4 Affordance

Affordances Are Neither Form nor Function

Don Norman said that it is obvious what is meant by "affordance": "Plates [on doors] are for pushing. Knobs are for turning. Slots are for inserting things into. Balls are for throwing or bouncing."[1] What is deceptively attractive about this list, for design at least, is the implication that the physical form of an artifact dictates which action to perform. The job of the "designer," from this perspective, is to ensure that the form of the artifact supports the desired function. But if Norman's definition is correct, then it offers little beyond the design credo that "form follows function." While there has been vociferous debate on the difference between form and function, the credos themselves shed no light on the practice of design, partly because speaking of "form" or "function" in the abstract makes little sense. One route out of the cul de sac of abstract function is to declare the "function" to be whatever culturally significant "meaning" is applied to a given form. In this way, however, we stumble back into information processing, where "meaning" has a symbolic representation. To preempt the argument that will be advanced in this chapter, assuming that "affordance" is a property of the artifact ignores the situation in which it is used, in terms of the capability of the user or the features of the environment. Further, the notion that there is a "desired function" that dictates how the artifact "should" be used implies that the best way to use an artifact can be dictated by the designer through the form of the artifact.

Looking at the holes in the handles of a pair of scissors, you might guess (if you had not seen such an artifact before and you are right-handed), that the smaller hole is for the thumb and the larger hole is for two fingers. Holding the scissors in this way allows movement of thumb and fingers to open and close the scissors. The form (holes in the handle) indicate function

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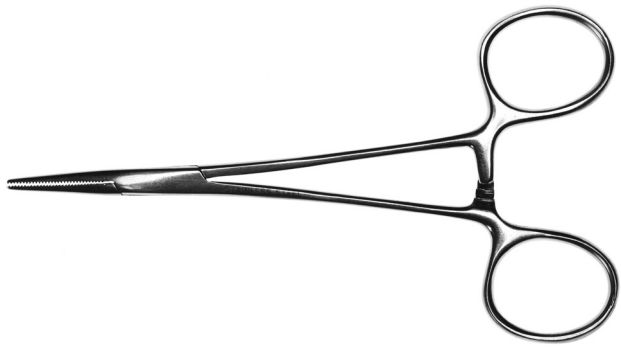

Figure 4.1
Needle holders. Needle holders do not necessarily "invite" an appropriate grasp, unless one has knowledge of the function (activity) to which they can be applied. The placement of thumb and ring finger is natural for the practiced surgeon but not necessarily intuitive for the inexperienced user. Surgical Instrument (clamp, needle holder) is licensed under CC BY 4.0.

(how to grasp the artifact and, once grasped, how this artifact might be manipulated). What happens if we apply this interpretation to a visually similar but less familiar artifact, such as the needle holders used in suturing (figure 4.1)? The holes in the handles of needle holders are the same size, so it is not obvious where to put thumb or fingers. You might assume that the thumb goes in one of the holes and the other is for the fore-finger or middle-finger if these were to be used for opening and closing like scissors. However, this is not the case. You should use the thumb and ring finger to preserve flexibility about the wrist. In other words, the form (of the needle holders) is not sufficient to indicate their function. Indeed, the function here is not simply a property of the artifact (needle holders) but arises from human capability (experience in using needle holders) interacting with it, and this would make most sense in a specific environment (the needle holders with a threaded needle and tissue to be sutured). Consequently, a concept of affordance must provide "a theory of the world as we experience it in terms of what we can do."[2] We constitute our experienced world through our bodily actions (i.e., we lay down a path in walking),[3] and a theory of affordance should be capable of reflecting this.

So, it makes no sense to speak of an artifact "having" an affordance. And yet, there is an extensive literature, particularly in the fields of design and

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human-computer interaction in which affordance is treated simply as a property of an artifact. The implication is that affordance is a property that can be designed-into the artifact (say, a coffee cup) and that this property supports, permits, invites, a person to perform an activity (say, drinking coffee). But there is an obvious problem here: the coffee cup also "affords" containing liquid (with additional affordances of transporting the liquid or keeping it hot), cleaning after use, storage, disposal, and so on. Even this trivial example raises the question of *which* affordance we might mean because the same artifact participates in a variety of affording situations.[4] Responding to an artifact depends on appropriate behavioral meanings. A scrub nurse picking up a pair of needle holders, to pass them to a surgeon, might not even use the holes in the handles, but might orient them so that the holes are presented for a suitable grip, or the nurse might handle them differently when picking them up to put them into a tray for sterilizing.

