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Updating the Baldwin effect☆
The biological levels behind Piaget's new theory

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A B S T R A C T

In 1964, Conrad Waddington (1905–1975) presented a paper in Geneva that led to an internal reassessment of the biological underpinnings of Jean Piaget's (1896–1980) theory. This in turn resulted in an overhaul of the theoretical framework upon which his stage theory of child development had been based, including his appeals to James Mark Baldwin's (1861–1934) "circular reaction." In addition to leading to the emergence of what has elsewhere been called "Piaget's new theory," this renovation also resulted in the update of the famous "Baldwin Effect." Because aspects of the subsequent framework are of contemporary significance, this essay will review some of the work leading up to those updates. In reaching behind the translations to trace the sources of the arguments to which Piaget appealed, the resulting examination fills some of the gaps found in the secondary literature without quibbling over the "correct" English interpretation of translated French terms. We also go beyond how Piaget's writings have been understood in English and extract some useful additional ideas from his sources, including how to conceive of the social context in which development takes place. We see as a result how Waddington and his colleagues, including Paul Weiss (1898–1989), provided a constructive "existence proof" for the formal hierarchy of levels that Piaget had come to by other means.

At the beginning of Jean Piaget's (1896–1980) career, when he received his doctorate in natural history from the University of Neuchâtel in 1918, the development of children was thought by most Europeans to recapitulate the evolution of the human species (Vonèche, 2003). By the late-1950s, however, ideas regarding development were being modernized (Cox, this issue). Dissidents from the neo-Darwinian synthesis of evolutionary biology, who were upset at the exclusion of Development (Embryology) from their science, were also constructing new theories drawing on insights from Ethology and Cybernetics (see e.g., Levit, Hossfeld, & Olsson, 2006). These changes enabled Piaget to "return" to his "first loves as a biologist" (my trans of Piaget, 1976b, p. 40).

Yet this is not really a story about Piaget's biology (see Messerly, 1996, 2009; Moessinger, 2000). Nor is it about the ideas his biology inspired (see Carey & Gelman, 1991; Langer & Killen, 1998; Parker, Langer, & Milbrath, 2005).

☆ This article is substantially revised and expanded from a talk delivered in August 2009 at the annual meeting of the Society for the History of Psychology (Division 26 of the American Psychological Association). It was written explicitly to develop feedback from Jeanette McCarthy-Gallagher, who highlighted the connection between Jean Piaget and Paul Weiss in response to an earlier talk about Piaget and Conrad Waddington at the annual meeting of the Jean Piaget Society in June 2009. Its revisions then benefited greatly from the discussion in Marga Vicedo's graduate seminar on Biology and Human Nature at the University of Toronto in 2011, as well as from comments by Brian Cox and Connie Milbrath. I am also grateful to the American Physical Society, and Jasmine Martin in particular, for granting me permission to include Paul Weiss' illustration of the hierarchy of levels (my Fig. 1, below). Similarly, the inclusion of my adaptation of Conrad Waddington's illustration was made possible by the STM Permissions Guidelines agreement, to which both Elsevier and the Nature Publishing Group are signatories (my Fig. 2, below). The project itself was made possible by financial support provided by the Jean Piaget Society (Pufall Award, 2009) and the Government of Ontario (Ontario Graduate Scholarship, 2011–2012). All support is gratefully acknowledged.

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Rather, this is a story about the discourse in which his theory was reconstructed: because changes were also occurring in other disciplines that he had relied upon in building his old theory of stages—such as Logic (Burman, submitted for publication)—his return to earlier interests reinvigorated the entire framework that had originated in his first works. This then ultimately led to the emergence of what has elsewhere been called the "new theory" (Beilin, 1980, 1986, 1988, 1989a, 1989b, 1989c, 1992a, 1992b, 1999c; Burman, 2007a, 2008b, submitted for publication; Davidson, 1986, 1988, 1993).

The new theory is not "new," *per se*. Many elements from the very earliest works were retained in every version of Piaget's system (e.g., equilibration). But the use of the label does highlight the fact that a series of changes were made, over the last decades of Piaget's life, and also that the results of those changes came to diverge from the interpretation generally accepted among American psychologists (see esp. Burman, submitted for publication). Here, we will examine one of the results of those changes: Piaget's extension, and ultimate updating, of James Mark Baldwin's (1861–1934) eponymous "Baldwin Effect" (so named by Simpson, 1953; see also Weber & Depew, 2003; Young, this issue). After tracing some of Piaget's more recent biological influences, we will then see how their ideas can be used to augment our understanding of Piaget's later proposals. We also find clarity on other issues not currently well-understood (e.g., his phenocopy proposal and the role of the social in human development).

