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Deception and the Concept of Behavioral Design

Nicholas S. Thompson
Clark University, nthompson@clarku.edu

CHAPTER 3

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NICHOLAS S. THOMPSON

Deception illuminates one of the most fundamental problems of behavioral science: the properties of natural design. The essence of design is the matching of the form of a behavior or structure to the circumstance in which that designed structure or behavior is employed. Each kind of natural design imputes two arrays and a correlation: an array of possible structures (or behaviors), an array of circumstances and a correlation between the two arrays such that particular behaviors are typically deployed in particular circumstances. A behavior or structure is said to be designed when its form selected from the array of forms is matched to the circumstances selected from the array of circumstances in which behaviors are employed.

Many readers will, I fear, be uncomfortable with the concept of *natural* design. In my view, the need to explore the concept arises from the need to balance the overwhelming dominance of explanation in the behavioral writing of the last two decades (Thompson 1981). During that time, we have learned an immense amount about how natural selection may have brought about behavior and about how neural structure and hormonal processes may control it. Such progress in explanation is obviously important, but it does not touch the question of what behavior is and how its organization may be described. What is so magical about behavior is that it seems so often suited to the effects it produces. In using the term "natural design" to refer to this characteristic of behavior, I take no position on the nature of the designing process or entity. Nor do I want to imply that the design is in any sense perfect. I imply only that in much of behavior is an appearance of appropriateness to the task at hand and that this appropriateness corresponds to what we mean in ordinary speech when we use the word "design." A consideration of the properties of behavior that gives rise to this appearance is long overdue.

The Varieties of Behavioral Design

In the course of my thinking about natural design, I have identified at least three forms: *adaptation*, *purpose*, and *development*. The different forms of natural design differ in the arrays that are correlated. In *adaptation*, the arrays are those of the form of the organism and the ecology in which that organism lives. To see that this statement is correct, consider how Darwin came to conclude that finches' beaks (particularly those of the finches on the Galapagos Islands) were adapted to the food habits of their owners. Like the life of many a naturalist, Darwin's day-to-day life constituted a methodology for the revelation of adaption (Darwin 1880; Barlow 1958). First, by wide travel Darwin familiarized himself with the array of the shapes of birds' beaks and the array of food sources on which birds fed. He then observed some general rules of relationship between the shape of the beak and the preferred food or habitat. Birds with curved beaks made their living by poking into flowers and crevices, birds with stout beaks made their living by hammering at things, birds with overlapping beaks made their living by shearing material such as fruit or flesh, and so forth. Finally, he observed that the Galapagos finches, while similar in a great many respects to one another and to finches on the mainland, were dissimilar in their beak shapes in just the manner suggested by his previous experience with other birds (Lack 1947). In general, then, to observe adaption in nature one must observe an array of different kinds of organism, each type living under an array of different environmental circumstances. Adaptation is a correlation between the items in these arrays. A particular organism or feature of an organism is said to be "adapted" when it observes such a correlation.

The second kind of design, *purpose*, can be observed in the behavior of a single organism if that organism's behavior is thoroughly observed in a wide variety of contexts. My understanding of purpose follows closely that of the philosopher Hofstadter. Hofstadter (1941) made a distinction between subjective teleology (the teleology that is experienced by the teleological actor himself) and objective teleology (the teleology that is experienced by an observer of the teleological actor). Hofstadter then went on to identify those attributes of behavior which cause an outside observer to say that a behavior is purposive. He wrote:

> There is, then, no initial difficulty in locating objective teleological processes in the rough. The problem is, what common traits do these actions exhibit? In particular, where in these actions do we find objectively purposeful character? And the answer is, *we never find an objective purpose by itself, but always in association with a certain "sensitivity to conditions," and a fund of "operative techniques" possessed by the actor. To seek for objective purpose alone, without reference to these two factors, is to embark upon an impossible quest* (p. 32).