Formal Descriptions of Affordance

One approach that has been explored to capture complementarity (as discussed in chapter 3) in human-environment-artifact systems is through formal descriptions, either in terms of computer programs or statements couched in formal logic. The concept of affordance has received much attention in the field of robotics, and this can be traced to the seminal work of Rodney Brooks and his claim that "world is its own best model."[5] Rather than working from a preprogrammed model of the world in which it is operating, a robot could learn relationships between properties of artifacts and actions that it can perform. From this, "affordances appear from the interaction between the robot and the environment and hence, depend on the world, the agent's motor and perceptual capabilities and its experience."[6] If the available information points to more than one sensorimotor pattern (or if the sensorimotor pattern is associated with more than one set of proprioceptive states) then affordance competition[7] could arise and would need to be resolved. Sridharan and Meadows offer an elegant solution to this problem by separating *affordance relations* from *executability conditions*.[8] What is attractive about these terms is that the focus is on the relations (between elements) rather than solely on the properties of either artifact or agent, and that these relations will change under different situations (or executability conditions). Further, while the work on affordances

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in robotics makes use of research on human activity, the concepts outlined here could be usefully applied back to discussion of human activity. For example, the emphasis on learned relationships (gained from repeated exposure to similar situations), the need to resolve affordance competition, and the distinction between affordance relations and executability conditions can all apply to human activity.

As we noted in chapter 3 the environment constrains activity in terms of the opportunities it presents, for instance, in terms of artifacts available to the individual or of the interaction between these artifacts and the bodily constraints of the individual. While bodily and environmental constraints can limit or encourage specific actions, the choice of action will further depend on task constraints, which could include a purpose for completing the action as well as some criteria that might define good or acceptable performance.[9] Performance can then be evaluated in terms of elements that constrain or allow activity. This combination of constraints implies a competing set of objectives and a need for multi-objective satisfaction (as we discussed in chapter 2)

Lewin, who provided a precursor definition of what became known as "affordance," developed a simple equation[10] to model behavior (B) as a function (f) of person (P) and environment (E):

$$B = f(P, E).$$

This could be read as a trivial statement that an environment supports an action. But I think the claim here is deeper in that Lewin presents this as a specific person (with defined capability, goals, and so on) responding to a specific environment (with defined features). One can see how this relationship could reflect the notion of bodily and environmental constraints. So, an adult human hand can grasp the handle of a full cup and lift it in a way that a child's smaller hand might not be able to,; in other words, the cup handle (for the adult) can be grasped because its properties (i.e., size and shape) match the disposition of the person, defined by hand-size, and the full cup can be lifted because of the adult's strength (which can also ensure stability during the lift). However, it is worth noting the obvious point here that one can lift a cup without using its handle. In this case, the diameter of the cup defines its property, which is matched by the disposition of the person. Whether one lifts the cup by its handle or not must be influenced by more than the form of the cup. In this case, the cup

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(and actions performed with it) exist in an environment that, according to Gibson, can be defined in terms of both convention and natural laws. The latter would relate to phenomena such as the temperature of the cup (one might be more likely to use the handle if the cup contained hot liquid) and the weight of the cup (lifting with the handle or grasping the cup above or below the handle would have different repercussions for counteracting the effect of gravity). The former would relate to what might be considered "polite" or "acceptable" behavior in a given environment, such as a greasy spoon café versus the Savoy Hotel.

Formal descriptions reflect relationships between bodily and environmental constraints, but they do not express task constraints or capture the situation in which the relationship arises.[11] Abbate and Bass develop a formal description that reflects situational constraints:

Possesses(affordance$_i$)(Xp, Zq).[12]

This relationship becomes expandable with specific values of the properties, *p*, of an artifact, *X*, which are relevant to a given "goal" and with specific values that define the capability, *q*, of an actor, *Z*, responding to these features. An example they provide involves a cabin door in an airplane. At altitude the door is plugged into its fitting under high external pressure, and on the ground the door can be opened by pulling out a lever and turning it. In this instance, the "environment" is defined in terms of airspace (which could be ground or in flight), aircraft (which could be a specific type), cabin (with properties that change according to airspace, e.g., pressurization), door (which can be opened), lever (which fits into a slot and can be moved). Relations between these can be defined in a formal description as follows:

possesses(doorOpenable)(Xp, Zq) = true if:
Xp. Airspace. Aircraft. Cabin. Door. Lever l [Slot][top_of] = overlapping ^
Xp. Airspace. Aircraft. Cabin. Door.p2 [Cabin][left_of] = contained_within ^
Zq. Airspace. Aircraft. Cabin. Door.q1[position_back] = true ^
Zq. Airspace. Aircraft. Cabin. Door.q1[translate_left] = true.[13]

This description elaborates the context under which the door "affords" opening (in terms of external air pressure and the position of the lever, and in terms of the action performed by the person). What is potentially interesting about this approach is that artifacts may contribute to several

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"executability conditions," depending on the state of the environment and the goals of the person.

