of unconscious perceptual learning in adults include visual discrimination of orientation (Seitz, Kim, & Watanabe, 2009) and motion (Watanabe, Náñez, & Sasaki, 2001).

A second reply is that there is also good reason to think that much perceptual learning in infants is conscious. The typical measure for infant visual discrimination is looking time. Infants look longer when they notice something new. For example, once infants have learned to process configural information, they look longer when an image of a face appears that has all the same features as the previous face, but different spacing (Galati, Hock, & Bhatt, 2016). The most natural explanation of this kind of looking pattern is that the infant is having a different visual experience. Insofar as we want to say that infants' looking generally involves conscious visual experience, we should also want to say that this kind of perceptual learning experiment also involves conscious visual experience.

The case of nonhuman animals is more complex due to the unsettled nature of debates over animal consciousness generally.[16] The kinds of experiments done to measure animal perceptual learning do not provide a particular difficulty in determining if an animal is having a conscious experience, beyond this broad debate. Such experiments typically involve animals engaged in perceptual activities like attentively looking and listening that would lead to conscious experiences if the animal has consciousness at all. A defense of animal consciousness is beyond the scope of this paper, so if the reader denies that there is anything it is like to be a bird or a fish, then they should focus on reply one above and reply three below.

A third reply to the worry that conscious and unconscious perceptual learning have different functions is that consciousness does not seem to capture a deep distinction between types of perceptual learning. In both cases, perceptual learning is driven by repeated exposure to a stimulus type, and in both cases perceptual learning results in changes to the operation of the perceptual system. Furthermore, the presence or absence of consciousness does not seem to alter the purpose of perceptual learning, which is what the function of perceptual learning should aim capture. If there were deeply different signatures, constraints, and impacts between conscious and unconscious perceptual learning then we might have reason to posit that they have different functions, but in fact conscious and unconscious perceptual learning seem to have all these features in common.

Given the ontogenetic and phylogenetic continuities in perceptual learning, our theorizing about its function should not be confined to a single species or developmental stage. Instead, an account of the function of perceptual learning should apply to the broad (but unified) spectrum of types of perceptual learning. The view that accounts of function should apply across the animal kingdom and development is shared by many proponents of teleosemantics and theorists of function more generally (e.g., Millikan, 1989a; Stegmann, 2009; Godfrey-Smith, 2016; Block, 2023).

There is also evidence for the Perceptual View and against the Offloading View that comes directly from adults. The tasks that adult perceptual learning accomplishes are very often not the kind of tasks that cognition could even accomplish in principle. For example, perceptual learning enables fine-grained color-discrimination (Goldstone, 1994). Absent perceptual learning, we are simply unable to discriminate colors to such a precise degree. We cannot look at two color swatches and use cognition to reason out whether they are the same or different. In color discrimination, it seems that there are no cognitive resources to offload, because the task simply cannot be accomplished without perceptual learning. The same goes for other forms of perceptual learning, such as flavor discrimination (Ishii et al., 2007) and perfect pitch (Wong et al., 2020). Much of perceptual learning consists of tasks that perception is uniquely qualified to perform, indicating that perceptual learning's function cannot be to free up resources that would otherwise be used by cognition, as on the Offloading View.[17] In contrast, the Perceptual View fits well with the task-specificity of many forms of perceptual learning. Very often perception itself performs tasks that cognition could not perform, such as extracting information from the environment, as part of its basic functioning. When perceptual learning targets such tasks, it functions to improve the functioning of perception.

Taken together, evidence from infant, adult, and nonhuman animal perceptual learning supports the Perceptual View of Perceptual learning, according to which the function of perceptual learning is to improve the functioning of perception. The Perceptual View also fits with a broader picture of the function of learning, according to which in general, learning in a given domain functions to improve the functioning of that domain. For example, social learning may function to improve the functioning of our social skills (e.g., cooperation or shared understanding) and language learning may function to improve the functioning of our language faculties (e.g., expression or communication). I do not aim to argue here for claims about any functions beyond that of perceptual learning, but it is worthwhile to note that the Perceptual View is generalizable.

5 | THE FUNCTION OF PERCEPTION

I have argued so far for the Perceptual View of the function of perceptual learning, according to which the function of perceptual learning is to improve the functioning of perception itself, whatever its function may be. In this section, I consider an alternative argumentative route to the Offloading View that is compatible with the Perceptual View: if the function of perceptual learning is to improve the functioning of perception, and if the function of perception itself is to offload resources from cognition, then the ultimate (albeit indirect) function of perceptual learning is to offload resources from cognition. Could both the Offloading View and the Perceptual View be correct? The answer to this question turns on the function of perception. I will argue that the function of perception is not to offload resources from cognition, so this alternative argumentative route to the Offloading View fails.