Having isolated "sensitivity to conditions," a "fund of operative techniques," and "ends" as the three components of objective teleology, Hofstadter then operationalizes his definition as follows:

> To discover operative techniques in teleological process in general requires a number of contexts of activity in which the subject of investigation appears and in which ends and sensitivities to conditions vary. Regularities in the choice of similar means for similar ends under similar conditions, different means for similar ends or similar means for different ends under different conditions, different means for different ends under similar conditions — all these indicate technological principles in operation, operative techniques. . . . Thus *the unitary attribute of the teleological actor is not the possession of end alone, or sensitivity alone, or technique alone, but of all the three in inseparable combination* (pp. 34-5).

The similarity in spirit between Hofstadter's definition of purpose and the definition of adaptation offered above is emphasized by his insistence that the "ascription of a unitary objective teleological attribute, consisting of end, sensitivity, and technique, to an object is in no way an explanation of its behavior. It is simply a shorthand way of describing that behavior" (p. 35).

Hofstadter's definition of purpose directs our attention not only to the termination points of behavior but to the "funds of techniques" and to "sensitivities" which the animal displays along the way. Transforming these ideas into a behavioral methodology requires that we know the array of circumstances to which the animal is sensitive and the array of behaviors possible to the animal, relevant to each behavioral termination point. Purpose, in any single instance, will be found in a persistent correlation between the sensitivities and the actions relevant to a particular end.

Consider the following example. My dog is crossing the field. He stops at each of a series of woodchuck holes and investigates; suddenly we see him dart across the grass, grab something and shake it. Now his behavior changes. Carrying his prize, he returns toward the house and crawls up under the porch, where we can hear him chewing and worrying at his prey for hours. What about those events causes us to infer that the dog was "hunting for a woodchuck"? The most striking event is the catching of the woodchuck and the abrupt change in the pattern of behavior which it precipitated. Clearly this terminal point in the behavior is important. Without it, however we might have diagnosed the dog's purpose from the fact that he was sensitive to the "woodchucky" aspects of the field and that the various behaviors he displayed are all relevant to woodchuck finding. Inferring purpose is like navigating with stars. Two elements are sufficient to make an inference of purpose, but real confidence about that inference only comes from a successful prediction from two of the elements to the third.

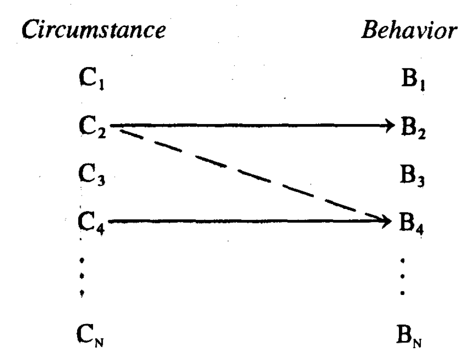
The third type of natural behavioral design I call *development*. As a form of natural design development is intermediate between purpose and adaptation in the scale of the arrays by which it is identified. It is unique in that it involves a time dimension. In development, the arrays are a sequential array of morphological or behavioral traits which is compared to a sequential array of environmental contexts in which the organism is growing. For development to be said to occur, there has to be a typical sequence of behavior traits that are deployed by a growing organism as well as a typical sequence of contexts in which it grows. Development consists in a meshing between these sequences such that a particular behavior is regularly deployed at the time when a particular environment is present.

All three of these conditions must apply or an instance of development is not at hand. For instance, as a kitten increases in size it typically deploys different clusters of behaviors: first rooting and groping, then crying and crawling, then walking, then straying short distances from the nest, then approaching strange objects, then wandering further and further from the mother and finally hunting entirely on its own (Schneirla, Rosenblatt, and Tobach 1963; Martin 1982). These behavior patterns occur in the face of a gradually altering environment provided by the mother. Early on, she nurses and licks the kittens frequently, assists them in elimination and restrains their attempts at independent locomotion. Gradually, however, she attends to them less frequently, approaches and restrains them less. Ultimately she begins actually to fend them off when they try to nurse and leads them on extended sorties away from the nest. Each stage in the kittens' behavior is fitted to a corresponding stage in the mother's behavior. What makes the kittens' growth an instance of development is not only that the kitten displays a stereotyped sequence of behaviors as it gets larger or that the environment displays a regular sequence of changes, but that there is a correlation between events in behavior and events in environment such that a particular cluster of behaviors is regularly deployed in particular environmental circumstances.