Any formal description is going to be bedeviled by the challenge of completeness; representing *all* contributory features of a situation using formal language quickly becomes overwhelming. Consequently, it is important to ensure that the problem is clearly stated (which, in turn, means that the problem is represented in a way that is amenable to the formal language in which it is being described). While this might offer benefits for verification and validation of design (which is what the formalism is intended to support), it does not provide a plausible model of what humans might do. To be fair, there is no intention on the part of Abbate and Bass that their formal description should reflect human cognition. This is also a way of highlighting the problem that an information-processing view of "affordance" might face: How would the human brain construct the ever-decreasing subtleties of this hierarchical knowledge structure?

To frame this problem more concretely, consider the notion of stimulus-response compatibility (SRC), which has been a staple part of ergonomics for the past half century. To illustrate this idea, in the choice–reaction time paradigm you have a row of four lights in front of you (labeled 1–4), and between you and the lights is a row of four buttons (labeled A–D). The buttons and lights are arranged so that 1 and A are adjacent, and so on. When one of the lights turns on, you must press one of the buttons to turn off this light as quickly as possible. In the adjacent (or congruent) arrangement, when light 1 turns on, you press button A. In an incongruent arrangement, when light 1 turns on, you have to press, say, button C. Not surprisingly, the congruent arrangement leads to much faster performance. Early accounts of the SRC suggested that the performance differences were due to "translation."[14] In information-processing terms, this "translation" is required to allow information-as-content in one "code" (stimulus layout) to relate to another "code" (action).

Contemporary explanations of SRC draw on the ability to extract salient features and pair these with an appropriate response. This is the "dimensional overlap" model,[15] which contrasts the overlap of dimensions (features) in a set (i.e., the congruence of arrangements) with the relevance of features within a set (i.e., how the features of a stimulus relate to a response). The congruent condition has both overlap and relevance. There is much to be said for the empirical evidence from SRC.[16] People prefer

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arrangements in which the features (light and button) are congruent, and this is termed a "population stereotype" (there is some work to suggest that different cultures might have slightly different population stereotypes).[17] Furthermore, most people produce faster responses with fewer errors in sets of stimulus-response pairings that have this preferred arrangement, as a consequence of SRC. From the perspective of affordance, it could be argued that SRC arises when information from environment (stimulus) relates to ability (response). In other words, there is potential argument that removes the need to appeal to a "translation" or a "dimensional overlap" to explain SRC.[18] Crossing one's hands in SRC experiments leads to an increase in reaction time, even when the position of stimulus and response artifacts remains constant, and this does not seem to be the result of a simple biomechanical constraint; reactions using crossed hands cannot be explained solely by conflict management, as proposed by the dimensional overlap model. This suggests that the relationship between response and stimulus involves more than the predefined mappings that SRC assumes. If we refer to the formalisms outlined earlier, it is difficult to see how these could account for the differences in SRC. In both congruent and incongruent conditions, Xp would be "light on," and Zq would be "press button." So, perhaps, we need to elaborate the Xp description to include Xp1 "light on" + Xp2 "light adjacent to button" (in the congruent condition), and to elaborate Zq1 "associate light label with button label" + Zq2 "press button" in the incongruent condition. But this would produce a near infinite regress in which all possible states need to be defined in order to produce a prediction of an action; in this way, the "action" becomes a matter of matching the features that define a given state. While the descriptions of affordance in this section provide formal descriptions of the relations between human-artifact-environment and their impact on outcomes, I am not proposing that this is meant to describe human behavior. For one thing, formal descriptions like those presented by Abbate and Bass cannot align with the radical embodied cognitive science (RECS) argument used in this book. On the other hand, these descriptions indicate how the elements in the human-artifact-environment system interact, in terms of the functions that are necessary and sufficient to ensure ongoing, reciprocal engagement, and the challenge of defining the "features" that need to be attended to. One reason for including this example is that it presents a set of "objectives" for an affordance. As noted in chapter 2, this set could be

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collapsed into an optimization problem, where some of the elements are held constant. In the cabin door example, the constant elements (for the human) could be defined by the environment and the physical relations between artifacts, and this would leave a subset of elements that relate to human-artifact interactions. For example, grasp and lift the handle.

Affordance, Capability, and Activity-Relevant Features

If an affordance was a property of an artifact, then, prior to performing an action with that artifact, one would need to "read" the salient features of the artifact that need to be elicited and interpreted. So, the notion of affordance-as-a-property-of-the-artifact could require the extraction of key features, alignment of these features to an appropriate mental model, and use of this mental model to specify the action to perform on the artifact. Having argued against the concept of mental model in chapter 2, we need to evoke a different explanation in order to account for affordances. In subsequent writings, Norman[19] distinguished "perceived affordances" from Gibsonian or "real affordances." Other writers distinguish "simple affordance" (which arises from perception-action coupling) from "complex affordance" (which involves interpretation and response to an artifact's form in terms of the user's culture, history, praxis).[20] Gibson's proposal is that we have a perceptual system that is tuned (through evolution and individual experience) to the environments in which we live. This means that there is no requirement for an interpretive act; we just "see" (or hear or otherwise perceive) a pattern of features to which we can respond: a cup full of steaming hot coffee is "seen" as a different artifact (supporting different actions) than a half-full cup of cold coffee.