In theorizing about the function of perception, we are asking what perception is for. That is, what role is perception supposed to play for an organism? On nearly all views of the function of perception, its function differs from that of cognition. While cognition manipulates information through reasoning and planning, perception connects us to our environment. For example, Block argues that perception functions to deliver news—that is, to tell us about what is happening here and now (Block, 2023).[18] Relatedly, Dretske argues that the function of perception is to provide us with information about the environment (Dretske, 1981, 1995). Sometimes perception's connection to the environment is put in terms of representation rather than information, e.g., in the claim that the function of perception is to produce accurate representations of the world (Palmer, 1999; Burge, 2010; Graham, 2014).[19] Schellenberg also emphasizes perception's connection to the environment in her view that perception functions to discriminate and single out environmental particulars (Schellenberg, 2018).

Rather than arguing that one of these views of the function of perception is correct, I want to point out what they all have in common. On all these views, perception serves as a bridge between the environment and cognition, by either providing information, accurately representing, or discriminating and singling out particulars. On all these views, there is also a weak sense in which perception serves cognition, by providing cognition with information, representations, or particulars for use in reasoning, decision-making, and planning. But on none of these views does perception serve to offload resources from cognition. Accurate perception can enable better cognitive functioning, but it does not decrease cognition's load. Cognition cannot directly connect us to the environment by its very nature, so without perception it would be left in ignorance rather than left expending additional resources.

This point becomes more vivid when we consider some of the specific tasks that perception performs. For example, vision includes a dedicated system for facial recognition that operates rapidly, automatically, and accurately (Kanwisher, McDermott, & Chun, 1997). If we attempted to recognize faces using only cognition, we would fail miserably. While we might form cognitive representations of the locations, dimensions, colors, and textures of individual facial features (in response to those individual perceptual representations), we could not cognitively combine these representations to achieve anything like perception's facial recognition accuracy. Cognition is also unable to perform simpler perceptual tasks such as detecting the immediate danger of a hot stove or sensing one's balance. When perception performs these proprietarily perceptual tasks, it cannot be functioning to offload cognitive resources.

Evidence from infants and animals further supports the claim that the function of perception is not to offload cognitive resources. In §2, I argued that in infants under one year old, perception is more mature than cognition and is their primary mode of interaction with the world. Just as infants have no need to offload resources from cognition through perceptual learning, they have no need to offload resources from cognition through perception. The same holds of nonhuman animals. The perceptual system of a fish or insect who lacks cognition cannot function to offload resources from cognition because the fish has or little cognition in the first place. If we want to hold onto the idea that the function of human perception is continuous with the function of perception in our evolutionary ancestors, it is implausible that perception's function is to offload resources from cognition.

The above considerations together support the idea that perception has its own distinct function grounded in its connection to the environment, rather than the function of offloading cognitive resources. This picture fits well with the epistemic role of perception. Perception allows us to check the outputs of cognition against the outputs of a system with an independent function. Fodor captures this idea when he writes, "The *point* of perception, surely, is that it lets us find out how the world is, even when the world is some way we don't expect it to be" (Fodor, 1983, p. 69). Perception's epistemic function, in some cases, is precisely to contradict cognition. If perception functioned to merely offload resources from cognition, it could not help us achieve this epistemic aim.

If the above arguments are correct that the function of perception is not to offload resources from cognition, the alternative argumentative route to the Offloading View falls through. Perceptual learning functions to improve the function of perception, where the function of perception is not offloading, but roughly to connect an individual to her environment.

6 | CONCLUSION

The Perceptual View of perceptual learning that I have argued for here is in some ways simpler than the Offloading View. According to the Perceptual View, perceptual learning functions to improve perception. This is what we might have expected pretheoretically: learning in a domain functions to improve that domain. Yet the Offloading View seemed appealing because it tells a story about how perception serves cognition. Cognition is often taken to have a kind of primacy in the mind. Cognition feels the most like "us," and looms largest in our image of the mind. Other systems like perception, language, and emotion are understood as secondary to cognition, and perhaps even designed to suit its needs. While an assessment of this picture is a task far beyond the scope of this paper, my defense of the Perceptual View here begins to chip away it. Perception and perceptual learning are not mere handmaidens of cognition but have their own independent functions.