The larger justification for this project relates to contemporary changes presently underway in Biology. After many years of separation, Evolution and Development are now being synthesized in a new approach known colloquially as "evo-devo" (see esp. Laubichler & Maeinschein, 2007). This reflects the discovery that Development was actively suppressed from the Evolutionary discourse in the 20th century (Amundson, 2005). And it recognizes the insight that Evolution and Development ought to be conceived-of as being on the same continuum (Carroll, 2005; Robert, 2004). These ideas are now being brought into Psychology (by e.g., Griffiths, 2007; Masterpasqua, 2009; Meaney, 2010; Robert, 2008; Szyf et al., 2009). Thus, the timing seems right for a wider synthesis.

A step in that direction was taken in an earlier project (Burman, submitted for publication). There, it was shown that Piaget's new theory was built upon the recognition of a formal hierarchy of levels. This, therefore, is a further extension of those efforts; a second step along the bridge to Piaget's "new" theory, but excavating some of his appeals to sources in Biology rather than to those in Logic. As a result, we see that Piaget's later biological writings—and his updating of the Baldwin Effect—can be tied to a larger discourse regarding the genesis of natural order (which he referred to as "the epistemology of logic").

1. Origins

Central to both the Baldwin Effect and Piaget's early theory is the concept of a recursive "circular reaction" (see esp. Sánchez & Loredo, 2007). This is the source of ideas regarding the constructive pairing of "assimilation" and "accommodation," which both Baldwin and Piaget used to explain the genesis of novel forms. It also provides the basis for Piaget's well-known developmental triad: assimilation-accommodation-equilibration (see Cahan, 1984; Cairns, 1992; but also Piaget, 1982). Yet this language can seem spooky, so we must define the terms.

If the environment never changes, then the organism is *born* equilibrated; the inherited evolutionary history of the species has shaped its individual fitness, into which it must simply mature. But if the environment does change, then the organism *must respond* if it is to *stay* equilibrated: first it must assimilate the effects of the change, then it must accommodate its way of life to that change in order to *retain* its fitness. To the extent that these accommodations then feed-back to affect the environment, the organism must also continue to respond to the changing demands placed upon it. The organism, in other words, is part of what ultimately came to be called "a dynamic system" (see e.g., Piaget, 1967/1971b, pp. 278–279; also Waddington, 1977).

This is easily misunderstood as being a homeostatic process. In development, however, the "set-point" is fluid. Through accommodation, the range of stimuli to which an organism can respond expands: not only can the organism assimilate the original set of stimuli, but it also comes to assimilate the new set as well. [Its assimilatory structures have broadened in scope (Burman, submitted for publication).] New possibilities are thus constructed from the history of past interactions: not only is the set-point fluid, therefore, but it seems also to advance across developmental time.

From this perspective, we see that the circular reaction is an adaptive engine that fits populations of unfit-but-plastic organisms to the demands of an unpredictable world. If a change is made to the organism's behavior, the resulting process—and its subsequent evolutionary effects—is called "the Baldwin Effect." If a change is made to the organism's development, followed later by a change in its genes, the process is called "genetic assimilation" (Crispo, 2007). And if it is made to the environment, such that the changed environment comes to shape both behavior and development, then it's called "niche construction" (Laland, Odling-Smee, & Feldman, 1999, 2000, 2001). Piaget called it something else: "phenocopy" (see esp. Piaget, 1974/1980, 1975/1995). But before we get into that, the basic argument should be summarized: the circular reaction enables adaptive change within the lifetime of the organism. This means that it enables variations that go beyond the limits of what is allowed by neo-Darwinian selection and replication (see Cox, this issue; Milbrath, this issue).

From an orthodox neo-Darwinian perspective, change is random. What's done can be undone: mutations that aren't selected-for (or -against) can vanish just as easily as they arise. Species-level adaptations therefore aren't improvements; they're a side effect of the selection of traits that produce a difference in relative fecundity. (Traits that help to make more babies will come to