As a cat walks through a narrow gap, its whiskers provide sensory information that enable it to keep away from the walls. Humans can judge whether to walk through a gap or whether we need to turn sideways, or avoid the gap entirely.[21] This ability to assess the appearance of artifacts in the world allows us to rapidly judge whether a particular action could be performed in all manner of situations, such as, for instance, step-onto-ability;[22] walking-up-ability;[23] sit-on-ability;[24] step-across-ability;[25] and pass-under-ability.[26] Rapid judgments about whether to turn your body to fit through narrow apertures as you approach these can be made even when bodies have been modified to an unfamiliar size, as when wearing "pregnancy packs," for

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example,[27] sports shoulder pads.[28] Increasing the weight of the body, such as by wearing a heavy rucksack, can alter judgments of the steepness of a hill.[29] These "body-scaled" perception of features of the environment guide action so that people are able to "see," or become "attuned" to, aspects of the environment in terms of an action that they want, and are able, to perform. What is important in this list of "*x*-ability" (where *x* is any verb) is that it is a reflection not simply of the properties of the artifact, but of the relationship between some features of this artifact and some property of the person. Related to this class of body-scaled affordances are action-scaled affordances; these involve people judging whether an action, such as reachability, is possible, so that people with longer arms estimate artifacts to be close to them[30] or people holding tools estimate artifacts to be closer.[31] These body- or action-scaled perceptions of environmental features provide partial support for the idea of embodied cognition. However, these should not be taken as complete explanations (any more than the suggestion that a cup is "pick-up-able"), because they capture one element (but not all) of complementarity in the human-artifact-environment system.

One might believe that the inexperienced user of an artifact needs to "read" the artifact prior to use to select an appropriate action, while the experienced user simply uses the artifact. However, an artifact such as a pair of needle holders (figure 4.1) might not obviously yield to such a reading without an understanding of the action involved in its use. Trial and error *might* allow you to try different grips (perhaps you could perform some basic suturing activity using the wrong grip without realizing that there is a superior means), but feedback would be required to confirm that the action was appropriate. This raises the question of what information is required to know how to *simply use* artifacts?

For this book, the challenge is to provide an account of what it means to "simply use" something. In connection with the contrast between "reading" and "simply using" an artifact, Humphreys[32] offered two distinct routes from artifact to action: (1) perception of specific features of an artifact (which Humphreys calls a "structural description"), which can be associated with knowledge of how to use that artifact (which he calls an "action description"); and (2) a direct link between the structural description of an artifact and the action description of how to handle that artifact (which he calls "affordance"). Notice that route 1 echoes Norman's "perceived affordance," and this is distinguished from route 2 affordance. This distinction between

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route 1 and route 2 hints at the question of what information is used in "reading" an artifact and how this information is obtained from the environment. When Norman uses the word "perceive," it is not in the same manner that Gibson uses it. Norman regards perception as an active process of assigning meaning to an artifact's features and associating that meaning with an appropriate action. For Gibson, perception is sensitivity to information that corresponds to action; there is no intermediary process of interpretation. This further illustrates the contrast between "information-as-content" and "information-as-context" and highlights a fundamental aspect of affordance.

Assuming that an artifact is perceived in terms of information-as-content, it might offer competing interpretations, and the challenge is how this competition might be resolved. We could, following Norman's proposal, seek to "read" the artifact so that certain of its features align with the function that the artifact can support. In this way, the size of the cup and the position of its handle might be more salient than the pattern that is painted on it. The idea of "reading" an artifact might be appropriate in disciplines such as archaeology, particularly when the form of the artifact is so unfamiliar that it does not easily support "reading," but it does not feel as if this is something that we perform with familiar artifacts in our everyday life. Indeed, according to his material engagement theory, Malafouris argues that understanding the manner in which people physically interact with the artifacts[33] is necessary to understand the embodied nature of interaction between person and artifact and how this supports ongoing, reciprocal engagement. If this is the case, then the range of affordances needs to be considered not solely in terms of the artifact but also in terms of the situation in which the artifact is placed, where the situation is shaped by the environment and the capabilities of the human. This idea has been developed by Rietveld and his colleagues in the skilled intentionality framework in their proposal that there are "landscapes of affordances."

Skilled Intentionality Framework

The skilled intentionality framework (SIF)[34] has four basic premises, which align neatly with RECS:

1. There is no division between "higher" and "lower" cognition; both can be understood in terms of skilled activities of engaging with situations in the world.

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2. Skilled activities are temporally extended processes in which agents coordinate to multiple relevant affordances simultaneously.
3. The affordances the environment offers are relative to the abilities available in a form of life.
4. "Higher" order cognition does not necessarily depend on mental representation.