ENDNOTES

[1] For further discussion of the notion of a function, see, Burge (2010), Cummins (1975), Millikan (1989b), Neander (2017), Papineau (1987), Rubner (2022), Schellenberg (2018), Shea (2018), and Wright (1973).

[2] These citations are drawn from Connolly (2019).

[3] For psychological research on cognitive and memory offloading more generally, see, e.g., Dunn & Risko (2016), Risko & Gilbert (2016), and Morrison & Richmond (2020).

[4] For additional discussion of the definition of perceptual learning, see Connolly (2017, 2019), Chudnoff (2020), Goldstone (1998), Goldstone & Byrge (2015), Jenkin (forthcoming a, forthcoming b), Kellman & Massey (2013), O'Callaghan (2022), Prettyman (2018), and Watanabe & Sasaki (2015).

[5] For discussion of what it means to free up resources and offload tasks, see O'Callaghan (2022).

[6] According to etiological theories of function (e.g., Millikan, 1989b; Neander, 2017), something's function is what it was selected for by natural selection. I take my methodology here to be compatible with etiological theories. By observing what a system is doing when it is functioning well, we are also typically observing the properties for which a system was selected.

[7] In certain circumstances, infants as young as 12 months old do display early signs of logical reasoning (Cesana-Arlotti et al., 2018). However, these early reasoning abilities are difficult to elicit because of infants' limitations on attention and working memory.

[8] These citations are drawn from Spelke (2022). See her chapter 8 for further discussion.

[9] For overviews of research on perceptual learning in infancy, see Bhatt and Quinn (2011) and Goldstone, Son, and Byrge (2011).

[10] While in this case a perceptual capacity is maintained rather than newly formed, it is nonetheless an example of perceptual learning. In keeping with Gibson's definition of perceptual learning (Gibson, 1963), repeated experience with a stimulus-type over time (in this case auditory experience of certain phonemes) leads to long-term changes in perception. In this case, the change is relative to what perception would be like absent the experience.

[11] For overviews of research on animal perceptual learning, see Mackintosh & Bennett (1998), Fisher (2009), and Hall (2009).

[12] These citations are drawn from Galati, Hock, & Bhatt (2016).

[13] These examples of perceptual learning in animals also undermines the argument that the Offloading View can make sense of infant perceptual learning by saying that it offloads resources from future adult cognition. Not only does this argument fail to make good sense of why infants engage in perceptual learning prior to the development of sophisticated cognition, but it also fails from the start with respect to animals who will never go on to develop sophisticated cognition.

[14] I thank Kevin Connolly for raising a version of this worry to me in conversation.

[15] Connolly allows that the changes to perceptual processing in perceptual learning are often conscious (Connolly, 2019, p. 74), but he does not state whether he thinks there is perceptual learning that involves no conscious experience.

[16] See Allen & Trestman (2023) for an overview of debates about animal consciousness.

[17] The differences in the kinds of tasks that perceptual learning and cognition perform raises the question of what exactly is offloaded according to the Offloading View. For discussion of this question, see O'Callaghan (2022).

[18] For a discussion and critique of Block's view, as well as a useful overview of views of the function of perception, see Phillips & Firestone (forthcoming).

[19] According to Burge, producing accurate representations is the representational function of perception (Burge, 2010, p. 313). He differentiates the representational function of perception from the practical function of perception, which is enabling engagement with the environment (Burge, 2010, p. 381). For Palmer and Graham, producing accurate representations is the biological function of perception. I treat biological and representational function together here in the service of my overall point that none of these functions is a version of offloading resources from cognition.

REFERENCES

Allen, C. & Trestman, M. (2023). Animal Consciousness. In E. N. Zalta & U. Nodelman (Eds.), *The Stanford Encyclopedia of Philosophy* (Summer 2023 Edition), forthcoming https://plato.stanford.edu/archives/sum2023/entries/consciousness-animal/.

Bahrick, L. E. & Lickliter, R. (2000). Intersensory redundancy guides attentional selectivity and perceptual learning in infancy. *Developmental Psychology*, 36(2), 190–201. https://doi.org/10.1037/0012-1649.36.2.190

Baron, J. (2014). The word-superiority effect: Perceptual learning from reading. In W. Estes (Ed.), *Handbook of Learning and Cognitive Processes, Vol. 6: Linguistic Functions in Cognitive Theory*. Hove: Psychology Press, 131–166.

