Gibson's "Affordances":
Evolution of a Pivotal Concept

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Abstract

Ecological psychology applies insights of Darwinian theory and Gestalt principles to the understanding of perceptual processes. James J. Gibson developed a perceptual theory of "affordances", a neologism he adopted for the pivotal concept in a radical view of how interactive organism-environment features index the behaviors an organism may perform (perceived action possibilities). Gibson asserted "a niche is a set of affordances" (Gibson, 1986, p. 128) and affordances "are properties of the environment relative to an animal (Gibson, 1966, p. 285). In the ecological view, understanding the constraints and opportunities offered by an environs (its affordances) requires recognition of a dynamic reciprocity between an organism's perception and specific environmental features (their demand characteristics, or "invariances") that together form the background (situation or context) of an organism-environment event. Affordances theory seeks both to objectify perceptual processes and to operationalize the foundational Gestalt principle of complementarity between 'figure' and 'ground'. Rationales for Gibson's hybrid approach are examined, and a chronology of theory development is accompanied by review of recent refinements, criticisms, and their implications.

Perceiving is for doing. (Gibson, 1979)

Ecological psychology, among the most generative of multidisciplinary fields in the social sciences, found its inception in the late 1940's. In part a response to challenges recognized by first-generation Gestaltists, it reframed problems central to the accurate description of behavior. This analysis traces development of a central concept (affordances), conceived by James J. Gibson, and further elaborated by his successors. A survey of theoretical principles is supplemented by examples of research and application.

As with any revolutionary concept, Gibson's principal idea is teaming with implications across multiple levels of meaning. The theory of affordances adopts radically new perspectives, and necessarily so; it seeks to unite perceptual points of view commonly thought dichotomous (subjective /objective, interior /exterior) by collapsing across the false binaries. At first approximation, the violation of convention can be unsettling. Apprehending Gibson's approach calls for a cognitive flexibility that appreciates both the limitations of linear logic and the opportunity that paradox presents. Despite its apparent complexity, the language of affordances is simply an operationalized presentation of ethology's fundamental principle: reciprocity between an organism and its environment. To explain the complementary nature of so grand a conceptual system, spanning apparently disparate levels of manifest life, requires recruiting familiar terms (*perception, situation*) to uncommon purposes, and revealing the fuzzy nature of implicit factors (*context, meaning*) to which we too casually appeal. Those who persevere may expect that, though they first seem faced with a Chimera, the affordance concept resembles more a mythological Janus, peering simultaneously in and out. In the end, one may recognize the seeming inconsistencies as artifacts of language, a function of bewitchment by our habits of thought.

Ecological psychology

Broadly speaking there are three types of theory of human perception: inferential (associated with Helmholtz), organizational (such as that pursued by Wertheimer and others of the Gestalt school), and ecological (such as that developed by Gibson).(Sheehy, 2004, p. 111)

Gestalt theory (stressing holism, phenomenological perspective, and nativism), and Kurt Lewin's work in particular, describe the back story of eco-behavioral science. Both Lewin and Kurt Koffka defined environmental objects dynamically, in accord with what an organism can do with them (Scarantino, 2003). Prefiguring the concept of affordances, Koffka radically revised the concept of a stimulus to refer to "real objects in functional relation to a perceiving and acting organism" (Buxton, 1985, p. 312). In essence, the Gestalt program sought to promote the centrality of meaning and values in psychological theory. Lewin furthered this perspective by noting how environmental properties (elemental composition, for example), couched in the language of

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physics or biology, are not themselves part of our immediate experience (Heft, 2001).From a phenomenological perspective, upon noticing environmental features, the experience of those features is intrinsically meaningful. Ecological psychology seeks to model and codify those relations.

Roger G. Barker is credited as the first to respond to Lewin's call for an eco-behavioral psychology. Along with a colleague, Herbert Wright, Barker used the population of the rural Kansas town of Oskaloosa (population 762) as participants at the first field station for naturalistic study of human behavior (Heft, 2001, p. 249; Pandora, under submission). Both Barker and Wright were Lewin postdoctoral fellows and faculty at the University of Kansas. In keeping with the Gestalt program, their project sought patterns and structure in dynamic streams of behavior. Patterns of action within "behavior streams" proved to be more easily encoded than "behavioral settings," yet the work of Barker and Wright achieved a partial fulfillment of Lewin's goal, a "psychological ecology" that captured relationships between non-psychological, objective features of environs, and the activity of individuals. They pioneered practical applications for the work of their former mentor and continued to leverage these accomplishments well into the 1960s (Raush, 1964).

Another figure, contemporary with Barker and Wright, worked to craft a vision of eco-behavioral science. James J. Gibson also adhered to Kurt Lewin's vision of an ecological psychology. In 1928, Gibson completed his Princeton dissertation testing a claim, derived from Gestalt principles, regarding memory for complex visual forms. Within months of this milestone, he encountered a translation of Kurt Koffka's *Principles of Gestalt Psychology*, and the influence of Gestalt thought thereafter permeated Gibson's professional work. Recognizing the necessity to account for intentional movements of a seeing organism, Gibson's studies of visual perception led to his founding the discipline of ecological optics (Sheehy, 2004). First proposed in *Perception of the Visual World* (1950), ecological optics was further elaborated in *The Senses Considered as Perceptual Systems* (1966).