Deception and Design

The essence of deception is behavior designed to defeat a design. Deceptive behavior is designed to produce a mismatch in the design arrays of the deceived organism. Imagine that Figure 3-1 represents the design arrays of an organism which is designed to respond to each circumstance, C, with a particular behavior, B. This organism has been deceived when another organism defeats its design by simulating one circumstance, say C_4, when another circumstance, say C_2, actually obtains. The deceived organism gives an inappropriate behavior, B_4, in a situation in which B_2 would have been appropriate. For instance, C_2 and C_4 might represent smaller and larger opponents respectively and B_2 and B_4 might represent attack and flight. In this case, the deceived organism would have been bluffed into flight by a smaller organism which appeared larger than it actually was.

Figure 3-1. Deception as the defeat of a design



That an organism has been misdirected is a necessary but not a sufficient condition for the diagnosis of deception. Evidence must also be produced of *design* for misdirection on the part of the deceiver. Thus the misdirection of the deceived organism must be shown to be one behavior in an array of behaviors which comprise deceptive design, whether an adaptation, a purpose, or a development. The concept of deception as "design to defeat design" imputes to the deceiving organism (or taxonomic group of organisms) an array of behaviors, one of which is the deceptive behavior. This array is correlated to an array of circumstances, one of which consists of the conditions under which the deceptive behavior is deployed (Figure 3-2).

Figure 3-2. The design arrays of a deceiver

Circumstances	*Behaviors*
C_1	B_1
C_2	B_2
C_3	B_3
Circumstances appropriate to deception	deceptive behavior
⋮	⋮
C_N	B_N

The paradigm can be illustrated by a simple mechanical example. A refrigerator is designed to turn its light on when the door is opened and turn it off when the door is closed. Thus the arrays of the refrigerator are shown in Figure 3-3.

Figure 3-3. The design arrays of a refrigerator

Circumstances	*Behaviors*
Open	Light on
Closed	Light off

An inquisitive little girl who wants to see the light go off may do so by deploying behavior designed to defeat the design of the refrigerator, e.g., by opening the door and pressing the button on the doorjamb. The little girl has induced the refrigerator to behave as if its door is closed, when in fact the door is open. Her behavior is designed to produce this effect in the sense that it belongs to an array of behaviors which she might deploy in an attempt to see the light go off. As she explored the refrigerator, she would enounter an array of molecular circumstances each of which might suggest a possible technique for seeing the light go on (Figure 3-4). Pressing the button is one of these techniques and would be suggested by feeling the button as she slid her hand along the doorjamb. This mechanical example illustrates that both the defeat of design and design for the defeat of design are necessary conditions for the recognition of deception.

Figure 3-4. The design arrays of the fridge opener

Circumstances	*Behaviors*
Door ajar	Peek as door is closed
Power drill near fridge	Drill hole in wall of fridge and watch light as door is closed
Feel button on jamb	Press button, watch light
Head inside fridge	Get inside and close door [!]
⋮	⋮
C_N	B_N

Depending on the nature of the arrays by which it is constituted, each form of design generates particular opportunities for deception. Not surprisingly, therefore, classical instances of biological deception are found which correspond to each form of natural design.

Deception Based on Adaptation

For instance, when one or more species of organism are designed to mismatch a design array in another species of organism, then the result is the phenomenon known as interspecific mimicry. The cleaner mimicry of certain species of tropical reef-fish provides a familiar instance. Large fish living in tropical oceans are often afflicted with parasites. These are removed by small symbiotic fish known as cleaners. The symbiosis is made possible by a careful adjustment of the design arrays of the patron and the cleaner. The cleaner is designed to approach patrons, and patrons are designed to accept the approaches of cleaners. What this means is that cleaners, by comparison with other small fish, have a very specialized way of approaching large fish and further that patrons, by comparison with their behavior toward noncleaners, have a very specialized way of responding to the approaches of cleaners. The behavioral design arrays of a typical patron include two elements (see Figure 3-5).