SIF accounts for an "individual's selective openness and responsiveness to a rich landscape of affordances."[35] Broadly, SIF seeks to explain how people can encounter multiple potential affordances in the environment and selectively respond to those that are salient to a specific situation.[36] In SIF, intentionality is considered in terms of skillful coping. In this manner, "Affordances are relations between aspects of a material environment and abilities available in a form of life,"[37] which can offer opportunities for action. In order to explain how we selectively respond to affordances, SIF proposes that there are "multiple simultaneous states of action readiness for engagement with affordances."[38] An interesting position that the developers of SIF take is that "skill" is not restricted solely to physical activity but can encompass all aspects of behavior, including those that we might term "cognitive" or "cultural." This accords with Ingold's notion of skill as "*the capabilities of action and perception of the whole organic being (indissolubly mind and body) situated in a richly structured environment*."[39] This notion is important because it allows us to move beyond so much of the discussion of "affordances," which have a tendency to focus solely on physical activity.

SIF proposes that affordances can be considered in terms of "solicitations," in which those affordances that are relevant to a given situation are preferentially attended to. This borrows from Gestalt thinking (in its implied meaning of "invitation character") and Merleau-Ponty's concept of "intentional object" to suggest that the "invitation character" of the artifact aligns with the lived experience of the skilled actor. These ideas were familiar to Gibson, as he had lectured on Merleau-Ponty's work.[40] Solicitations allow the human to have "maximal grip" (in Merleau-Ponty's terms) in their engagement in the situation. From this perspective, affordances are relations between aspects of the ever-changing sociomaterial environment and the abilities available in a form of life.[41] In this case, a "form of life" is an expression coined by Wittgenstein[42] as a means of describing the routine or patterns of activity of our workaday and everyday lives. Thus, artifacts are not simply physical things but also value-rich ecological objects (where

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the "values" are defined by the social and cultural milieu in which they are encountered, i.e., by Gibson's notion of "conventions"). In this way, skillful coping is not simply the enactment of physical activity but also social and cognitive behaviors that are possible and plausible for members of a given community. Situating affordance within the social setting means that activity can be socially constrained in terms of what is an acceptable way to employ an artifact is, as noted in chapter 3.

The Politics of Affordance

The linkage between environment and action is influenced (according to Gibson[43]) in three ways:

1. convention;
2. projection (arising from the effects of physics, such as a shadow behind an artifact), and
3. natural laws.

"Convention" and "natural laws" provide the twin poles from which an epistemology of artifacts can be defined. Convention represents sociocultural norms, while physics reflects the world as it is (Gibson assumes an objective reality that can be reliably defined through the laws of physics). From this, Gibson sought a "lawful" relation that would define "affordance." For Gibson, affordance "*implies the complementarity of the animal and the environment.*"[44] "Complementarity" can occur only in the interactions between "animal and environment." In other words, "affordances" exist in the relations between features of the environment and the capabilities of the animals in those environments.[45] In chapter 3, we discussed how an environment can be considered in terms of the ecological niche for a type of animal. The concept of affordance develops this further, in that it is concerned with the ways in which the ecological niche can be considered in terms of its activity-relevant features and how these can be responded to by the animal. In the words of Gibson, "*A niche is a set of affordances.*"[46] That is, sensory capabilities of the animal become linked to specific features of the environment that constrain (or support) that animal's actions. When the animal experiences a similar situation, then that action will be more likely to be performed. As Pickering says, "*Affordances . . . are the behavioural meanings of the environment for particular organisms.*"[47]

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While the "behavioural meanings" of affordances change with the "webs of relations" between the artifacts, humans, and the environment, much of the previous research on affordance has focused on relations between artifacts and their users. But, as the SIF highlights, this omits the importance of the ecological niche in which the landscape of affordances exist, and, in particular, the social dimensions in which normative action is defined. Gibson spoke, for instance, about "convention" as one of the aspects that influence complementarity, but the literature has been surprisingly quiet on this. As a consequence, the manner in which affordance relations might change in different social settings has not received as much attention as it ought to. The recent book by Jenny Davis[48] not only highlights this omission but also provides substantial contributions as to how to conceptualize and address these problems.

Davis begins with the observation that the literature on affordance often assumes a binary distinction between having or not having affordance. We have noted how the SIF has shifted debate beyond this to a more nuanced sense in which "skill" (as adaptive coping) provides a way of conceptualizing the ability of an individual, both in terms of the ways in which actions are performed and also in terms of the ways in which goals or intentions are defined. However, the manner in which such goals are made meaningful to individual actors is less clearly developed, and this where Davis makes a key contribution. For Davis, affordances involve mechanisms through which and conditions under which they are effected.