> In the latter work (Gibson, 1966), he wrote briefly about the affordance concept: When the constant properties of constant objects are perceived (the shape, size, color, texture, composition, motion, animation, and position relative to other objects), the observer can go on to detect their *affordances*. I have coined this word as a substitute for *values*, a term which carries an old burden of philosophical meaning. I mean simply what things furnish, for good or ill. What they *afford* the observer, after all, depends on their properties. (p. 285)

Both Lewin (1935) and Koffka (1935) characterized objects in terms of what actions an organism may perform with them (Scarantino, 2003). "The brevity of his statements concerning affordances in this book suggests that Gibson was still formulating his thoughts on this important matter" (Jones, 2003, p. 111); this author tracks the affordance concept as it evolved throughout Gibson's career, and notes how the theory was explicitly a work in progress, "subject to revision" (Gibson, 1971, in Reed & Jones (eds.), 1982). The freshly-conceived concept of affordances bears this description in Gibson's 1966 book:

> The hypothesis that things have affordances, and that we perceive or learn to perceive them, is promising, radical, but not yet elaborated. Roughly, the affordances of things are what they furnish, for good or ill, that is, what they afford the observer... Not only objects but also substances, places, events, other animals, and artifacts have affordances... I assume that affordances are not simply phenomenal qualities of subjective experience (tertiary qualities, dynamic and physiognomic properties, etc.)... instead, they are ecological, in the sense that they are properties of the environment relative to an animal.(p. 285)

In keeping with his fluid conception and tentative statement of the theoretical dimensions of affordance, a 1971 memo penned by Gibson pointedly notes that his examples are exploratory ("intended to be only suggestive"). Produced while the concept remained in its earliest formative stages, it references:

> surfaces and surface-layouts related to posture and locomotion; surfaces that reveal or conceal; transparent or opaque objects affording manipulation; substances with affordances; the affordance of injury or benefit; the detecting of affordances by young nimals. (Reed & Jones, eds., 1982, p. 131)

A maturing vision of affordances can be found in *The Ecological Approach to Visual Perception* (Gibson, 1986):

> The verb *to afford* is found in the dictionary, but the noun *affordance* is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment (p. 127)... An important fact about the affordances of the environment is that they are in a sense objective, real, and physical, unlike values and meanings, which are often supposed to be subjective, phenomenal, and mental. But, actually, and affordance is neither an objective property nor a subjective property; or it is both if you like. An affordance cuts across the dichotomy of subjective-objective and helps us to understand its inadequacy. It is equally a fact of the environment and a fact of behavior. It is both physical and psychical, yet neither. An

affordance points both ways, to the environment and to the observer. (p. 129)

Employing an especially revealing analogy, Gibson offers a lucid glimpse of the unusual yet accessible aim of the affordance concept:

> Ecologists have the concept of a *niche*. A species of animal is said to utilize or occupy a certain niche in the environment. This is not quite the same as the *habitat* of the species; a niche refers more to *how* an animal lives than to where it lives. I suggest that a niche is a set of affordances. (Gibson, 1986, p. 128)

A *habitat* has physical referents, yet it is also a placeholder for abstract, dynamic qualities of space, time and resources. Likewise, both *habitat* and *niche* both infer greater abstractions in that the referent species, too, is in dynamic play across space and time. Affordances, however, embody a second order of abstraction lacking in the terms Gibson invokes for this comparison. His vision collapses across categories and dichotomies a pedestrian view takes to be inviolate: subjective-objective, interior-exterior, individual-collective, synchronic-diachronic (Still & Good, 1992). What a niche is to a habitat, an affordance is to "situated" behavior; affordances reflect the reciprocity of an acting organism and specified features of an environs- an operationalization of the foundational Gestalt perceptual principles of figure/ground and "direct perception."

> Affordances are the meanings an environment has for an organism; they guide behavior. Gibson claimed that affordances can be perceived directly, without prior synthesis or analysis. This means, for instance, that the properties of objects that reveal they can be grasped can be directly perceived from the pattern of stimulation arising from them. For example, a child who is shown in a novel object can instantly tell whether that object can be grasped or not because there is enough information in the object for the child to make an appropriate deduction. (Sheehy, 2004, p. 97)

Perhaps no other feature of the affordance concept creates such consternation in the psychological community as Gibson's insistence upon this stance. Absent an appreciation of the radically synthetic nature of his theorizing, Gibson's position appears both paradoxical and dismissive of cognitive science's emphasis on neuronal processes in the formation of perception. It remains, though, that Gibson makes no claim against the principles of cognitive science. The conventional cognitive modalities of description are incommensurate with the phenomenological stance integral to the codification of affordances. It may suffice to note that, according to the community of ecological psychologists, Gibson's basic motive was to objectify psychological processes (J. A. Devenport, personal communication, December 5, 2007). We may infer from

Gibson's model a stance that novel processing of environmentally-derived percepts is unnecessary to the perception of affordances, and that his theory is accordingly parsimonious.

Gibson's descriptive account of affordances exteriorizes psychological features that an empirically-minded psychologist takes for granted as "interior." If taken from the prescribed frame of reference- reciprocal relations between the organism and environment- one can more clearly see this view for what it is: a blend or synthesis of both perspectives (subjective-objective) rendered in a phenomenological frame. Affordances are apprehended by the individual organism, yet are conceived as features associated with the environment whether or not an individual organism apprehends them. Gibson's model calls for a figure/ground synthesis describing an organism's specific action in reciprocal interaction with external environmental features (from which emerges both context and meaning). As to the cognitivist's fixation on inter-cerebral machinations, bottom-up neuropsychological processes are simply inessential to Gibson's perspective and affordances' level of description.