Figure 3-5. The design arrays of a cleaner patron

Circumstances	*Behaviors*
Approached by a cleaner	Present for cleaning
Approached by a noncleaner	Attack

Into this idyllic arrangement intrudes a third species, the cleaner mimic, which is adapted to defeat the design of the patron (Wickler 1968:157-76). The cleaner mimic is a member of a group of fish called blenny, mostly blunt-headed, poor swimming fishes that make their living gnawing crustaceans off of inanimate objects, such as rocks. The typical response of a blenny to the presence of a larger fish is to cower in a rock crevice. Among its fellow blennies, the cleaner mimic shows considerable evidence of design for its life circumstances. It is a relatively strong swimmer. It has a tapered head and can adopt well-developed stripes on the lateral surfaces of its body, both traits which emphasize its resemblence to the cleaner. The cleaner mimic is similar

Figure 3-6. The design arrays of blennies' feeding techniques

Circumstance	*Behavioral and Morphological traits*
Rock cleaner	Blunt forehead, meager swimming skills, avoid large fish
Cleaner mimic	Tapered forehead, stripes, rapid swimmer, approach large fish, "dance"
"Smash-and-grab" specialist	Tapered forehead, rapid swimmer, lurk in wait for large fish, grab chunks of flesh

to certain other blennies which might be called "smash-and-grab" specialists. These fish are also relatively good swimmers with tapered heads. They make their living by ambushing larger fishes from hiding places in rock crevices and snatching off pieces of flesh. Thus if we consider blennies as a group, two elements of their adaptation arrays might be as in Figure 3-6. The cleaner mimic is adapted to induce the patron to act as if it were in the presence of a cleaner in the sense that its mimicry is but one of several techniques by which blennies get food off the surface of much larger objects. Deception is said to occur because the design of the mimic defeats the design of the patron which is induced to deploy behavior appropriate to cleaners when there is in fact no cleaner present.

Deception Based on Purpose

In a similar manner, the design arrays of purpose seem to underlie the phenomenon of social deception. de Waal (1982) provides a classic instance of social deception in his story of the chimpanzees who did not dig up the grapefruit. In so doing, this chimp defeated the purposive design of his fellow group members. Underlying this example are general design principles which describe chimpanzee behavior in relation to food. A solitary chimpanzee searching for food will display purposive arrays somewhat as in Figure 3-7. A second chimpanzee attempting to locate food using social skills will use a different set of design arrays in which the circumstances of its behavior are the behaviors of the solitary searching chimp (see Figure 3-8). The combination of the two sets of arrays results in a rough mapping of the second chimpanzee's behavior onto the conditions of the first chimpanzee's behavior (see Figure 3-9). This mapping means that the

Figure 3-7. The design arrays of a solitary searching chimpanzee

Circumstances	*Behaviors*
Food absent	Go to places where food might be
Food nearby but not in sight	Search nearby
Food partially hidden	Dig it up
Food in hand	Eat

behavior of the second chimpanzee is designed roughly for the circumstances being experienced by the first.

Figure 3-8. The design arrays of a socially searching chimpanzee

Circumstances	*Behaviors*
Other chimp goes to where food might be	Follow
Other chimp searches in limited area	Search nearby while watching other closely
Other chimp digs	Dig nearby
Other chimp eats	Beg, steal

It is this design in the behavior of second chimpanzees that the behavior of de Waal's deceptive chimpanzee was designed to defeat. By deploying behavior appropriate to the condition "food absent" when in fact the state of affairs was that the food was partially hidden in the earth, the deceiving chimpanzee produced a mismatch in the design arrays of its colleagues and successfully led them away from the source of the food.

Figure 3-9. The mapping of the behavior of a socially searching chimpanzee upon the circumstance of a solitary searcher

Circumstances	*Behaviors*
Food absent	Follow other chimp
Food nearby but out of sight	Search where other is searching
Food partially hidden in earth	Dig where other is digging
Food in hand	Beg, steal

Deception Based on Development

The design arrays of development are often the source of instances of intraspecific mimicry. An example of such developmental deception is found in the behavior of the ordinary house sparrow or English sparrow, as it is often known in the United States. As young sparrows grow, the behavior of the adults around them characteristically changes from caregiving to tolerance to intolerance (see Figure 3-10). The fluttering posture, in which the feathers are puffed up, the legs are bent and the back is arched is a posture by which the young of many species of birds induce feeding from their parents. In English sparrows, however, the fluttering is used by adults to defeat one another's design arrays. Adults who for various reasons seek to be tolerated in proximity to other adults will adopt variants of the infant begging posture so that toleration or even feeding is induced when the behavior attack would be appropriate.