In terms of mechanisms, Davis draws a loose distinction between "bids by" and "bids on" an artifact (although, of course, the term "artifact" ought to be read in terms of the relations between person-artifact-environment). In the category of "bids by" she includes "requests" (which are, I think, synonymous with "solicitations" in SIF and Gestalt-inspired versions of affordance). However, she elaborates on this category with the inclusion of "demands." For example, if you want to prevent people from walking into a particular space, you could string a piece of rope between poles as a "request" to them to avoid this area, or you could build a metal fence as a "demand" for them to keep out. She makes the interesting point that it is not simply the physical property of the artifact that implies a demand; for example, the police tape that might be placed around a crime scene has the flimsiness of the rope but a much more forceful message in terms of its meaning. Thus, the difference between request and demand is a matter of

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social convention as much as physical form. So, a fence could be viewed as a request to protestors who desire to occupy the area beyond it.

In the category "bids on," she includes affordances that "encourage" behaviors—for example, large plates enable people to have large portions of food—or that "discourage" behaviors—for example, the character limits on Twitter discourage long-form content. This is not to say that, in either case, behavior is prevented (you could put less food on a large plate, or you could post multiple tweets to form a long message), but there are, perhaps, additional social constraints or physical demands on countering these bids on the artifact. At the extreme ends of these constraints or demands are affordances that "refuse" an action. She uses the example of Robert Moses's civic planning in New York in which low bridges that could not allow public transport to pass under them were placed across the rivers into some boroughs. Or affordances could simply "allow" an action without commitment, as in the case of a fork in the road.

What is apparent in her expansion of the types of affordance is that Davis emphasizes the social, moral, ethical, political, and other values that inform particular stances that are taken in the design of artifacts. Her view of the conditions of affordance can be expressed as "How does this object afford (mechanism) and for whom and under what circumstances (conditions)?" These conditions are covered by perception, dexterity, and cultural and institutional legitimacy. In this context, "perception" is akin to Norman's "perceived affordance," in which the artifact's "meaning" depends on the awareness of its users and their interpretation of features. To continue with an embodied cognition (rather than information-processing) argument, I would suggest that "perceived affordance" could be reflected by Merleau-Ponty's notion of an "intentional object" (discussed in chapter 3), which includes that collection of features in an artifact that correspond to a given intention for its user. Implicit in this notion is that different users, by virtue of their experiences of the world, experience artifacts as different "intentional objects." For Merleau-Ponty, we are embodied perceivers who act upon the world (and have the world act upon us). Sensations are the basic material of perception, not as a stream of inputs that need to be processed, but as a pattern against a background. We perceive those sensations to which we are most tuned. "*I discover vision, not as 'thinking about seeing,' to use Descartes expression, but as a gaze that grips with a visible world.*"[49] Thus, each person seeks to exert *maximal grip* on the world through responding to

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the pattern that provides an optimal collection of sensations for *that* individual, with *those* capabilities and goals, in *that* situation. As one develops experience of things in the world, so one begins to respond less to the specific features of each individual thing and more to essential aspects of the situations in which these things exist. Key to Merleau-Ponty's phenomenology is the notion of intentionality, which is concerned with how we "see" an artifact in terms of how we intend to interact with it (rather than as a collection of features). That is, we see the intentional object in relation to our goal. One way of appreciating this is through the concept of "Gestalt" (with which Merleau-Ponty was familiar), which is not some property of the artifact but rather the combination of the sensory stimulation evoked by an artifact in a given context. This means not only that the Gestalt is more than the sum of its parts, but also that the artifact can be interacted with differently under different conditions.

Merleau-Ponty's notion of "essential aspect" might, at first glance, feel overly metaphysical and clearly at odds with Gibson's arguments about the physical properties of artifacts. However, another reading of "essential aspect" would be to consider the specific set of features that the person sees (e.g., when the artifact is viewed from a particular angle) as defining the information that constrains an action. In this case, the visual appearance of the artifact will be influenced by "physics" and the action by "convention" (to return to Gibson's explanation). If one takes this point a little farther and rephrases this as the specific set of features to which a person attends, then it is possible to see the artifact not as a single, homogenous entity but as collection of features that can be attended to for different actions. So, the situation in which we look at an empty cup has a different essential aspect to one in which the cup is full of steaming coffee. In both cases, the artifact provides opportunities for action (which is another formulation that Gibson used to describe affordance), but the actions depend on the set of features (and on the interactions between these features and the person and the situation in which the action is to be performed).

A second condition of affordance for Davis is dexterity. This relates to the ways in which degrees of freedom (chapter 1) are managed and to the skillful coping of the individual. A key issue for the politics of affordance relates to the question of what dexterity involves. For people with a visual, physical, or other disability, skillful coping and dexterity involves their ability to adapt to the demands of the environment. Affordance, in this

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context, should mean the adaptation of the environment and artifacts to better support and enable their dexterity. Bad designs can exclude users. For example, the designer could exclude swathes of users on the assumption that everyone has the same abilities. While design in practice focuses on the needs of specific user groups, there can still be challenges for people at the extremes of these groups. More insidiously, Davis points out how designs can exclude and marginalize potential users in ways that are due to more than just anthropometry or physiology.

