Introduction

Ecological psychology was originally formulated in the works of James and Eleanor Gibson. Since then, the ecological approach has become a scientific framework that provides an alternative to mainstream theories of perception and **perceptual learning** within experimental psychology and cognitive science. In this Element we will explore and analyze the most relevant conceptual and methodological moves that led toward ecological psychology as well as the subsequent developments in the field up to the present.

For now though, it is worth noting that James and Eleanor Gibson's overall aim was to explain all aspects of perception and perceptual learning without invoking nonperceptual, cognitive resources of any kind. In a world still dominated by the behaviorist stimulus–response arc but already witnessing a change toward the notions of computation and representation typical of cognitive psychology, they offered a third path. As James Gibson (1967[1982]) put it:

> We [James and Eleanor Gibson] have no patience with the attempt to patch up the S–R [stimulus–response] formula with hypotheses of mediation [e.g., mental representations]. In behavior theory as well as in psychophysics you either find causal relations or you do not. (p. 12)

Most mainstream theories of perception and perceptual learning since at least the time of Helmholtz have relied on different forms of psychological mediators. Unconscious inferences, homunculi, brain regions with psychological powers or computational capacities; all these have been postulated to mediate between stimuli and responses in order to explain perceptual experience and behavior. James and Eleanor Gibson tried to avoid this explanatory strategy and, to do so, embraced a simple but powerful hypothesis: there are aspects of stimulation, however complex, that enable perceptual experience, the perceptual control of action, and perceptual learning without the need for mediatory processes. This hypothesis is at the core of ecological psychology, and it is also the seed of notions like **direct perception**, **ecological information**, and **affordance**.

After exploring the historical roots of the ecological approach to perception and action in Section 1, in Section 2 we will dive deeper into the ways James and Eleanor Gibson developed its core hypotheses and concepts. In Section 3, we will explore how ecological psychology has evolved over the last few decades, giving rise to a series of solid research programs. Finally, in Section 4 we will review the current state of the ecological approach to perception and action and its future directions. After the four sections, we offer a succinct Glossary with the most important concepts used throughout the Element.

Before starting, however, we must warn the reader that purely philosophical discussions, like the ontological nature of affordances and the ecologically inspired arguments against mental representations are kept to a bare minimum, although we do not deny their importance. Indeed, a proof of their relevance is the extensive attention they have received in the literature (e.g., Chemero, 2009; Heras-Escribano, 2019). However, had we included them, they would have been a distraction from the main aim of this Element: to provide a systematic account of ecological psychology as a scientific framework full of lively research programs.

1 The Historical Roots of Ecological Psychology

The first step in order to get a full picture of ecological psychology is to acknowledge its historical roots. To do so, we will review the core ideas of American functionalism, radical empiricism, **Gestalt** psychology, and some forms of behaviorism. All these ideas played a crucial role in the education of James and Eleanor Gibson, and many of their core tenets were at the basis of the ecological approach to perception and action. Some of these tenets include that certain aspects of stimulation can lead to perception without mediatory processes, that perception–action loops must be treated as indivisible units, and the focus on the active character of perception and experience.

1.1 American Functionalism and Radical Empiricism

The path toward ecological psychology began with the academic career of James Gibson. He obtained his PhD at Princeton University under the supervision of psychologist H. S. Langfeld and the mentorship of psychologist E. B. Holt. Holt's influence was crucial to him during his formative years to the extent that he described himself as a "radical empiricist, like Holt" in his autobiography (J. J. Gibson, 1967[1982], p. 12). It was during these years that James Gibson got exposed to American functionalism and, evidently, radical empiricism. And it was during this time that some ideas from these two frameworks got into his own thinking.