Bhatt R. S., & Quinn, P. C. (2011). How does learning impact development in infancy? The case of perceptual organization. *Infancy*, 16(1), 2–38. https://doi.org/10.1111/j.1532-7078.2010.00048.x

Birch, E. E. (1993). Stereopsis in infants and its developmental relation to visual acuity. In K. Simons (Ed.), *Early visual development, normal and abnormal*. New York: Oxford University Press, 224–236.

Blair, C. A., Hall, G. (2003). Perceptual learning in flavor aversion: evidence for learned changes in stimulus effectiveness. *Journal of Experimental Psychology: Animal Behavior Processes*, 29(1), 39–48. https://doi.org/10.1037//0097-7403.29.1.39

Block, N. (2023). *The Border Between Seeing and Thinking*. New York: Oxford University Press.

Bradlow, A.R., Akahane-Yamada, R., Pisoni, D. B., & Tohkura, Y. (1999). Training Japanese listeners to identify English /r/and /l/: Long-term retention of learning in perception and production. *Perception & Psychophysics*, 61(5), 977–985. https://doi.org/10.3758/BF03206911

Bryan, W. L., & Harter, N. (1899). Studies on the telegraphic language: The acquisition of a hierarchy of habits. *Psychological Review*, 6(4), 345–375.

Bufford, C. A., Khanh-Phuong T., Ho, J., Xiong, C., Hines, C. A., Kellman, P. J. (2016). Perceptual learning of abstract musical patterns: recognizing composer style. *Proceedings of the 14th annual international conference for music perception and cognition*, 8–12.

Burge, T. (2010). *Origins of Objectivity*. Oxford: Oxford University Press.

Burns, E. M. & Ward, W. D. (1978). Categorical perception—phenomenon or epiphenomenon: evidence from experiments in the perception of melodic musical intervals. *Journal of the Acoustic Society of America*, 63, 456–468. https://doi.org/10.1121/1.381737

Burns, T., Yoshida, K., Hill, K., & Werker, J. (2007). The development of phonetic representation in bilingual and monolingual infants. *Applied Psycholinguistics*, 28(3), 455–474. https://doi.org/10.1017/S0142716407070257

Carey, S., De Schonen, S., & Ellis, H. D. (1992). Becoming a face expert. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 335, 95–103. https://doi.org/10.1098/rstb.1992.0012

Carey, S., & Diamond, R. (1994). Are faces perceived as configurations more by adults than by children? *Visual Cognition*, 1, 253–274. https://doi.org/10.1080/13506289408402302

Carmel, D., & Carrasco, M. (2013). Attention and specificity in unconscious perceptual learning. *I- Perception*, 4(7), 481–481. https://doi.org/10.1068/ig5

Cesana-Arlotti, N., Martín, A., Téglás, E., Vorobyova, L., Cernarski, R., & Bonatti, L. L. (2018). Precursors of logical reasoning in preverbal human infants. *Science*, 359 (6381), 1263–1266.

Cheour, M., Ceponiene, R., Lehtokoski, A., Luuk, A., Allik, J., Ahlo, K., & Näätänen. (1998). Development of language-specific phoneme representations in the infant brain. *Nature Neuroscience*, 1, 351–353. https://doi.org/10.1038/1561

Chien, S. H. L., Wang, J. F., & Huang, T. R. (2016). Developing the own-race advantage in 4-, 6-, and 9-month-old Taiwanese infants: A perceptual learning perspective. *Frontiers in Psychology*, 7, 1606. https://doi.org/10.3389/fpsyg.2016.01606