Davis's third condition of affordance involves cultural and institutional legitimacy. Earlier in this chapter, I made the trivial observation that picking up a cup to drink by grasping the handle or the rim might depend on the environment. More precisely, Davis argues that "as a condition of affordance, cultural and institutional legitimacy addresses the way one's location within the larger social structure and the related norms, values, rules and laws of a social system inform human-technology relations."[50] While Gibson's notion of "convention" nodded toward this condition, his work (and much of the subsequent debate surrounding affordance) has not grappled with the implications of the ways in which such conventions reflect the power balances within society—by economics and access to technology, for instance, as much as norms of "good" behavior. To a great extent this is due to the fact that the "environment" is not simply physical but also defined by social conventions and normative practices (as recognized by SIF). This means that the normative behaviors that an artifact is intended to support need not apply in all situations. Consequently, the concept of affordance has to cover the artifact, the ability of the user, the normative social conventions, and the physical environment in which actions involving the artifact are performed. In the next section, I consider how affordance relates to information and how this influences interpretation of artifacts.

Affordances as Information

For Gibson, "information" is available in the relations between features in an environment and this results in an action, but this information can arise only for an agent attuned to it. In chapter 1, I introduced the distinction between information-as-content (which can be processed and assigned meaning) and information-as-context (which influences action). In this section, I relate this distinction to the concept of "affordance." Koffka wrote that artifacts "tell us what to do with them"[51] through their "demand character."

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Interestingly, Koffka was a colleague of Gibson's in the 1930s,[52] and Gibson quotes his words as a description of "vivid and essential features of the experience itself."[53] Koffka claimed that artifacts solicit actions: "A fruit says 'Eat me'; water says 'Drink me'; thunder says 'Fear me.'"[54] From the tradition of American pragmatism, Peirce[55] suggested that the artifact (as a specific thing) can be perceived as a representamen (as a class of thing), which is then made sense of as an interpretant (as a concept). So, when Koffka wrote that an artifact "says" to do something, he is treating the artifact as a representamen in order to evoke an interpretant. But even a cursory consideration of an artifact, say a specific item of fruit, could take different forms, such as an apple on a tree, in a fruit bowl, in a lunch box. Each of these can be perceived as different a representamen (e.g., nature, still life, food) and, in turn, can result in different interpretants (e.g., harvest, painting, eating).

To claim that what something (or someone) "says" has a single meaning is to collapse a host of potential representamens into a single interpretant. This would imply that (a) there is only one meaning possible, (b) that one has little choice but to perform an action in response to this meaning, and (c) that the artifact requires a specific action (because the word "say" has an imperative force that arises from the artifact itself). For some approaches to design thinking (as discussed in chapter 2), this might help to bound the solution space for the problem being solved by a focus on the form of the artifact. But I doubt if any designers would agree that this all they do.

We could separate affordance from the interpretive act. Gaver[56] introduced terms such as "false affordance" (in which the form of an artifact implies a possible, but undesired, action; say, a decal on a product that looks like a button you can push) or "hidden affordance" (in which information is obscured and needs to be discovered). The notions of false and hidden affordance imply the need to search for and make judgment on the information that can be perceived in an artifact. This takes us further into the realm of information-as-content. Both Norman and Gaver present a theory in which the function of the artifact needs to be read from the form of that artifact. While it might be useful to consider the consequences of "false" or "hidden" information, this confuses the definition of affordance. We could take their ideas to mean that we should be concerned with designing visual signifiers that cue an action; but surely this is much the same as stating that the form of an artifact signifies its functions? If affordance is to provide a different and useful perspective on design and use of artifacts, then it needs to be more clearly articulated. To return to the example of scissors versus needle

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holders—one could place the thumb in the smaller of the two holes and then see where the fingers were positioned. In this respect, the "meaning" of an artifact could just as easily be physical rather than cognitive. This implies that there could be a "semiotics for action" in which, rather than reading the meaning of an artifact, we respond to its potential for action. In this case, the features of the artifact to which we respond could be influenced by task and environment (as an "intentional object") and the "meaning" of these features would be defined by the salience of the artifact to our skillful coping.

There is an implication that salience is agent-specific, and so, information itself could be agent-specific. Worried that defining such relations in an agent-specific manner would mean that there could not be natural laws, Gibson wanted to define information in generic terms. In the 1930s, the Gestalt psychologists developed concepts that directly inspired the notion of affordance. Kurt Lewin introduced the term *aufforderungscharaktere*[57] (which can be translated as "invitation-character" or "prompt-character," or "demand character" as per Koffka) as a way of indicating how the character, or property, of an artifact solicits a certain action by a person. For Lewin, behavior was influenced by "valences," which were modified by the person's motivation, and situational demands. For example, a cup of coffee might *not* afford drinking if the person was trying to reduce caffeine intake or was in a rush to leave for a meeting or was angry or was concerned about the cleanliness of the cup in which the coffee was served. Thus, the *aufforderungscharaktere* is not simply an attribute of the artifact but the sum of factors that define the situation in which the artifact is encountered.