Before behaviorism took over the psychological sciences in around the 1920s, American functionalism – or just functionalism – was one of the main frameworks within experimental psychology. Notably related to the ideas of William James and John Dewey, it was named 'functionalism' as opposed to 'structuralism,' defended by the prominent psychologist Edward Titchener (1898). Structuralism was concerned with the identification and analysis of the building blocks of experience; for instance, the identification and study of simple sensations as the elementary components of perceptual processes. Once

these building blocks are known, so the story goes, we will be able to find the processes and rules that merge them into different psychological structures. Against this approach, functionalism characterized the task of psychology as the identification and study of psychological functions and took the building blocks of experience described by structuralists to be artifacts of their research logic and methods. In fact, functionalists claimed that the focus on such building blocks was an obstacle for the study of psychological functions and events as unified wholes. William James' critique of simple sensations is a perfect illustration of this view:

> Most books start with sensations, as the simplest mental facts, and proceed synthetically, constructing each higher stage from those below it. But this is abandoning the empirical method of investigation. *No one ever had a simple sensation by itself.* Consciousness, from our natal day, is of a teeming multiplicity of objects and relations, and what we call simple sensations are results of discriminative attention, pushed often to a very high degree. (James, 1890, Vol. 1, p. 224; emphasis added)

In their critique of structuralism, functionalists do not only regard simple sensations as theoretical artifacts but also call into question the whole stimulus–response structure – aka *reflex arc*. Dewey (1896) thought that the characterization of psychological events as chains of atomic stimuli that trigger atomic responses was a misguided attempt to capture those events. Only after a response is triggered, Dewey argues, can an environmental feature be meaningfully described as a stimulus. Even more, the very notion of a triggered response is inadequate, for only already-active organisms are in the position of registering, identifying, and coordinating with those environmental events called 'stimuli.' Dewey famously appealed to James' example of a child and a candle to exemplify this point:

> The ordinary interpretation [of a child-candle grasping situation] would say the sensation of light is a stimulus to the grasping as a response, the burn resulting is a stimulus to withdrawing the hand as response and so on . . . Upon analysis, we find that we begin not with a sensory stimulus, but with a sensorimotor coordination, the optical-ocular, and that in a certain sense *it is the movement which is primary, and the sensation which is secondary*, the movement of body, head and eye muscles determining the quality of what is experienced. In other words, *the real beginning is with the act of seeing; it is looking, and not a sensation of light*. (Dewey, 1896, p. 358–359; emphasis added)

Psychological events are thus described in terms of coordinated, organic circuits in which elementary components only make sense within the particular context of the whole system. Regarding one or another part of the circuit as primary or secondary – or as stimulus or response – is just a way to arbitrarily break the

whole event for some explanatory purpose. Dewey's point is that, while the ordinary interpretation of the child-candle situation is that it starts with the sensation of light, it is perfectly possible to set its beginning in the optical-ocular sensorimotor coordination. There is no principled way to set the beginning or the end of a psychological event when it is taken to be an organic circuit. The whole is ontologically and epistemologically primary.

In this context, if the organic circuit is the starting point of any psychological explanation, a structuralist research logic based on the primacy of component identification seems deeply misguided. This radical idea stayed within the repertoire of James and Eleanor Gibson for the rest of their careers and was central for the development of ecological psychology. Both their criticism of the notion of stimulus in psychology and their defense of perception–action loops as indivisible units reflect the functionalist inheritance of the ecological approach.

But this is not the only aspect in which American functionalism influenced James and Eleanor Gibson. William James proposed the hypothesis that whatever is given in sensation is more complex than what was acknowledged by the psychophysicists and physiologists of his time. In an argument often repeated in *The principles of psychology* (1890) that afterwards became the keystone of radical empiricism, James claims that sensations are not just atomic events but that there are sensations of *relations* between different aspects of the world. In the *Principles*, James (1890) says:

> If there be such things as feelings [i.e., sensations] at all, then so surely as relations between objects exist in *rerum naturâ*, so surely, and more surely, do feelings exist to which these relations are known . . . We ought to say a feeling of and, a feeling of if, a feeling of but, and a feeling of by, quite as readily as we say a feeling of blue or a feeling of cold. (Vol. 1, pp. 245–246; emphasis in the original)

Similarly, when he writes on radical empiricism, he says that "*the relations that connect experiences must themselves be experienced relations, and any kind of relation experienced must be accounted as 'real' as anything else in the system*" (James, 1904[1987], p. 1160; emphasis in the original).