The location of meaning, seen through the lens of ecological reciprocity, likewise defies the false binary of inside/outside. Meaning can satisfactorily neither be included in nor excluded from scientific modeling. The debate regarding its "location" is arbitrary. In the final analysis, meaning is simply not an object to which one may assign physical location, yet there is no more salient fact about the matter than Gibson's (and the Gestaltist's) observation that meaning figuratively *attaches* to objects. Perhaps the affordances theory would seem more credible if no placement was inferred. Still, in a discrete event, perception of meaning manifests with immediacy; meaning is mapped on the environs and its relevant objects instantaneously (from a phenomenological perspective).

> The Gestalt psychologists recognized that the meaning or the value of a thing seems to be perceived just as immediately as its color. The value is clear *on the face of it*, as we say, and thus it has a *physiognomic* quality in the way that the emotions of the man appear *on his face*... These values are vivid and essential features of the experience itself... Hence, they have what Koffka called 'demand character'. (Gibson, 1986, p. 138)

Put more succinctly, the affordance concept is founded on the primacy of perception over sensation, and the perceptual primacy of surface characteristics (Nakayama 1994).

> The whole thrust of [Gibson's] theory was to emphasize the richness and complexity of information in the environment rather than assuming the impinging information to be impoverished and requiring manipulation by

mental processes in order to achieve a coherent interpretation of the world. (Collins, 2007, p. 66)

Gibson's foundational adoption of Gestalt *direct knowing*, reflecting the immediacy of perception, conflates with philosophic issues of realism in the minds of recent commentators (Chemero, 2003; Hecht, 2000; Heft, 2001; Jones, 2003; Kirlik, 2004; McGrenere & Ho, 2000; Michaels, 2003; Natsoulas, 2004). The issue points up the radical nature of Gibson's assumptions:

> James Gibson wanted to understand how perception- that is, an animal's only means of collecting information from outside itself- can inform the animal about the meanings of environmental objects. For example, how does perception inform my cat that she can or cannot jump onto the kitchen table... Theories that address such questions fall into two categories. The first category assumes that objects and events have no inherent meaning, and that's the meaning must be created internally and stored by the animal, that is, an indirect-perception view. The other category assumes that objects and events have inherent meaning, which is detected and exploited by the animal without mental calculation, that is, a direct-perception view. J. J. Gibson's theories fell into the latter category. In fact, within experimental psychology, it is not clear that the latter category even existed before Gibson. (Jones, 2003, p. 107)

In a proposed clarification of the affordance concept, Stoffregen (2003) asserts that "affordances are properties of the animal-environment system... The dynamics of the animal-environment system are an emergent property and, as such, cannot be identified in the dynamics of the animal or in the dynamics of the environment" (p. 124). In another account (Natsoulas, 2004), the issue is couched as "Gibson's proposed direct realism of perception... This direct realism should not be misconstrued to be a naïve realism... it is rather, one might say, a sophisticated direct realism." I propose we recognize that the dominant issue remains phenomenological, not ontological. Further, granting that realism might be an appropriate focus, the naïve point of view ought not be excluded. It is the ecologically valid default perspective. Reflexively treating perceptions as veridical (naïve realism) is no less than the standard ecological imperative (Hergenhahn, 2001). As it is, this argument resembles the false binary of inside/outside wearing another mask, and it is in keeping with Gibson's hybrid logic to bid for inclusion, not exclusion. To our misfortune, Gibson largely fails to explicate "direct perception"- a persistent criticism of his theorizing (Sheehy, Chapman, & Conroy, 1997; Ullman, 1980). Although one cannot condemn the impulse to explore the philosophic venue in attempts to better define the figurative construct of affordances (situated in its conceptual ground of ecological psychology), these efforts have yet to bear much fruit. Perhaps the greater wisdom lies in recognizing that the concept of affordances, owing to the Gestalt principles from which it arises, must inevitably appear to do violence to these discrete, dichotomous categories of description.

The aspect of Gibson's theorizing that most directly attaches to considerations of sensation and perception (as conventionally conceived) is absent many discussions of affordance, yet essential to understanding its basis. If one appreciates the holistic nature of an affordance proper as a representation of top-down theorizing, the complementary bottom-up aspect of Gibson's ecological psychology appears in the issue of *invariants*, components of the patterned structures in perception that enable apprehension of affordances.

> The concept of invariants is essential to Gibson's theory. Gibson considered perception to be an activity- a dynamic process. A perceptual invariant is a higher-order property of patterns of stimulation which remain constant during changes associated with the observer, the environment or both. For example, when you approach an object the pattern of stimulation on your retina changes, but not randomly. There are patterns of flow and this flow is lawful or invariant. (Sheehy, Chapman, & Conroy, 1997, p. 234)

Such patterns are known as formless invariants (Reed & Jones, 1982). Structural invariants are patterns of relationship that are reliable features of perceptual stimulation, as when size constancy allows our visual judgment of relative distance or proximity of comparably sized objects (the one presenting a smaller image being farther away). Controversy persists regarding the degree to which these perceptual capacities are inferential and experience-based, genetically innate, or both (Rock, 1995).

Both the subtlety and utility of Gibson's theorizing can be appreciated in the example of his wartime studies regarding perceptual patterns of optical flow. This work demonstrates how perception of a *formless* invariant defines an affordance (in this case, a pilot's targeted landing).

> In his early work on aviation he discovered what he called 'optic flow patterns'. When pilots approach a landing strip the point towards which the pilot is moving appears motionless, with the rest of the visual environment apparently moving away from that point. (McLeod, 2007, paragraph 20)

Note, too, how "optic flow patterns" exemplify the interdependent and emergent nature of the resulting affordance. Neither the observer nor the environment alone can account for this quality of cognitive manifestation.

