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Guest Editorial

Epigenetic Innovations for Developmental Science

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Developmental science is trans-disciplinary. New perspectives in biology take new form every year and researchers on the psychology side of developmental science need to have an educated glimpse into what is happening in one's neighbouring fields. Hereby we establish on the pages of the International Journal of Developmental Science an interdisciplinary forum for bringing our readership up to date in the contemporary work done in epigenetics, and to discuss its implications for developmental science.

This is very timely – epigenetics is coming into fashion. Such sudden jump to fame—fortified by the rapid accumulation of empirical evidence in the biological sciences that seems to point to its adequacy in contrast to the traditions of genetic determinism— is deeply ambiguous. It can be seen as "the final victory" of the developmental perspectives in the biological sciences over their ontological counterparts. Finally—two centuries after *Naturphilosophie* (Schelling, 2004/1799) —has the notion of the predetermined fixation of the *being* of organisms given way to the focus on their *becoming*. Developmentalists within psychology can only applaud this change – an innovation that sets the primary focus on *becoming* is needed at our time. Yet changing a framework does not automatically mean a breakthrough in knowledge. Developmental ideas have had long and uneven way in entering into both biology and psychology—their prominence has been declared, talked about, and—forgotten. Many perspectives that are presented as developmental are that only in name (Shanahan, Valsiner, & Gottlieb, 1997). Hopefully the recent innovations in genome research would make the advancement of developmental ideas fully sustainable in biology. But how could it work in psychology?

Psychology's Epistemological Purgatory

Psychology at large, and developmental psychology in particular, are in danger of becoming extinct as sciences because their focus on data—their collection and analyses—has run ahead its own theoretical innovation. As long as psychology depends upon the "turn tools to theories" habit (Gigerenzer, 1991) it can expect no breakthroughs beyond the general set of ideas on which the particular tool was based. This produces "normal science"—in Thomas Kuhn's terms (1970)—the axiomatic bases of a method become turned into the basis of a theory that is inductively constructed through that method. Psychology has its staple example of creating an empirically productive but theoretically mute domain of research—that of intelligence—where the assumptions of the intelligence test created a fixed end state for our understanding. There is no way to proceed beyond the "IQ", within that paradigm. Jean Piaget (1952) of course understood that in his young years and changed the paradigm in his first work in psychology.

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Creating a theory based on the widespread tool of ANOVA is something that reifies the givenness of the sum of components of the total variance, and fortifies the idea that psychological processes are linear. But what if they are not? And there is much proof of that (Puche Navarro, 2009; Rudolph, 2013). A psychologist building such ANOVA-based theories is like a surgeon insisting upon using an axe—and only that—in performing sophisticated operations. The patients are unlikely to survive this treatment. So are psychological phenomena when treated by fixed methodological credos and without taking their nuanced structure into account.

Developmental science has an additional curse upon it—its assumption that the use of genetics in psychology is best reduced to the tradition of behavioral genetics and to speculations about inherited and acquired characteristics. The old "nature/nurture problem" still looms large in child development textbooks and is episodically surfacing again at conferences of child studies. It is a dead end street which contemporary biological sciences have already surpassed. And that may prove to be a way out for psychology. The detailed efforts of epigenetics over the last half-century show how this can be done. No longer is the question of heritability coefficients asked, but the focus is on the particular ways in which the genetic substance can be guided by the environment in the process of development. Today, the interesting question is the developmental dynamics of DNA methylation, and the role of various forms of RNA in the regulation of the translation of the genotype into a phenotype.

The Future Emerges from the Past

Interestingly, epigenetics antedates genetics. What looks "the new framework" is actually old—building on the 18th century traditions of thought (Caspar Friedrich Wolff finished his *Theoria Generationis* in 1759 which could be considered to be the beginning of epigenetic thought) whereas the talk about genetics was a 19th/20th century invention (Toepfer, 2013). What is at stake here is the coordination of two world views—one in principle stable, pre-determined (even if at times out of balance), the other—in principle open to change, unpredictable, and, hence—somewhat scary. However, developmental science has included a bold model—that of Gilbert Gottlieb's model of probabilistic epigenesis (e.g. Gottlieb, 1997, 1998; cf. e.g. Scheithauer, Niebank, & Gottlieb, 2007; Tucker Halpern, Hood, & Lerner, 2007; Valsiner, 2007) that serves as the link between psychology and genetics.

Promises to Practice

Contemporary epigenetics is on the battlefield of proving its practical value as well—and here may be its rub. The social demand settings of common sense ask for answers to questions phrased in terms of linear direct causality ("*If I do X will I improve my health or epigenome?*") whereas the scientific knowledge in epigenetics operates in terms of catalyzation processes that are themselves conditional upon the directionality of the development of the organism. Development is guided by context-sensitive constraining (Juarrero, 1999) of the organism oneself, in coordination with the environment. In contrast, practical actions in medical profession call for simple and direct treatment possibilities. This tension is already visible in the caution that contemporary biologists express about too quick and too direct commercialization of the knowledge of individual genome as to prediction of the future health risks of individuals. To move from the promises of genetic counseling to the real therapeutic procedures based on epigenetics is a major challenge not only to practice, but to our thinking of the ways realistic treatments are possible.

The Present "Ongoing Special Section" on Probabilistic Epigenesis

In the course of next two years, we plan to bring to our readers five different perspective on epigenetics, furnished with commentaries published with them. We begin in this issue with the target article by Vanessa Lux, and commentaries by Robert Lickliter (2013), Gary Greenberg (2013), and Ehud Lamm (2013). Vanessa Lux is one of the key authors in the German language room who has made the study of epigenetic processes her target of investigation. Starting from the psychology of psychological trauma (Lux, 2011b) she moves forcefully into the study of epigenetic processes that can be of relevance for psychology (Lux, 2011a; Lux & Richter, in press). In her article in this Issue (Lux, 2013) she links the epigenetic and developmental science perspectives together in a new way. The upcoming special sections will be devoted to the merits of Gottlieb's model of probabilistic epigenesis from different persepectives, such as biology, or cognitive science. It

is our hope that our planned collective tour of the landscape of modern epigenetics in many of its facets will be of interest to our readership, and could ideally motivate continuous discussion on the pages of this Journal.

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Bio Sketches

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