The view that relations are directly experienced entailed the rejection of some of the principles of psychophysics and physiology and required a completely new understanding of experience. A good illustration of these consequences is James' critique of Helmholtz's theory of spatial perception. In general, James thought that any process of inference that went from simple sensations to complex experiences was untenable or just "pure mythology" (James, 1890, Vol. 1, p. 170), but he was especially blunt in the context of spatial perception. Helmholtz's theory began with simple sensations without spatial properties; namely, simple sensations that tell us

nothing about location, direction, and so on. These simple sensations were then associated to construct the perceived spatial properties by a process of *unconscious inference*. In this context, James (1890) asks:

> But how, it may be asked, can association produce a space-quality not in the things associated? How can we by induction or analogy infer what we do not already generically know? Can 'suggestions of experience' reproduce elements which no particular experience originally contained? This is the point by which Helmholtz's 'empiristic' theory, as a theory, must be judged. No theory is worthy of the name which leaves such a point obscure. Well, Helmholtz does so leave it. At one time he seems to fall back on inscrutable powers of the soul, and to range himself with the 'psychical stimulists'. He speaks of Kant as having made the essential step in the matter in distinguishing the content of experience from that form – space, course – which is given it by the peculiar faculties of the mind. (Vol. 1, p. 279)

According to James, Helmholtz's explanatory strategy ultimately relied on some form of obscure a priori knowledge – the "inscrutable powers of the soul" – the origins and structure of which remained unjustified and mysterious. To use James Gibson's words, such a priori knowledge serves to patch up the stimulus–response formula with some mediatory, inferential steps that help transforming simple sensations with no spatial properties whatsoever into full-fledged perceptual experiences of space. William James never wanted to appeal to such inferences for, as we have seen, he regarded them as mostly mythological. James and Eleanor Gibson shared this feeling, and both pursued a Jamesian solution to avoid mediatory inferences, accepting the complexity of experience and the richness of stimuli to support it. As an American functionalist and a radical empiricist, William James' fundamental commitment was that sensations are rich enough to provide us not just with the experience of simple events but also of their relations.[1] James and Eleanor Gibson inherited this radical hypothesis and developed it into a scientific theory: the ecological approach to perception and action.

1.2 Gestalt Psychology (and Phenomenology)

Although the Jamesian influence was there from the very beginning through the mentorship of Holt (a student of William James himself; see Heft, 2001), James and Eleanor Gibson took some time to fully develop a scientific theory compatible with the core hypotheses of American functionalism and radical empiricism. Indeed, a little detour was needed.

[1] The relationship between stimulation and sensation can be problematized. However, James' use of "sensation", and sometimes "feeling," is mostly a matter of preference. The differences with James and Eleanor Gibson's use of "stimulation" are not relevant for the compatibility of their positions.

In 1928, James Gibson was hired to teach experimental psychology at Smith College (Northampton, MA, USA). Moving to Smith College was crucial for him, first of all, because there he met Eleanor (who was his student), eventually married her, and began a lifelong, shared intellectual quest within experimental psychology (E. J. Gibson, 2001). And second, because he became an academic fellow of Kurt Koffka, the prominent gestalt psychologist. Although he wrote his dissertation against Gestalt psychology, the exposure to Koffka's thinking and, later, to gestalt theory and philosophical phenomenology more generally made an important mark on James Gibson. By the end of his life, he even claimed the ecological approach was "a sort of *ecological* Gestalt theory" (J. J. Gibson, 1979[1982], p. 112).

Gestalt psychology is a theoretical framework developed by psychologists Max Wertheimer, Kurt Koffka, and Wolfgang Köhler in Germany and Austria in the early twentieth century (see Ash, 1995; Koffka, 1935; Wagemans et al., 2012). Like American functionalists and radical empiricists, gestalt psychologists rejected the structuralist explanatory strategy based on the identification of simple sensations. According to them, perceptual experience has formal features (or gestalts) that go beyond the addition or association of elementary components. For instance, we see groups, series, or some figures for which we do not have any sensation (Figure 1). Thus, gestalts cannot be reduced to the association or combination of simple sensations: there is no way to find simple sensations for groups, series, or some figures along with typical simple sensations like "dot", "hard", or "blue." Gestalt psychologists then faced the same dichotomy William James identified in Helmholtz's theory of spatial perception: if our perceptual experience includes elements that are not given in the form of simple sensations, we are forced to either postulate some obscure a priori knowledge or to find a different solution to explain such experience.