In the Darwinian context of evolved behaviors, where environmental change and organismic development are each said to reciprocally shape the other, sign stimuli and display behaviors serve as mundane examples of *structural* invariants that serve to discriminate between types of aggression. In simpler species, perceptible sign stimuli signaling mere presence of another of like species may trigger acts of territorial defense. More complex organisms employ discrete display behaviors for aggressive acts ranging from juvenile play fighting to contests for mates, each of which serves as a structural invariant upon which elaboration of their respective affordance depends. In the case of play behaviors, the perceptible proximity of adults can be considered another defining structural invariant.

Gibson sought the means to match specific behaviors and perceptual phenomena with precise environmental features to render enriched, more definitive descriptions of behavior; these advanced codifications respect the mutuality and reciprocity inherent in ecologically valid stimuli. Too often, our convention is to merely provide ad hoc, interpretive labels for situations in which observed behavior is embedded. These labels can function as hidden assumptions that obscure as much about an event as they reveal. Ecological perceptual theory seeks those empirical referents that may better index the context of behaviors (to which unambiguous meaning(s) might then be assigned).

Why a new psychology of perception?

Compared to the ecological view, the most prominent of our perceptual theories are extraordinarily reductive and emphasize static sensory representation (versus process). As befits our scientific heritage, we tend to model a Newtonian universe in both descriptive speech and writing. Note how uncritically we disseminate Helmholtz's conceptual model of sensation, grounded in assumptions derived from classical mechanics (Buxton, 1985). Any departure from this conventional stance can appear inherently transgressive, or inferior. To conscious awareness, our cognition appears to craft mental representations- discretely sliced, freeze-frame captures, abstracted from the sensory stream to which we have access from a solitary perspective in space and time. However imperative it may be for us to condense and objectify percepts (given the apparent constraints of mental representation), the process profoundly constrains cognition. We could speak of a profound and fundamental inconsistency between the constant flow of what is real, and the static representations that our percepts capture. Intact experience is a rich, dynamic *flow* rather than a string of manipulable, frozen percepts that can only feign to represent that multimodal richness. In short, our conventional ways of modeling reality necessarily introduce systematic distortions (even in "simple" perception). The Gestalt program lives on in witness to these truths.

Gestalt psychology emphasizes structure in our perceptual or phenomenal field. In field theory, "environmental features constrain and channel goal-directed behavior rather than provoke or elicit it" (Heft, 2001, p. 213).

> The only framework for the analysis of perception available to most psychologists is one that takes physical stimulation as the appropriate conceptualization of the "stimulus". Beginning with a conceptualization of the stimulus as physical stimulation at the receptor level creates enormous, and perhaps insurmountable, theoretical and philosophical problems for any account of perception because from the outset the structural properties of the environment are absent. (Heft, 2001, p. 8)

How are an organism's senses interactively adapted to achieve interface with the world? This issue is central to an ecologically valid psychology (and a physiologic science which supports it). Any cursory examination of our conventional frame of reference reveals a glaring deficit in consideration given to our representation of the environment.

> From the outset, experimental psychology has been caught between, on the one hand, following successful paths established in the physical sciences and, on the other, recognizing the necessity of grounding its concepts in evolutionary theory. A dilemma arises from psychology's being thusly positioned because of some conceptual differences between the Newtonian worldview that underlies classical physical science approaches and a functional perspective of an evolutionary account of living processes. Newtonian physics is an attempt to describe a timeless world that is already in place. An evolutionary approach assumes a dynamic world continually coming into existence in often unforeseeable ways. (Heft, 2001, p. xxix)

Invoking the phenomenon of organism-environment interaction is often limited to referencing the general principle in the absence of context, with no explication. Should an elaborated account be offered, it commonly concerns speculative inferences regarding the evolution of organismic functions or, more rarely, the qualities of a niche that are thought to account for species characteristics. Gibson's ecological psychology aims to model the dynamic interaction of specific environmental features (with their accompanying opportunities and constraints) and particular organismic capacities (actions) embedded in situational contexts.

Whereas the conceptualization of person processes has radically changed over the past three to four centuries, the concepts that psychologists employ today to describe the environment are substantially the same as those that scientists used in the days of Galileo, Descartes, and especially Newton... Here is the origin of many of the theoretical tensions in experimental psychology. Put perhaps much too simply, the reason is this: the implications of the Darwinian revolution in the life sciences have yet to catch on fully in contemporary psychology. While psychological analyses of organismic processes have been transformed by evolutionary thinking, psychological analyses of the environment relative to organismic functioning have not. (Heft, 2001, p. 5)

The reciprocal nature of interaction between an organism and its environment is central to ethology and ecological theory. A species comes to display certain characteristics as a consequence of its shaping and being shaped by key demand characteristics of its environs (Goodson, 2003). Accordingly, fundamental to ecologic perceptual theory is the assumption that feature characteristics of an environment shaped the nature of an organism's perception. In accord with this logic, how could the meaning of an environmental object fail to be intrinsically associated with invariant perceptual patterns intrinsic to environmental features? Gibson's affordance theory is clearly a first step toward discriminating and codifying these interactive, complementary phenomena.