The idea of a collection of elements that corresponded to valences was antithetical to Gibson's views. For Gestalt psychologists the artifact has a phenomenal value that the person experiences. Gibson wanted to claim that these phenomenal values are redundant. Rather, one ought to focus on the physical property of an artifact as something that can be directly perceived and, through this direct perception, acted upon:

> The affordance of something does *not change* as the need of the observer changes. The observer may or may not perceive or attend to the affordance, according to his needs, but the affordance, being invariant, is always there to be perceived. An affordance is not bestowed upon an artefact by a need of an observer and his act of perceiving it. The artefact offers what it does because it is what it is.[58]

Here, Gibson argues that the affordance must be an invariant property of the artifact, and this property must be independent of the observer. This would constitute the "natural laws" that underpin affordance. In terms of

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natural objects, likes pebbles or sticks, one *might* wish to claim that the physical appearance of the object would remain constant irrespective of where it was found or who found it. If this is the case, then Gibson seems to be arguing that one *can* design an artifact to have a particular affordance.

And yet, Gibson continually contradicted this assumption of invariance. This is especially the case when considering manufactured artifacts. In this quotation, about a post-box, Gibson is arguing both for and against the experienced reality of the artifact:

> To be sure, we define what it is in terms of ecological physics instead of physical physics, and it therefore possesses meaning and value to begin with. But this meaning is meaning and value of a new sort. For Koffka it was the phenomenal post-box that invited letter-mailing, not the physical post-box. But this duality is pernicious. I prefer to say that the real post-box (the only one) affords letter-mailing to a letter-writing human in a community with a postal system.[59]

First, the question of how one might separate a "phenomenal" from a "real" post-box is tricky. Possibly one might consider the "real" post-box as a physical artifact in the street but it remains a phenomenal post-box by virtue of the fact that its "salience" arises in relation to a specific activity (letter mailing) arising from a specific human capability (letter writing) within specific sociocultural norms (community with a postal system). Of course, the post-box could "afford" other activity—one could drop trash into it (which would contravene norms), for instance, or one could use it as a table, perhaps to read a map or check the contents of one's purse, or one could use it to hide behind. By wanting to argue against the Gestalt notion of valence, Gibson seems to be forcing the concept of affordance onto the artifact itself rather than from the web of relations in a given situation (which contradicts what he has said elsewhere).

Can Affordances Be Designed?

If an affordance is *not* a property of an artifact, how can affordances be designed? In order to address this, I want to introduce a related concept, that of "habitability," which refers to "the match between the language people employ when using a computer system and the language that the system can accept."[60] The analogy I wish to draw between habitability and affordance relies on the assumption that the action that a person performs (whether physically using an artifact or speaking to a computer) involves the person's best effort after salience in a given situation. For habitability,

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action is constrained by semantics (the goal that the user seeks to achieve), dialogue (the history of utterances to that point), syntax (the structure of spoken commands that would be acceptable), lexicon (plausible words that relate to the user's goal), and recognition (performance of the speech recognizer). In speech recognition systems, the user could be given explicit instructions in terms of words to say or could be given an open-ended prompt, as in "say in your own words what you would like help with." From our constraint model of habitability, we suggested that identifying the most likely constraint that contributed to an error could help in providing useful guidance for the next action. For example, if the user selected a word that was not in the lexicon, the computer could suggest a word from its lexicon, assuming that it was able to make a guess at the user's goal; if it could not guess that user's goal, it could offer a set of possible "goals" for the user. From this, the computer provides guidance on the basis of gaps between its expectation and observation of user action. In a similar manner, "seamful design"[61] seeks to identify the gaps or "seams" between different functions of a computer as a resource to guide user action.

Rather than considering how the form of the artifact will solicit an action, it is more important for the designer to think about the situation in which different users could respond to the artifact as an intentional object in terms of their dexterity and skillful coping. Doing so involves consideration of the affording situations in which the artifact might participate—that of the human-artifact-environment system and how these could generate different activities and outcomes. Several of the examples of design practice that were explored in chapter 2 share an affinity with the open-endedness of this approach. Sketching and model-making become the basis not simply for exploring what the artifact might look like but, more importantly, for considering how people will respond to it, how they might interact with it, and what could be done to encourage activity in particular situations. In this respect, affordances are contingent on environment, situations, and goals and dexterity of the users, as much as the form of the artifacts. In other words, affordances arise from the dynamics within the human-artifact-environment system. In the next chapter, I elaborate on this point and explore an approach to design that is closely allied to Gibson's ecological psychology and, I argue, that allows the principles of RECS to apply to design.

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