Gestalt psychologists found a physiological solution for this issue. Instead of proposing a mediatory, psychological process such as an unconscious inference, they gestured toward laws of self-organization of brain activity. In this context, "self-organization" has to do with the spontaneous activity of the brain that reaches some ordered state (a gestalt) given some stimulation. As cited by Stadler and Kruse (1990), Wolfgang Köhler describes this process in terms of the achievement of "stationary equilibrium distributions developed from the inner dynamics of the optical system itself" (p. 34). In other words, we perceive gestalts because our brain is the way it is, and its dynamics self-organize the way they do. Thus, gestalt psychologists rehearse a solution different from the structuralist one but also different from the one proposed by American functionalists; whereas American functionalists endorsed the hypothesis that the

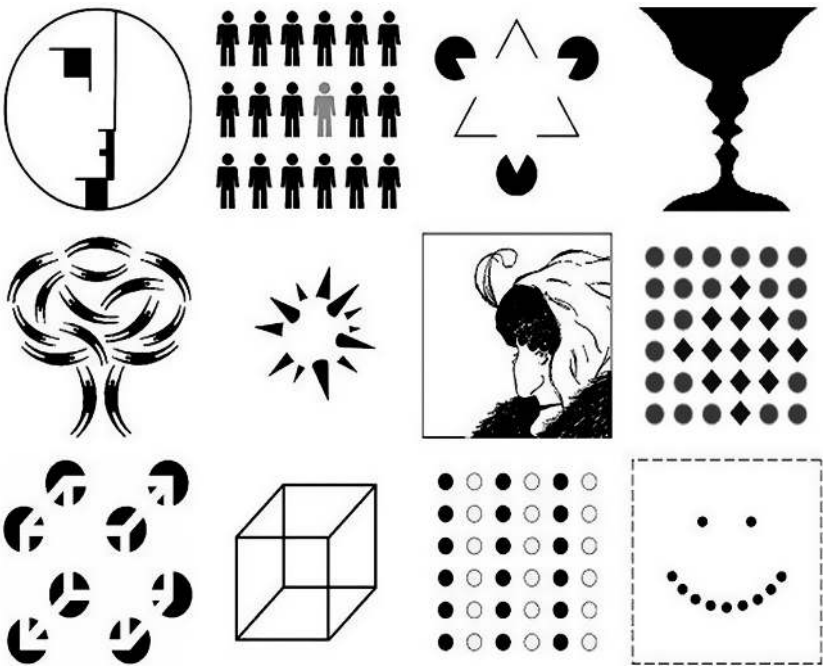

Figure 1 Examples of gestalts in visual perception. For instance, an all-white triangle for which no simple sensation is available (1st row, 3rd figure left to right), an all-white sphere in the origin of the thorns for which no simple sensation is available (2nd row, 2nd figure left to right), or a grouping by similarity for which no simple sensation is available (3rd row, 3rd figure left to right). (Copyright holder: Impronta, CC BY-SA 3.0 – Source. www.interaction-design.org/literature/topics/gestalt-principles; accessed March 31, 2022.)

richness of sensations is enough to support perceptual experience, gestalt psychologists opted for a solution based on intrinsic brain dynamics.

From this point of view, it is not surprising that James Gibson attached the adjective "ecological" when he claimed his own theory was a sort of gestalt theory. He generally agreed with the critique of simple sensations and mediatory processes. Also, he valued the general move toward understanding perceptual experience in terms of complex holistic structures (gestalts) and self-organization. However, he thought such self-organization should not be found just in the brain alone but, as we will see, in the whole ecological, organism–environment system. The influence of Gestalt psychology in the ecological approach to perception and action was therefore not a matter of James and Eleanor Gibson embracing gestalt theory as such, but worked more as a ladder

to streamline and complement their functionalist tendencies. Gestalt psychology provided them with further arguments against the understanding of experience as the product of adding simple sensations together.

The general influence of gestalt theory in ecological psychology lasted all the way up to the final works of James Gibson and beyond. Indeed, James Gibson was explicit about this influence many times. In addition to considering the ecological approach as a sort of ecological gestalt theory, he also claimed, in a letter to his lifelong friend Gunnar Johansson, that what he was defending was that in a sense "there are Gestalt laws and not only for the brain, but also for light" (Gibson, 1970a/1982, p. 85). In a way, he was a realist about gestalts.