Conceptual frameworks provided by the physical sciences and the life sciences, as well as phenomenological analysis, are alternative descriptive systems and each descriptive system may be more appropriately suited to one kind of phenomenon than another. What often seems to be absent in much of contemporary psychology is explicit recognition that many of its commonly used concepts stemmed from alternative explanatory systems. One way to conceptualize the differences between the concepts of these alternative explanatory systems is with reference to the notion of differing levels of organization. (Heft, 2001, p. 6)

Our immediate sense of lived experience in the world is a presence populated with intact items and discrete "others". This natural state of awareness, arising in phenomenological mind, does not encompass an analysis of constituent components (a microscopic view). Neither does it ordinarily embrace dimensions of macroscopic structure beyond the family or other intimate groups. We are typically aware neither of the electrochemical transactions of our nervous system nor of energy patterns of the greater biosphere (save perhaps the local weather). We are especially and uniquely attuned to those things in our ordinary experience that we have habitually objectified and are near at hand, both as phenomena and as percepts. Neither quantum nor astrophysical phenomena, fascinating though they be, are relevant to awareness from the ecologic perspective.

Gibson's *The Ecological Approach to Visual Perception* (1979) begins with the presentation of an ecological perspective. Essential to this perspective are two claims: that the relation between the animal and the environment is best characterized as a mutuality and a reciprocity, and ecological phenomena are to be found at an intermediate range of scale and duration.... A physicalistic framework operates at the extremes of size, from atomic and subatomic analysis, on the one hand, to cosmic analysis, on the other. The psychological level operates at an intermediate range of size, at a scale comparable to an organism considered holistically and purposively. A description of the environment commensurate with this level of analysis is an ecological description. (Heft, 2001, p. 109 & 111)

This author proposes that the language Gibson employs to define his central concept deserves careful consideration and special treatment. He is crafting a not entirely literal and denotative concept but one that also bears elements that appear connotative, a non-convention made necessary by the inevitable distortions inherent in the act of adopting common dichotomies (i.e., subjective-objective) as polar perspectives. Collapsing these false binaries gives rise to operational definitions that read unlike other scientific description, and necessarily so. Furthermore, the theory of affordances is genuinely and quite literally radical. Gibson's novel linguistic code, as peculiar as it may seem, remains essential. Admittedly, his novel use of language generates descriptions that, at first appraisal, can appear inconsistent. Instead, these formulations call for an understanding grounded in a non-Aristotelian logic that transcends conventional linear thinking and requires that we relax a reflexive tendency to rigidly categorize the components.

Though Gibsonian theory implies that sensory apparatus alone is sufficient for effective perception, we may yet infer that our sensory system is dynamically restructured by its experience. Although the phenomenological perspective of ecologic perception does not address learning, one may also infer that active processing educates the senses (and yet no active processing be required for direct perception). This nonlinear logic allows both/and instead of either/or reasoning. In sum, put more simply, the affordance concept represents a hybrid perspective that demands hybrid descriptions, and a commensurate logic to apprehend its insights.

We have seen that the application of a rigid, excluded-middle logic has no legitimate bearing on the

meaning of environmental objects. Then, is meaning dependent upon inside-the-head CNS processing or, as Gibson proposes, can the senses themselves function as perceptual systems? The appropriate deduction? It's a trick question. There is empirical evidence for a plurality of theoretical stances, each potent with explanatory force, and we must therefore conclude that the whole of perceptual theory is decidedly underdetermined.

Proposed refinements of the affordance concept

The critical factor of *context* is well recognized in the psychology of learning, memory, and cognition. In decision theory, the issue appears as *framing*. Then, recall that specifying *situation* is essential to fully delineate an affordance:

> [T]he framing assumptions of ecological psychology are one form of a general theoretical stance ... called *situativity theory* (p. 337)... in which cognitive processes are analyzed as relations between agents and other systems... Bickhard and Richie (1983) argued that Gibson's thinking evolved from a view of perception as encoding features of the environment toward a more general view of perception as an aspect of a person's or animal's interaction with the environment... The term *affordance* refers to whatever it is about the environment that contributes to the kind of interaction that occurs.... Affordances and abilities are, in this view, inherently relational... The relativity of affordances and abilities is fundamental. Neither an affordance nor an ability is specifiable in the absence of specifying the other. (Greeno, 1994, p. 338)

Situated cognition is a multidisciplinary approach to human-computer interaction and cybernetics (Clancey, 1997):

> The theory of situated cognition ... claims that every human thought and action is adapted to the environment, that is, *situated*, because what people perceive, how they *conceive of their activity,* and what they *physically do* develop together. (p. 1-2)

A symposium held at the 2002 meeting of the International Society for Ecological Psychology (ISEP) was dedicated to the exploration of affordances. What constitutes an affordance, the membership was quick to note, remains an open issue (Jones, 2003). Chemero, among the emerging authorities on Gibsonian theory, notes a continuing controversy between two views concerning environmental characteristics relative to affordance theory. Though some have sought a logical connection with evolution by natural selection, claiming that animals exploit discrete properties of objects, affordances derive from a different ontological

perspective than that of classical physics. Chemero's clarification argues that affordances are not properties (or at least not always so), being better understood as particular features of whole situations. And, underscoring their unconventional ontologic status, he asserts that affordances serve to characterize the organism-environment interaction; that is, they are not "in" the environment but specify a relationship within a situation (Chemero, 2003):

> It is neither of the person, nor of the environment, but rather of their combination ... [P]erceiving affordances is placing features, seeing that the situation allows a certain activity. Thus, the environmental relata in affordances must be features, not properties. (p. 187)

He further claims that the current formal definition of affordance is deficient, lacking specificity regarding "which aspect of the environment is related to which aspect of the organism, and in what way" (p. 187). Chemero emphasizes Gibson's lucid analogy (cited previously) and the principle of complementarity implicit in affordances:

> Gibson (1979) pointed out that a *niche* is the set of affordances for a particular animal...[and] suggested that this is the way to make sense of the mutuality of animals and environments. An animal's abilities imply an ecological niche. Conversely, an ecological niche implies an animal. (p. 191)

Whereas a habitat has a definable location, a niche does not. Yet niches, comparable to affordances in this respect, are recognized as real.

