

# Baldwin effect

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The **Baldwin effect**, also known as **Baldwinian evolution** or **ontogenic evolution**, is a theory of a possible evolutionary process that was originally put forward in 1896 in a paper, "A New Factor in Evolution," by American psychologist James Mark Baldwin. The paper proposed a mechanism for specific selection for general learning ability. Selected offspring would tend to have an increased capacity for learning new skills rather than being confined to genetically coded, relatively fixed abilities. In effect, it places emphasis on the fact that the sustained behavior of a species or group can shape the evolution of that species. The "Baldwin effect" is better understood in evo-devo (evolutionary developmental biology) literature as a scenario in which a character or trait change occurring in an organism as a result of its interaction with its environment becomes gradually assimilated into its developmental genetic or epigenetic repertoire (Simpson, 1953; Newman, 2002). In the words of Daniel Dennett,

Thanks to the Baldwin effect, species can be said to pretest the efficacy of particular different designs by phenotypic (individual) exploration of the space of nearby possibilities. If a particularly winning setting is thereby discovered, this discovery will *create* a new selection pressure: organisms that are closer in the adaptive landscape to that discovery will have a clear advantage over those more distant. (p. 69,<sup>[1]</sup> quoting Dennett, 1991)

## Examples

Suppose a species is threatened by a new predator and there is a behavior that makes it more difficult for the predator to kill individuals of the species. Individuals who learn the behavior more quickly will obviously be at an advantage. As time goes on, the ability to learn the behavior will improve (by genetic selection), and at some point it will seem to be an instinct.

Baldwin gives the following case involving cooperation: "Animals may be kept alive let us say in a given environment by social cooperation only; these transmit this social type of variation to posterity; thus social adaptation sets the direction of physical phylogeny and physical heredity is determined in part by this factor" (Baldwin, 1896, p. 553).

The appearance of lactose tolerance in human populations with a long tradition of raising domesticated animals for milk production has been suggested as another example. This argument holds that a feedback loop operates whereby a dairy culture increases the selective advantage from this genetic trait, while the average population genotype increases the collective rewards of a dairy culture.

## Contrary effect

The opposite of the Baldwin effect is 'shielding'.<sup>[2]</sup> Modern medicine for example could artificially control a pathogen preventing any genetic immunity against the pathogen from being selected for. Here learned behaviour that improves fitness prevents genetic adaptation.

## Status

The Baldwin effect theory has been controversial, with scholars being split between "Baldwin boosters" and "Baldwin skeptics".<sup>[3]</sup> The theory was first called the "Baldwin effect" by George Gaylord Simpson in 1953 (p. 3<sup>[3]</sup>). Simpson "admitted that the idea was theoretically consistent, that is, not inconsistent with the Modern Evolutionary Synthesis" (p. 4<sup>[3]</sup>), but he doubted that the phenomenon occurred very often, or if so, could be proven to occur.

There have been a number of arguments against the effect. For example, it has been argued that the change from learning to instinct might not constitute an improvement, because only very stable environments where change is extremely slow would favour innate traits as opposed to the plasticity of learning (especially social learning, which

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doesn't have such high costs as individual learning by trial-and-error). The very mechanism of the transition has also been questioned, as genetic variations which "tend to decouple [...] behaviour from environmental signals" might be "distant from those genotypes that mediate plastic, learned response".<sup>[4]</sup>

Still, "it is striking that a rather diverse lot of contemporary evolutionary theorists, most of whom regard themselves as supporters of the Modern Synthesis, have of late become 'Baldwin boosters'" (p. 4<sup>[3]</sup>). These Baldwin boosters

are typically evolutionary psychologists who are searching for scenarios in which a population can get itself by behavioral trial and error onto a "hard to find" part of the fitness landscape in which human brain, language, and mind can rapidly coevolve. They are searching for what Daniel Dennett, himself a Baldwin booster, calls an "evolutionary crane," an instrument to do some heavy lifting fast. (p. 4<sup>[3]</sup>)

According to Dennett, recent work has rendered the Baldwin effect "no longer a controversial wrinkle in orthodox Darwinism" (p. 69<sup>[1]</sup>).

## References

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- Simpson, G Gaylord. 1953 The Baldwin effect; *Evolution* **7** 110-117
- Newman, Stuart A. 2002 Putting Genes in their place; *Journal of Biosciences* **27** 97-104<sup>[7]</sup>

## Notes

- [1] Daniel Dennett (2003), "The Baldwin Effect, a Crane, not a Skyhook" in: Weber, Bruce H.; David J. Depew (2003). *Evolution and learning: The Baldwin effect reconsidered* (<http://books.google.com/books?id=yBtRzBilw1MC&pg=PR9&dq=baldwin+effect#v=onepage&q&f=false>). Cambridge, Mass.: MIT Press. pp. 69-106. ISBN 0262232294. .
- [2] Steven Levy, *Artificial Life - The Quest for a New Creation* (1992 Jonathan Cape), p268-269.
- [3] David J. Depew (2003), "Baldwin Boosters, Baldwin Skeptics" in: Weber, Bruce H.; David J. Depew (2003). *Evolution and learning: The Baldwin effect reconsidered* (<http://books.google.com/books?id=yBtRzBilw1MC&pg=PR9&dq=baldwin+effect#v=onepage&q&f=false>). Cambridge, Mass.: MIT Press. pp. 3-31. ISBN 0262232294. .
- [4] <http://www.vuw.ac.nz/phil/staff/documents/sterelny-papers/baldwin.pdf>
- [5] [http://www.brocku.ca/MeadProject/Baldwin/Baldwin\\_1896\\_h.html](http://www.brocku.ca/MeadProject/Baldwin/Baldwin_1896_h.html)
- [6] <http://www.sciencemag.org/content/5/121/634.extract>
- [7] <http://www.nymc.edu/sanewman/PDFs/Putting%20Genes%20in%20their%20Place.pdf>

## External links

- Baldwinian evolution (<http://www.ecs.soton.ac.uk/~harnad/Hypermail/Cognition.Sociobiology.98/0101.html>)
  - The Evolution of Phenotypic Plasticity through the Baldwin Effect ([http://www.chass.utoronto.ca/pcu/noesis/issue\\_vi/noesis\\_vi\\_4.html](http://www.chass.utoronto.ca/pcu/noesis/issue_vi/noesis_vi_4.html))
  - Bibliography (<http://www2.create.human.nagoya-u.ac.jp/baldwin/>)
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