Chudnoff, E. (2020). *Forming impressions: Expertise in perception and intuition*. Oxford: Oxford University Press.
Connolly, K. (2017). Perceptual learning. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Summer 2017 Edition) https://plato.stanford.edu/archives/sum2017/entries/perceptual-learning/
Connolly, K. (2019). *Perceptual learning: The flexibility of the senses*. New York: Oxford University Press.
Cowan, N. (2016). Working memory maturation: Can we get to at the essence of cognitive growth? *Perspectives on Psychological Science*, 11(2), 239–264. https://doi.org/10.1177/1745691615621279
Cummins, R. (1975). Functional analysis. *Journal of Philosophy*, 72, 741–765.
Daw, N. (2006). *Visual Development* (2nd edition). New York: Springer.
Dretske, F. (1981). *Knowledge and the Flow of Information*. Stanford, CA: MIT Press.
Dretske, F. (1995). *Naturalizing the Mind*. Cambridge, MA: MIT Press.
Dunn, T. L. & Risko, E. F. (2016). Toward a metacognitive account of cognitive offloading. *Cognitive Science*, 40, 1080–1127. doi: 10.111/cogs.12273
Fisher, J. (2009). Perceptual learning and representational learning in humans and animals. *Learning & Behavior*, 37, 141–153. https://doi.org/10.3758/LB.37.2.141
Fodor, J. (1983). *The Modularity of Mind*. Cambridge, MA: MIT Press.
Galati, A., Hock, A., & Bhatt, R. S. (2016). Perceptual learning and face processing in infancy. *Developmental Psychobiology*, 58(7), 829–840.
Gallistel, C. R. (1990). *The Organization of Learning*. Cambridge, MA: MIT Press.
Gallistel, C. R., Brown, A., Care, S., Gelman, R., & Keil, F. (1991). Lessons from animal learning for the study of cognitive development. In S. Carey & R. Gelman (Eds.). *The Epigenesis of Mind: Essays in Biology and Cognition*. Hillsdale, NJ: Erlbaum, 3–39.
Gibson, E. J. (1963). Perceptual learning. *The Annual Review of Psychology*, 14, 29–56. https://doi.org/10.1146/annurev.ps.14.020163.000333
Godfrey-Smith, P. (1994). A modern history theory of functions. *Noûs*, 28(3), 344–362.
Godfrey-Smith, P. (2016). *Other Minds: The Octopus, the Sea, and the Deep Origins of Consciousness*. New York: Farrar, Straus, and Giroux.
Goldstone, R. (1994). Influence of categorization on perceptual discrimination. *Journal of Experimental Psychology: General*, 123(2), 178–200.
Goldstone, R. (1995). The effect of categorization on color perception. *Psychological Science*, 6, 298–304. https://doi.org/10.1111/j.1467-9280.1995.tb00514.x
Goldstone, R. L. (1998). Perceptual learning. *Annual Review of Psychology*, 49, 585–612. https://doi.org/10.1146/annurev.psych.49.1.585
Goldstone, R. L. & Byrge, L. A. (2015). Perceptual learning. In M. Matthen (Ed.), *The Oxford Handbook of Philosophy of Perception*. Oxford: Oxford University Press.
Goldstone, R., de Leeuw, J. R., & Landy, D. H. (2015). Fitting perception in and to cognition. *Cognition*, 135, 24–29. https://doi.org/10.1016/j.cognition.2014.11.027
Goldstone, R., Son, J. Y., & Byrge, L. (2011). Perceptual learning in infancy. *Infancy*, 16(1), 45–51. https://doi.org/10.1111/j.1532-7078.2010.00054.x
Graham, P.J. (2014). The function of perception. In Fairweather, A. (ed.), *Virtue Scientia: Bridges between Virtue Epistemology and Philosophy of Science*. Dordrecht, Netherlands: Synthese Library, 12–31.
Griffiths, P. (1993) Functional analysis and proper functions. *British Journal for the Philosophy of Science*, 44, 409–422.
Hall, G. H. (2009). Perceptual learning in human and nonhuman animals: A search for common ground. *Learning & Behavior*, 37(2), 133–140. https://doi.org/10.3758/LB.37.2.133
Hess, T. M., & Wallsten, S. M. (1987). Adult age differences in the perception and learning of artistic style categories. *Psychology and Aging*, 2(3), 243–253. https://doi.org/10.1037/0882-7974.2.3.243
Hsu, H. Y., & Chien, S. H. L. (2011). Exploring the other-race effect in Taiwanese infants and adults. *Chinese Journal of Psychology*, 53, 35–57.
Ishii, R., Kawaguchi, H., O'Malley, M., & Rousseau, B. (2007). Relating consumer and trained panels' discriminative sensitivities using vanilla flavored ice cream as a medium. *Food Quality and Preference*, 18, 86–96. https://doi.org/10.1016/j.foodqual.2005.08.004
Jenkin, Z. (forthcoming). Perceptual learning. *Philosophy Compass*.
Jenkin, Z. (forthcoming). Perceptual learning and reason-responsiveness. *Noûs*. https://doi.org/10.1111/nous.12425

Johnson S. P. (2004). Development of perceptual completion in infancy. *Psychological Science*, 15(11), 769-775. https://doi.org/10.1111/j.0956-7976.2004.00754.x

Káldy Z., Leslie A. M. (2005). A memory span of one? Object identification in 6.5-month-old infants. *Cognition* 97, 153–177. https://doi.org/10.1016/j.cognition.2004.09.009

Kanwisher, N., McDermott, J., & Chun, M. M. (1997). The fusiform face area: a module in human extrastriate cortex specialized for face perception. *The Journal of Neuroscience: The Official Journal of the Society for Neuroscience*, 17(11), 4302–4311.