James Gibson also acknowledged the phenomenological psychologist Albert Michotte as a researcher who was generally pursuing a project similar to the ecological one (Gibson, 1967[1982]). Michotte was himself influenced by Gestalt psychology and phenomenology, and he was convinced that perceptual experience was richer than acknowledged by mainstream behaviorism. In his work, Michotte (1946) was primarily concerned with the perception of causality and defended that we perceive causes without the need for any kind of mediatory, cognitive inference. Such directness made causation a kind of gestalt and highlighted the reason why James Gibson thought of Michotte as an ally within experimental psychology. Finally, it is well known that James and Eleanor Gibson were influenced by the works of Maurice Merleau-Ponty, the French phenomenologist who was in turn greatly influenced by gestalt theory (Käufer & Chemero, 2015). The influence of Merleau-Ponty's phenomenology is most visible in the ecological characterization of perception as an embodied process (see Section 2.3).

1.3 The Other Behaviorism

We should not forget, however, that for most of their careers James and Eleanor Gibson identified themselves with some form of behaviorism. James Gibson was influenced by the works of E. B. Holt, and for Eleanor Gibson, Clark L. Hull was the most influential figure. Both Holt and Hull represented different forms of behaviorism that were nevertheless equally far from the somewhat cartoonish received view of the framework.

As history is usually written by the victors, in this case cognitive psychologists, behaviorism is often described as concerned with just simple stimulus–response loops, as neglecting any form of physiology or physiological work, as turning a blind eye to the active and spontaneous character of behavior, and so on. This description of most behaviorists is of course mostly inaccurate, and even mainstream ones like Edward Tolman or B. F. Skinner, would reject all these accusations.

This received view of behaviorism is even more misleading in the case of Holt and Hull. Holt was a radical empiricist in the theory and a behaviorist in the methods. He developed *molar behaviorism*: a lawful approach to behavior in which the mainstage is not for stimulus–response circuits, but for objects of the world and organized behavior considered as a coordinated totality: "[T]he fairly accurate description of [psychological] activity will invariably reveal a law (or laws) whereby this activity is shown to be a constant function of some aspect of the objective world" (Holt, 1915a, p. 370).

Moving away from the stimulus–response framework toward a more complex organism–environment relationship is a key property of the ecological approach to perception and action. But that's not all. Another important aspect of molar behaviorism is its focus on the intrinsically active character of behavior and experience. Instead of picturing cognitive systems as purely reactive machines, Holt leveraged a very peculiar interpretation of the Freudian notion of *wish* to account for their active character: "The *wish* is purpose embodied in the mechanism of all living organisms, that it is necessarily a wish about . . . some feature of the environment; so that a total situation comprising both *organism and environment* is always involved . . . Mind is a relation and not a substance" (Holt, 1915b, p. 99; emphasis in the original).

According to Holt, cognitive systems exhibit a form of intrinsic, endogenous organized activity that encompasses themselves and their environments. Crucially, both perceptual experience and behavior depend on this active nature. Similarly, in ecological psychology, the perception–action loop is unbreakable: action is as needed for perception as perception is needed for action. Even more, perception is regarded as an activity in itself and is taken to be always occurring in the context of the organism–environment system. Again, the Holtian influence is prominent in the ecological approach.

The works of Clark L. Hull do not feature within the mainstream of behavioristic psychology either. Hull proposed a nonstandard view of behavior within the behaviorist coordinates: a (self-proclaimed) *neo*behaviorist theory that aimed to explain learning and motivation from the laws of behavior. First and foremost, he viewed behavior as goal-directed. Namely, he viewed behavior not in terms of responses triggered by stimuli but in terms of purposeful actions driven by some need – aka Hull's *drive theory*. For him, behavior is spontaneous and intrinsically motivated by the needs of the organism. In this context, Hull takes learning to be based on the emergence and reinforcement of habits that respond to those needs.

Eleanor Gibson arrived at Hull's lab in 1934, after she was accepted as a PhD student at Yale University but was refused by Robert L. Yerkes because he did not allow women in his lab. During her PhD, she studied verbal learning by applying two of the classical principles of conditioning: generalization and