Stoffregen, another emerging authority, offered this modification of the affordance concept at the 2002 ISEP symposium:

> In this definition, affordances are properties of the animal-environment system, and they exist only at the level of the animal-environment system. An important feature of this new definition is that it does not refer to or include behavior; that is, it does not include the actualization of affordances. Affordances are opportunities for action; they are properties of the animal-environment system that determine what can be done... The dynamics of the animal-environment system are an emergent property and, as such, cannot be identified in the dynamics of the animal or in the dynamics of the environment. (Stoffregen, 2003, p. 124)

Another symposium participant noted a need to counter the perception that an affordance necessarily implies performance of associated behaviors, and nominated the more succinct term "perceived affordance" to better distinguish the concept (Norman, 2004).

Harry Heft is arguably the leading authority in the field of ecological psychology. His 2001 *Ecological Psychology in Context* stands in evidence of that credential. Heft's input to the 2002 ISEP symposium

contributed a wealth of knowledge clarifying Gibson's foundational principles and their underpinnings in both Gestalt psychology and William James's radical empiricism:

> Why is it that affordances have received attention within psychology only in recent decades if they are supposedly what individuals perceive most fundamentally? This paradox can be explained, in part, by the fact that psychologists have usually considered the character of perceiving from a detached stance, and then reified the results of this analysis- an error William James called *the psychologist's fallacy*- rather than attending to the immediate flow of perception-action... (Heft, 2003, p. 149)

Elsewhere, this perceptual trap has famously been explained by the principle, "a map is not the territory" (Korzybski, 1994, 1933). The error is hardly limited to naïve psychologists but is an extraordinarily pervasive bias that manifests in both concrete and abstract mental representation. That is, the internal reality of our reductive interpretations is not equivalent to the richness of external reality, yet this folk psychological stance commonly prevails unchecked.

Heft (2003) has clarified fundamental issues regarding what constitutes an affordance, and offered what may be the most insightful explication of Gibson's key concept to date:

> Let me first be clear about the phenomena to which *affordances* refer... [A]t a basic, prereflective level of awareness, prior to the abstractions (e.g., categorization, analysis) all humans so readily perform on immediate experience, we perceive our everyday environment as a place of functionally meaningful objects and events... This aboriginal mode of awareness runs through the flow of our ongoing perceiving and acting, constituting its experiential bedrock... Perceiving the affordances of our environment is, if you will, a first-order experience that is manifested in the flow of our ongoing perceiving and acting. By *first-order experience* I mean experience that is direct and unmediated... *Awareness* sinks to a minimum at these times to such an extent that encounters with the world seem nearly automatic and habitual, and the experience of a boundary between the self and the world is negligible. (p. 151)

Striking ironies emerges with respect to apprehension of affordances and the standard scientific mindset. Affordances are experiential, whereas scientific investigation tends toward awareness grounded in deductive expectancy uninformed by awareness of either the nature of introspection or our compelling tendency to reify products of thought. An unfortunate but logical consequence is that pervasive bias and fundamental error

James labeled the *psychologist's fallacy* (Heft, 2003, 2001; Still & Good, 1998):

> The scarcity of affordances in psychological discourse is largely explainable in terms of the nature of intellectual inquiry itself. Science is fundamentally an analytical enterprise; thus, when we think about the environment for the purposes of psychological study we are prone to adopt this more detached attitude- and affordances are difficult to notice from a stance of detachment... This distinction between immediate and reflective modes of awareness has been made many times in 20th-century philosophy, particularly by individuals identifying themselves with a phenomenological orientation. An early expression of this distinction was offered by James in The Principles of Psychology (1890/1981)... We mistake concepts for percepts. In such cases, which are all too common, the psychologist is confusing *'his own standpoint with that of the mental fact* about which he is making his report' (James, 1890/1981, p. 195).

Heft (2003) offers this clarification of James's terminology: "In his late writings, James (1912/1976) called the phenomena of immediate (unmediated) experience *percepts* and the phenomena of reflection or analysis *concepts*" (p. 153). Again, a map is not the territory, and we too readily reify our conceptual models as if they fully captured the world's richness and depth.

Representative research

Graceful and intuitive examples of application for Gibson's theory of affordances lie outside the realm of psychology proper. In particular, the related fields of design and ergonomics provide accessible illustrations of affordance:

> The computer system, with its keyboard, display screen, pointing device (e.g., mouse) and selection buttons (e.g., mouse buttons) affords pointing, touching, looking, and clicking on every pixel of the display screen... The real question is about the perceived affordance: Does the user perceive that clicking on that location is a meaningful, useful action to perform? (Norman, 2004)

Perhaps because psychological consequences are clearly implicit in human engineering, discussion of design implementation may naturally segue to consideration of opportunities and constraints across related dimensions of manifestation: physical, psychological, sociocultural. Physical constraints are closely related to real affordances: Thus, it is not possible to move the cursor outside the screen: this is a physical constraint. Logical constraints use reasoning to determine the alternatives... Cultural constraints are learned conventions that are shared by a cultural group. The fact that the graphic on the right-hand side of the

display is a "scroll bar" and that one should move the cursor to it, hold down the mouse button, and "drag" it... all this is a cultural, learned convention. (Norman, 2004, paragraph 6).

