Commentary on Gottlieb (2007)

Socially nested reciprocities in perception-action and development

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Gottlieb’s (1991) study on social malleability of ducking response to maternal calls is perhaps a paradigmatic example of research within the transactional approach to behavioral development—an approach which has fundamental links with the ecological approach to perception-action (Gibson, 1979). This commentary fleshes out these links especially as they relate to the social nature of the organism-environment system and social influences on perception-action and development.

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A number of years ago, David Miller and I (Wagman & Miller, 2003) attempted to draw fundamental parallels between the transactional approach to behavioral development (Gottlieb, 1999; Lehrman, 1953; Oyama, 2000) and the ecological approach to perception-action (Gibson, 1979; Turvey & Shaw, 1999). The purpose of this commentary is to expand on ideas that were not fully developed in that paper, particularly as they relate to Gilbert Gottlieb’s 1991 landmark paper in Animal Behaviour (Gottlieb, 1991).

As we described, the “hallmarks of the transactional view are a conceptual acknowledgement of (a) the complexity of development, (b) the potential flexibility in the developmental trajectory, and (c) the exchanges over the various levels of the organism-environment system” (Wagman & Miller, 2003, p. 329). Importantly, Gottlieb (1991) highlights all three of these hallmarks, and as result, this paper serves as a paradigmatic example of research in the transactional approach to behavioral development.

In what follows, I shall attempt to (a) flesh out each of these hallmarks with respect to this (and related) work by Gottlieb and (b) draw parallels between the transactional approach to development and the ecological approach to perception-action with respect to each of these hallmarks. In particular, I shall focus on such parallels as they relate to the social nature of the organism-environment system and social influences on perception-action and development.

Complexity. The variables that influence both perception-action and development are often subtle or nonobvious and their effects are often nonlinear (Wagman & Miller, 2003). Gottlieb’s discovery that social rearing induces malleability of duckling responses to maternal calls would not have been possible without his previous work on the nonlinear influences on the development of such responses. Specifically, the ability of mallard ducklings to respond appropriately to maternal calls depends not on their postnatal
experience hearing maternal vocalizations but on their prenatal experience hearing their own vocalizations (Gottlieb, 1980). The variables that influence perception also exhibit such subtlety, nonobviousness, and nonlinearity. In general, the stimulation variables that allow for perception of behavior-relevant properties of the environment are not the static and isolated variables of standard physics (so-called “lower-order” stimulation variables) but rather are the dynamic and relational variables of an ecological physics (so-called “higher order” stimulation variables) (Turvey & Shaw, 1999). For example, perception of distance flown by honeybees depends not on the energy expended during flight (or even on the actual distance flown), but rather on the rate of flow of optical texture during flight (Srinvisian, Zhang, Altewein, & Tautz, 2000).

**Flexibility.** Perception-action and development often exhibit remarkable flexibility, much of which can be attributed to the multidirectional (or what Gottlieb refers to as “probabilistic”) nature of the variables that influence these processes (Wagman & Miller, 2003). In earlier work, Gottlieb investigated responses to extra-specific (i.e., chicken) maternal calls in individually reared ducklings (Gottlieb, 1987). Importantly, the development of this behavior exhibits remarkable flexibility. Specifically, he found that individually reared ducklings developed a behavioral response to the chicken call if they were exposed to it while unable to hear their own prenatal vocalizations (as a result of being devocalized) (Gottlieb, 1987). Perception-action also exhibits similarly remarkable flexibility due to multidirectional influences. In large part, perception is modality independent—the same environmental property can be perceived by means of entirely perceptual modalities despite the fact that the different perceptual systems are sensitive to entirely different energy media. For example, under certain circumstances, participants show comparable performance in perceiving speech sounds by eye, by ear, and by hand (see Rosenblum, 2005).

**Organism-environment system.** Perhaps the most fundamental similarity between the ecological approach to perception-action and the transactional approach to behavioral development is that in each case, the unit of analysis is not the organism or even the organism and the environment but rather the organism-environment system—a complex and emergent reciprocal relationship between organism and environment (Gibson, 1979; Gottlieb, 1999). What Gottlieb’s 1991 paper in Animal Behaviour emphasizes is that the organism-environment system includes other organisms—it is a social system. He found that when ducklings were reared in the presence of other ducklings and exposed to an extra-specific chicken maternal call, they developed a behavioral response to that call (even if they were able to hear their own prenatal vocalizations) (Gottlieb, 1991). Social rearing was sufficient to bring about remarkable behavioral flexibility in response to maternal calls and demonstrate the nonlinear influences on this behavior.

Most of the research on the organism-environment system in perception-action has focused on the complex and time evolving reciprocal relationship between an individual organism and the environment. For example, research on (inorganic) attachments to the body such as hand-held tools has shown that such objects are gen-
erally experienced as extensions of the body itself (Wagman & Taylor, 2005; Hirose, 2002). An important implication of such work is that the boundary between organism and environment is malleable.

Comparatively less work has focused on the social nature of the organism-environment system in perception-action. However, this area has shown recent growth (see Marsh, Richardson, Baron, & Schmidt, 2006, for a review). For example, research on coordination dynamics has shown that two people who are asked to swing pendulums at their own individual tempos often become unintentionally coordinated with each other when they can see each other’s movement patterns (Schmidt & O’Brien, 1997; Richardson, Marsh, & Schmidt, 2005). Importantly, such work has suggested that just as structured stimulation patterns lawfully couple organisms to their environments, such stimulation patterns lawfully couple individual organisms to each other. Moreover, a possible (but perhaps unavoidable) implication of such work is that the boundary between individual organisms is malleable. Gottlieb’s (1991) paper, of course, shows that the same may be true in development.

The legacy of Gottlieb’s 1991 paper in Animal Behaviour is the intertwining of the three hallmarks of the transactional approach to behavioral development described throughout this commentary—hallmarks that are shared (at least implicitly) by the ecological approach to perception-action. The paper raises fundamental questions about the proper unit of analysis in development (and of perception-action). Both perception-action and development are functions of the organism-environment system. As a general rule, such a system is a social system, and this has important implications for the study of perception-action and development.

References


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