Figure 3-10. The design arrays of an adult English sparrow

Circumstances	*Behaviors*
Young in nest gape	Feed
Young at edge of nest, fluttering	Feed, tolerate
Young in adult plumage near nest	Attack

Some readers may have difficulty thinking of this and similar examples as behavior designed to defeat a design, since such fluttering behaviors by adult English sparrows are so much an integral part of the day-to-day social behavior of the sparrow. This difficulty arises from the appearance of misappropriation and modification in the behavior. As with human implements, behaviors which are adapted to one context may be employed in another. A human being may take an implement which is adapted for one use and put it to another. For instance, a Saturday do-it-yourselfer needing a chisel to set a hinge but finding only a screwdriver in his poorly provided tool kit might use a screwdriver to excavate wood. He would do so because a screwdriver is by its form preadapted for use as a chisel. Furthermore, he might modify the design of the screwdriver by sharpening its blade with a file and by driving a large carpet tack into its butt to serve as a striking point for a hammer. What emerges from this modification is neither a chisel nor a screwdriver but an implement whose form is designed for both uses. Such an implement is an anomaly when considered in the context of the entire tool kit.

The adult English sparrow's begging behavior doesn't seem entirely like deceit because it seems modified in a manner analogous to the modification of the screwdriver. Adult fluttering English sparrows, particularly the males in courtship, perform the behavior in a particularly elaborate way, arching their backs, fanning their wings and tail feathers and hopping about frenetically like clockwork toys. Compared against the array of begging behaviors of other birds, the sparrows' begging seems adapted to its use in courtship. Thus the reluctance to call this behavior "deception" is based on the very real fact that the deceptive behavior is part of the design of the courtship and other displays of this species.

But appreciaiion of the redesign of the behavior should not be the cause of doubting the original perception that the behavior is design to defeat design. One of the striking characteristics of the designs of organisms is that they very often seem to be adapted from other designs. It is from such evident modifications of design that the concept of organic evolution arises. This peculiar property of organisms suggests that the designing entity or process did not work with undifferentiated material (such as clay) but with highly structured material (such as the designs of previous organisms).

Conclusions

For the last several pages, we have been looking at deception in nature in design terms. Our analysis has suggested that the phenomena which are frequently called deceptive in nature are characterized by a particular and complex form of natural design. Whether they be phenomena displayed by all members of the species, or by particular developmental stages of a species, or by individuals of a species, these phenomena are all characterized by design to defeat a design. Behavioral scientists are interested in deception because it presents a second order of natural design. Not only is behavior designed but some behaviors are designed to defeat the designs of other behaviors. The capacity of deceptive phenomena to reveal this second order of design gives them their particular importance to behavioral science.

But this discussion has had a more fundamental purpose than explaining ethologists' interests in deception. It illustrates how far we may proceed in discussing behavior without reference to explanatory concepts, if we are willing to speak explicitly in terms of natural design. Without reference to hypothetical programs of natural selection, genetic mechanisms, or physiological substrates, we can come to grips with the organization of behavior and reveal themes in its complex patterning. I hope that the use of the conception of natural design in the discussion of deception will suggest other uses of the same concept in behavioral analysis and that we may see in the next decade the development of efforts in the description of complex behavior which will balance the efforts at explanation that have so characterized the last decades of our science.

Acknowledgments

This chapter grew out of conversations held during my stay in the Sub-Department of Animal Behaviour at Madingley, Cambridge with Mike Simpson, Pat Bateson, Saroj Datta, Mauvis Gore, Joan Hall-Craggs and Robert and Joan Hinde. While I am aware that it is traditional at this point to absolve one's colleagues of all responsibility in one's folly, I am afraid that I cannot do so in this case. I can only say that they bear no more responsibility than did Alladin for the behavior of the genie, once it has been conjured from the bottle.

The chapter is dedicated to the inhabitants of 9 Adams Road who made me feel at home in England.

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