Many researchers studying human-computer interface, artificial intelligence, and information processing have grasped the high utility of ecological perceptual theory (Norman, 2004; Clancy, 1997). Recent work in these camps has been generative of both theoretical refinements and practical applications:

> In reaction to Norman's (1999) essay on misuse of the term *affordance* in human-computer interaction literature, this article... [affirms] the importance of this powerful concept... We define and use four complementary types of affordance in the context of interaction design and evaluation and evaluation: *cognitive affordance, physical affordance, sensory affordance, and functional affordance.* (Hartson, 2003, p. 315)

Novel implementations of information processing (IP) strategies transcend the linear "symbolic cognitive modeling" characterizing mainstream cognitive psychology:

> Broadly speaking, situated cognition is a philosophical perspective and an engineering methodology... According to this theory... the memory mechanism that coordinates human perception and action is quite different from the stored-description memory of descriptive models... Descriptions allow us to extend our cognitive activity into our environment ... (Clancey, 1997, p. 3)

Situated cognition views affordance theory as pivotal to implementing detailed expression of the evolutionary concept of *structural coupling*: "By this view, it is the structure of the organism that 'determines that it may be perturbed and how it will be perturbed by other objects' (Dell, 1985, p. 8)" (as cited in Clancey, 1997, p. 90).

In an early research application of Gibson's theory, Heft (1983) crafted a comparison studies of affordances. His set of experiments explored the relative utility of visual sequences of vistas and the transitions between vistas in the process of way-finding. The hypothesis framed way-finding in terms of perceivable invariant features (transitional views) that connect a succession of vistas. Subjects viewed a film that portrayed either a complete walk along a particular route, an edited version showing only the transitions at turns, or an edited version that showed only the vistas seen between transitions. Viewing transitions alone proved to be "somewhat more reliable" than viewing vistas alone for performance in way-finding. That ranking was confirmed by confidence ratings of associated turn decisions as well (Heft, 1983). Discussion emphasized the contrast with standard theories of perception (as constructive process):

From Gibson's ecological approach, perception does not require supplemental cognitive processes because the information available to the perceiver is sufficiently rich so as to unequivocally specify objects, events, and the extended layout of the environment.
    (p.136)

A literature review of affordance studies notes how the early 1980s saw the focus of social perception research shift away from errors in perception toward adaptive function. This new thrust directed attention toward external sources of stimulation in people's appearance, movement, and voice. Researchers sought valid cues for recognizing traits, hypothesizing how we may use particular constellations of cues to appraise traits in others (Zebrowitz & Collins, 1997).

> [C]onsistent with the tenet that 'perceiving is for doing,' social affordances are the opportunities for acting, interacting, or being acted upon that others provide. Because affordances are inherently connected to a particular social context, studying the accuracy of perceived affordances will compel researchers to consider the neglected topic of contextual influences on accuracy. (p. 217)

The authors "advocate the value of studying not only the accuracy of perceived traits but also the accuracy of perceived affordances" (p. 205), claiming that people's accuracy in perceiving the latter has "at least as much theoretical and practical importance as determining accuracy in perceiving others' traits" (p. 217). Applying foundational principles of evolutionary theory, the authors elaborate an ecological rationale of social perception based on attunement to adaptively relevant features of social interaction. Emphasis is given to overgeneralization affects in social perception:

> The evolutionary importance of detecting attributes such as age, emotion, health, species, and identity may have produced such a strong preparedness to respond to the physical qualities that reveal them that our responses are overgeneralized to individuals whose physical qualities merely resemble these attributes. (p. 212)

The foregoing array of studies is decidedly unthematic, the primary intent being to showcase the flexibility and wide-ranging utility of Gibson's theory. Reading across the assembled examples allows a perspective to emerge that highlights the radical and seminal nature of the affordance concept. True to their origins in Gestalt thought, affordances represent a patterning of perception, applicable across the abstract landscape of our mental representations, from the simplest perceptions of physical features of the environs to the richly intertwined percepts of the social realm. Across contexts, shifts of emphases highlight one or another fundamental principle of ecological psychology to greater

or lesser degree, yet the gist remains. For all its apparent paradox, the affordance concept represents psychology's current best effort to codify the dynamic, reciprocal relationships of an aware organism embedded in its rich environment.

Synthesis, implications

Ecological perception takes place within an organism's natural, real-world placement (VandenBos, 2007). Gibson's theory makes necessary the specification of relationship between particular environmental features, and the functions (and potential performance) of an organism. Gibson viewed ecological perception as holistic, seeing organism and environs as a single and inseparable system. This holism is revealed in his ancillary concept of environmental invariances, which is clearly representative of that necessary relationship, of both inside and out, both of organismic function and environmental structure. As the concept of affordances evolved across disciplines, the necessity of accounting for context has become increasingly apparent; one must address a specific organism in its specific environs and specific situation to realize the full meaning inherent in what opportunities and constraints an affordance presents.