Kellman, P. J. (2002). Perceptual learning. In H. Pashler & C.R. Gallistel (eds.), *Stevens' handbook of experimental psychology: Learning, motivation, and emotion* (Vol. 3, 3rd ed.). New York, NY: John Wiley & Sons, 259–299.

Kellman, P. J., & Garrigan, P. B. (2009). Perceptual learning and human expertise. *Physics of Life Reviews*, 6(2), 53–84.

Kellman, P. J., Massey, C. M., & Son, J. (2009). Perceptual learning modules in mathematics: enhancing students' pattern recognition, structure extraction, and fluency. *Topics in Cognitive Science (Special Issue on Perceptual Learning)*, 2(2), 285–305. https://doi.org/10.1111/j.1756-8765.2009.01053.x

Kellman, P. J. & Massey, C. M. (2013). Perceptual learning, cognition, and expertise. In B. H. Ross (ed.), *The psychology of learning and motivation* (Vol. 58). Amsterdam: Elsevier Inc, 117–165.

Kibbe, M. M. (2015). Varieties of visual working memory representation in infancy and beyond. *Current directions in psychological science*, 24(6), 433–439. https://doi.org/10.1177/0963721415605831

Kuhl, P. K., Williams, K. A., Lacerda, F., Stevens, K. N., Lindblom, B. (1992). Linguistic experience alters phonetic perception in infants by 6 months of age. *Science*, 255, 606–608. https://doi.org/10.1126/science.1736364

Levi, D. M. (2022). Learning to see depth. *Vision Research*, 200. https://doi.org/10.1016/j.visres.2022.108082

Lively, S. E., Logan, J. S., & Pisoni, D. B. (1993). Training Japanese listeners to identify English /r/and /l/. II The role of phonetic environment and talker variability in learning new perceptual categories. *Journal of the Acoustic Society of America*, 94, 1242–1255. https://doi.org/10.1121/1.408177.

Lucon-Xiccato, T., Manabe, K., & Bisazza, A. (2018). Guppies learn faster to discriminate between red and yellow than between two shapes. *Ethology*, 125(2), 82–91.

Mackintosh, N. J., & Bennett, C. H. (1998). Perceptual learning in animals and humans. In M. Sabourin, F. Craik, & M. Robert (Eds.), *Advances in psychological science, Vol. 2. Biological and cognitive aspects*. Hove: Psychology Press/Taylor & Francis, 317–333.

Maurer, D., Le Grand, R., & Mondloch, C.J. (2002). The many faces of configural processing. *Trends in Cognitive Sciences*, 6, 255–260. https://doi.org/10.1016/s1364-6613(02)01903-4

McKone, E., & Robbins, R. (2011). Are faces special? In A. J. Calder, G., Rhodes, M. H. Johnson & J. V. Haxby (Eds.), *Oxford Handbook of Face Perception*. New York, NY: Oxford University Press, 149–176.

Millikan, R. (1989a). Biosemantics. *Journal of Philosophy*, 86(6), 281–297. https://doi.org/10.2307/2027123

Millikan, R. (1989b). In defense of proper functions. *Philosophy of Science*, 56(2), 288–302.

Mody, S. & Carey, S. (2016). The emergence of reasoning by the disjunctive syllogism in early childhood. *Cognition*, 154, 40–48.

Mondloch, C. J., & Thomson, K. (2008). Limitation in four-year-old children's sensitivity to the spacing among facial features. *Child Development*, 79, 1513–1523. https://doi.org/10.1111/j.1467-8624.2008.01202.x

Moriguchi, Y. (2014). The early development of executive function and its relation to social interaction: A brief review. *Frontiers in Psychology*, 5:388, 37–63. https://doi.org/10.1016/S0885-2014(96)90027-1

Morrison, A. B., & Richmond, L. L. (2020). Offloading items from memory: individual differences in cognitive offloading in a short-term memory task. *Cognitive Research: Principles and Implications*, 5(1). https://doi.org/10.1186/s41235-019-0201-4

Mundy, M. E., Dwyer, D. M., & Honey, R. C. (2006). Inhibitory associations contribute to perceptual learning in humans. *Journal of Experimental Psychology: Animal Behavior Processes*, 32(2), 178–184. https://doi.org/10.1037/0097-7403.32.2.178

Neander, K. (2017). *A Mark of the Mental*. Cambridge, MA: MIT Press.