Definitions of what constitutes an affordance remain partial, and can appear ambiguous. A global definition is likely not possible, and it is fitting there exist both general and discipline-specific descriptions. Gibson's last writings were published in 1979, the year of his death. Much work remains to consolidate, refine, and fulfill his vision. His final book (Gibson, 1979), "concluded with the plea that the terms and concepts of his theory should 'never shackle thought as the old terms and concepts have'" (Sheehy, 2004, p. 100). We wisely employ reductionistic language, yet foolishly ignore the greater meanings behind reified terms and constraining metaphors. The utility of our scientific heritage and vast knowledge is significantly impaired by this forgetfulness. Life forms are not machines, yet we indoctrinate our children with this fiction, blithely encouraging the misapprehension that biology is mere physics (an inductive inference with defensible logic, perhaps- but dependent on a code of physics that does not exist).

> Critics have argued that Gibson's account denies a place for information processing... Supporters counter that his ecological theory shows how the environment augments the internal processes of the mind/brain, so that information processing can no longer be understood except in terms of factors [external] to an animal. (Sheehy, 2004, p. 98)

Gibson's critics invite a counter-accusation of essentialism. Information processing (IP) theory enjoys significant explanatory power, yet so too does gestalt theory. The strengths of one derive from its differences from the other, and this simple fact serves to emphasize the limitations of any one system of representation. These contrasts invite analogic interpretation of perceptual theories as Gibsonian affordances, with each stance bearing characteristic ideational opportunities and constraints.

Inordinate devotion to any lone theory invites denial of the tentativeness of its assumptions (and their reification), promoting fallacious thinking born of metaphor error, occurring "when a seems like or works like concept takes on a life of its own and then confuses rather than clarifies" (Goodson, 2003, p. 318).

> Because we do not understand the brain very well we are constantly tempted to use the latest technology as a model for trying to understand it. In my childhood we were always assured that the brain was a telephone switchboard. ('What else could it be?') I was amused to see that Sherrington, the great British neuroscientist, thought that the brain worked like a telegraph system. Freud often compared the brain to hydraulic and electro-magnetic systems. Leibniz compared it to a mill, and I am told some of the ancient Greeks thought the brain functions like a catapult. At present, obviously, the metaphor is the digital computer. (Searle, 1986, p 44)

Another conspicuous example concerns modularity of cognitive function, an increasingly common extension of the IP metaphor (Fodor, 2001). While the analogy of hard-wired modules is not without utility, we now suffer claims that mental functions are locally identifiable by positron emission tomography (PET) scanning and functional magnetic resonance imaging (fMRI), a state of affairs inspiring one prominent neuroscientist to label such assertions "the new phrenology" (Uttal, 2001). Any monolithic approach to scientific modeling places unconscionable constraints on the character of all other knowledge claims- a stance that inspired the neologism "epistemopathology" (Koch, 1981). Koch speaks of "scientistic role playing" whereby:

> thought or inquiry regards knowledge as the result of "processing" rather than discovery. It presumes that knowledge is an almost automatic result of a gimmickry, an assembly line, a "methodology." ...Presuming as it does that knowledge is generated by processing, its conception of knowledge is fictionalistic... (p. 257 & 259)

The assumptions that underlie IP theory need not be adopted in ecological psychology any more than information processing need incorporate the language of emotion or imagination. Finally, witnessing the character of lived experience suffices to withstand such criticisms:

> As Gibson long argued, when the dynamic nature of perceptual experience is fully embraced and, accordingly, when event perception is recognized as fundamental (Warren & Shaw, 1985), the

traditional take on perceiving as an epistemologically dumb process, necessarily in need of supplementation by extraperceptual factors, must be reevaluated.
(Heft, 2003, p. 166)

The frontier of affordance theory belongs to those researchers seeking to clarify the nature of environmental properties- the Gibsonian invariances that facilitate perception of events. Early work using artificial intelligence modeling of vision spoke of the challenge:

Marr (1982)... points out that the task is enormously more complex than Gibson supposed. This does not mean that Gibson is wrong, but it suggests that something he considered to be relatively straightforward turns out to be extremely problematic, and this indicates that part of his theory is underelaborated. (Sheehy, Chapman, & Conroy, 1997, p. 234)

Conceptually, many advances have been achieved, terminology clarified, and theory elaborated. Goodson (2003), for example, offers a particularly thorough exploration of perceptual structuring, environmental factors, and dynamic change as these pertain to ecological psychology. Clancey (1997) remains a most elaborate and sophisticated exploration of representational systems, and critical implementation of ecological theory. Heft (2001) is unsurpassed in scope, and offers a most comprehensive and coherent account of the landscape of Gibsonian ecological psychology.

For many, the most significant dimension of affordance theory is its grounding in first principles of Darwinian ecology: an organism and its environs are reciprocally shaped; perceptual features are adaptively molded in response to specific environmental features; both simple and complex organisms exhibit patterns of response to stimuli that are demonstrably innate. Gibson's work is among the first efforts to operationalize these general principles. He argued that the adaptive value of environmental objects and events are directly perceived (Kazdin, 2000). An affordance, Gibson reasoned, is defined by a pairing of an organism (and by extension, its potential or realized behavior) with specific environmental features, embedded in a particular situation or context.

The fact that so many cognitive scientists still do not understand it can probably be attributed to two factors, of which the first is more fundamental: Gibson's conceptions are really, remarkably, genuinely *new*... Perhaps unfortunately, Gibson made this argument just when psychologists were least prepared to hear it... This is the second reason why so many cognitive scientists are mystified-and sometimes irritated- by the ecological approach. They believe that what might be called the "sciences of the inside of the head" (especially neuroscience) are making rapid progress and that many classical problems, including those of perception, may soon be resolved. For Gibson, in contrast, the inside of the head was exactly the wrong place to begin (Neisser, 1990).

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