Needham, A., Dueker, G., Lockhead, G. (2005). Infants' formation and use of categories to segregate objects. *Cognition*, 94(3), 215–240. https://doi.org/10.1016/j.cognition.2004.02.002

Norris, D., McQueen, J. M., & Cutler, A. (2003). Perceptual learning in speech. *Cognitive Psychology*, 47(2), 204–238. https://doi.org/10.1016/S0010-0285(03)00006-9

O'Callaghan, C. (2022). Perception, flux, and learning. *Analysis*, 83(3), 560–584. https://doi.org/10.1093/analys/anac040

O'Hara, W. (1980). Evidence in support of word unitization. *Perception and Psychophysics*, 27, 390–402.

Palmer, S. (1999). *Vision Science: From Photons to Phenomenology*. Cambridge: MIT Press.

Papineau, D. (1987). *Reality and Representation*. Oxford: Basil Blackwell.

Pascalis, O., Scott, L. S., Kelly, D. J., Shannon, R. W., Nicholson, E., Coleman, M., & Nelson, C. A. (2005). Plasticity of face processing in infancy. *Proceedings of the National Academy of Sciences*, 102(14), 5297–5300. https://doi.org/10.1073/pnas.040662710

Phillips, I. B. & Firestone, C. (forthcoming). Visual adaptation and the purpose of perception. *Analysis*.

Prettyman, A. (2018). Perceptual learning. *WIREs Cognitive Science*, 10(3). DOI::10.1002/wcs.1489

Reynolds, G. D., & Romano, A. C. (2016). The development of attention systems and working memory in infancy. *Frontiers in Systems Neuroscience*, 10, Article 15. doi: http://doi.org/10.3389/fnsys.2016.00015

Risko, E. F. & Gilbert, S. J. (2016). Cognitive offloading. *Trends in Cognitive Science*, 20(9), 676–688. https://doi.org/10.1016/j.tics.2016.07.002

Rooney, N. J., Guest, C. M., Swanson, L. C. M., & Morant, S. V. (2019). How effective are trained dogs at alerting their owners to changes in blood glycaemic levels? Variations in performance of glycaemia alert dogs. *PLoS One*, 14(1), e0210092. https://doi.org/10.1371/journal.pone.0210092

Rose, S. A., Feldman, J. F., & Jankowski, J. J. (2001). Visual short-term memory in the first year of life: Capacity and recency effects. *Developmental Psychology*, 37, 539–549. https://doi.org/10.1037/0012-1649.37.4.539

Ross-Sheehy, S., Oakes, L. M., & Luck, S. J. (2003). The development of visual short-term memory capacity in infants. *Child Development*, 74(6), 1807–1822. https://doi.org/10.1046/j.1467-8624.2003.00639.x

Rubner, A. (2022). Normal-proper functions in philosophy of mind. *Philosophy Compass*, 7, 1–11.

Rush, J. C. & Sabers, D. L. (1981). The perception of artistic style. *Studies in Art Education*, 23, 24–32. https://doi.org/10.2307/1319689

Saffran, J.R., Aslin, R.N., Newport, E. L. (1996). Statistical learning by 8-month-old infants. *Science*, 274(5294), 1926–1928. https://doi.org/10.1126/science.274.5294.1926. PMID: 8943209.

Sarasso, P., Perna, P., Barbieri, P., Neppi-Modona, M., Sacco, K., & Ronga, I. (2021). Memorisation and implicit perceptual learning are enhanced for preferred musical intervals and chords. *Psychonomic Bulletin & Review*, 28, 1623–1637. https://doi.org/10.3758/s13423-021-01922-z

Scott, L. S., & Monesson, A. (2009). The origin of biases in face perception. *Psychological Science*, 20(6), 676–680. https://doi.org/10.1111/j.1467-9280.2009.02348.x

Schellenberg, S. (2018). *The Unity of Perception: Content, Consciousness, Evidence*. Oxford: Oxford University Press.

Seitz, A. R., Kim, D., Watanabe, T. (2009). Rewards evoke learning of unconsciously processed visual stimuli in adult humans. *Neuron*, 61(5), 700–707. https://doi.org/10.1016/j.neuron.2009.01.016.

Shea, N. (2018). *Representation in Cognitive Science*. Oxford: Oxford University Press.

Skelton, A. E., Maule, J., & Franklin, A. (2022). Infant color perception: Insight into perceptual development. *Child Development Perspectives*, 16(2), 90–95. https://doi.org/10.1111/cdep.12447

Slater, A., Mattock, A., Brown, E., & Bremner, E. J. (1991). Form perception at birth: Cohen and Younger (1984) revisited. *Journal of Experimental Child Psychology*, 51(3), 395–406. https://doi.org/10.1016/0022-0965(91)90084-6

Sokol, S. (1978). Measurement of infant visual acuity from pattern reversal evoked potentials. *Vision Research*, 18(1), 33–39. https://doi.org/10.1016/0042-6989(78)90074-3

Spelke, E. (2022). *What Babies Know, Volume 1: Core Knowledge and Composition*. New York: Oxford University Press.

Stegmann, U. (2009). A consumer-based teleosemantics for animal signals. *Philosophy of Science*, 76, 5, 864–875. https://doi.org/10.1086/605820

Sugita, Y. (2008). Face perception in monkeys reared with no exposure to faces. *Proceedings of the National Academy of Sciences*, 105(1), 394–398. https://doi.org/10.1073/pnas.0706079105

Symonds, M., & Hall, G. (1995). Perceptual learning in flavor aversion conditioning: Roles of stimulus comparison and latent inhibition of common stimulus elements. *Learning & Motivation*, 26, 203–219. https://doi.org/10.1016/0023-9690(95)90005-5

Szpunar, K. K., Schellenberg, E. G., Pliner, P. (2004). Liking and memory for musical stimuli as a function of exposure. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 30(2), 370–381. https://doi.org/10.1037/0278-7393.30.2.370.

Watanabe, S. (2011). Discrimination of painting style and quality: Pigeons use different strategies for different tasks. *Animal Cognition*, 14(6), 797–808. https://doi.org/10.1007/s10071-011-0412-7

Watanabe, S. (2013). Preference for and discrimination of paintings by mice. *PLoS One*, 8(6), e65335. https://doi.org/10.1371/journal.pone.0065335

Watanabe, T., Náñez, J. & Sasaki, Y. (2001). Perceptual learning without perception. *Nature*, 413, 844–848. https://doi.org/10.1038/35101601

Watanabe, T. & Sasaki, Y. (2015). Perceptual learning: Toward a comprehensive theory. *Annual Review of Psychology*, 66, 197–221. https://doi.org/10.1146/annurev-psych-010814-015214

Werker, J. F. (1989). Becoming a native listener. *American Scientist*, 77(1), 54–59.

Wheeler, A., Anzures, G., Quinn, P. C., Pascalis, O., Omrin, D. S., Lee, K. (2011). Caucasian infants scan own- and other-race faces differently. *PLoS One*, 6 (4), e18621. https://doi.org/10.1371/journal.pone.0018621. PMID: 21533235; PMCID: PMC3076379.

Wilcox, T. & Chapa, C. (2004). Priming infants to attend to color and pattern information in an object individuation task. *Cognition*, 90(3), 265–302. https://doi.org/10.1016/S0010-0277(03)00147-1

Wilcox, T. & Woods, R. (2009). Experience primes infants to individuate objects: Illuminating learning mechanisms. In A. Woodward & A. Needham (Eds.), *Learning and the Infant Mind*. New York: Oxford University Press, 117–143.

Wong, Y. K., Lui, K. F. H., Yip, K. H. M., Wong, A. C. (2020). Is it impossible to acquire absolute pitch in adulthood? *Attention, Perception, & Psychophysics*, 82(3), 1407–1430. https://doi.org/10.3758/s13414-019-01869-3.

Wright, L. (1973). Functions. *The Philosophical Review*, 82, 139–168.

Zelazo, P. D. & Frye, D. (1998). Cognitive complexity and control. *Current Directions in Psychological Science*, 7(4), 121–126. https://doi.org/10.1111/1467-8721.ep10774761

How to cite this article: Jenkin, Z. (2023). The function of perceptual learning. *Philosophical Perspectives*, 1-15. https://doi.org/10.1111/phpe.12186