Review

Historical Roots of Developmental Science

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Developmental Science aims to generate a new body of knowledge that encompasses and integrates findings from various well-defined academic disciplines concerned with developmental processes of human and non-human organisms. Although all development related research traditions surely have their own distinct history, certain theoretical ideas formulated by James Mark Baldwin, Jean Piaget, Lev Vygotsky, and Albert Bandura among others can be considered intellectual cornerstones in the history of Developmental Science. However, the claim for interdisciplinary developmental research put forth by these theorists and more recently by scientists such as Clarence Luther Herrick and Zing-Yang Kuo did not receive much attention. It has only been in the past few decades that through the establishment of several interdisciplinary research centres and through the increasing number of publications—in the form of compendia, textbooks, and journals—the long standing endeavour to promote Developmental Science as independent research tradition slowly begin to take an effect.

Keywords: Developmental Science, History, Developmental processes

It is beyond the capacity of any single researcher to grasp a sufficient understanding of all the processes that play a part in the development of living organisms. The basic aim of Developmental Science is to provide an intellectual framework for a new coherent picture on human (and non-human) development by the integration of concepts defined within different scientific disciplines. That is, Developmental Science encompasses findings that originated in the disciplines of biology, anthropology, biology, communication sciences, linguistics, medicine, psychology, and sociology, or any other discipline that is concerned with the ever-changing dynamics of living organisms (Scheithauer, Niebank, & Gottlieb, in this issue). In the following we aim to identify the historical roots of Developmental Science and present current progress in research and training. However, with each discipline contributing to Developmental Science evidently originating from its own idiosyncratic theoretical and empirical roots, the task to trace the historical roots of Developmental Science seems an unattainable challenge. In order to tackle this task of providing an overview of the early roots of Developmental Science, we will be discussing the works from a selected group of scientists of different intellectual backgrounds and time periods who have substantially contributed to the current state of this complex research framework.

Considering the broad scope of Developmental Science we can merely provide a sketchy picture of all the contributions that have been influential to the advancement of developmental science. In order to nevertheless present a reasonable synopsis of the historical roots of such a broad approach we will have to constrain our discussion to only...
some of the key contributors. Furthermore, we will limit our review to the contributions of theorists that concentrate on human development rather than on animal research. Further, we will confine ourselves to some of the major work that has been concerned with behavioural development rather than research investigating microbiological processes. In doing so we are still left with the challenge to appraise a scientific approach that investigates multilayered and interrelated areas of human development.

In a first attempt to present an overview of the relevant topics for Developmental Science given our above mentioned constraints we may summarize the following five topics (compare Cairns, 1992): 1) personality and social actions, 2) behavioural adaptations in the context of social and cultural changes, 3) the development of perception, motor-development and language, 4) the development of psychopathology and emotional disorders, and 5) the development of cognition. We will describe the common historical roots of these vastly different research areas by identifying some of the key ideas linking these research traditions at a rather abstract level that form -at the very core- the meaning of Developmental Science in its beginnings and today.

Developmental Science aims to go beyond the accumulation of findings from various disciplines or research areas and instead intends to create a new and unique body of knowledge within its own theoretical reference frame with the goal to enable scientists to conceptualise and realise the interdisciplinary study on individual and shared development across the lifespan considering cultural, social, cognitive and biological processes.

The main goal of Developmental Science, therefore, is to understand how multiple aspects of human existence (e.g., biological, social, and cognitive) concurrently influence development. However, the term development is far from being finite in its meaning. Depending on one’s research tradition, development concerns the biological morphogenesis of nonhuman creatures, physical and mental maturation of individuals, advancements in technology, economic or societal improvements, or even the proceeding of raw material into a consumable product. The complexity of the term development is nicely illustrated by The Oxford English Dictionary (1989) that defines development in twelve different ways, relating the concept to various fields such as poetry, organisms, evolution, advancements of individuals, economies, and societies, though not explicitly to human beings. Developmental Sciences draws on all of these definitions and considers development as an interrelated process of cognitive abilities, perception, emotional, and motivational processes, physical, biological, social and even spiritual components (Diamond, 2007). Developmental Science is hence concerned with an equally multifaceted combination of biological, psychological, and social developmental issues, and alone for that reason an inherently multidisciplinary approach. As a consequence, Developmental Science demands the dissolution of traditional boundaries of scientific disciplines as the cooperation of scholars and the integration of their findings become more and more indispensable. For this end, Developmental Science tries to overcome disciplinary and institutional confines and to integrate our existing knowledge within a unique and coherent framework.
In order to explore the historical roots of Developmental Science, we borrow the definition of development that has been put forth by the authors of a recent textbook on Developmental Science by Petermann, Niebank, and Scheithauer in 2004. The authors approximate this complex definition by pointing out that “development is understood as biopsychosocial re-organisation, which is expressed by a re-organisation of the individual concerning significant developmental tasks and passages” (p.4, original quotation: “Entwicklung als biopsychosoziale Neuorganisation verstanden [wird], die sich vor allem in der Neuorganisation des Individuums mit bedeutsamen Entwicklungsauflagen und -übergängen zeigt”). The authors further allocate their perspective of development to the contextualist view of human development and interaction. But even though the authors clearly position current Developmental Science within the contextualist paradigm, Petermann and colleagues consider Jean Piaget as one of the intellectual contributors to Developmental Science. As a prominent representative of the organismic view on development, he furthered our understanding of children’s cognitive development within the realm of Developmental Science in several ways.

While he was certainly not the first to offer the concept of a stage-like development Piaget’s work can be credited to turning this model into a mainstream concept of cognitive developmental theories. Despite the many critical reviews of Piagetian theory, the concept of stage-like development has been a dominating model in explaining development. While Jean Piaget adhered to an organismic developmental framework by arguing that human beings adapt to the world in sequential levels that are biologically pre-determined to occur during early development, he considered multilayered sources to be paramount in development beyond the organismic process: organic maturation, natural experimentation by the individual, observation of others, and equilibration, which he termed the motor of development. In his work, Piaget focused on cognitive development being more than an automatic process taking place within the individual but being integrally dependant and interrelated to the experience with the outside world - a position that has turned into a benchmark idea for modern cognitive sciences and in the work of many who are concerned with the interrelatedness of cognition, emotion, and other aspects of human development. In addition, by focusing on the process of the child’s active construction of new knowledge that is intertwined with stimuli from the child’s social environment, Piaget’s theory is clearly distinct from other theorists attempting to depict cognitive development as a pre-programmed process.

However, Piaget was not the first to conceptualise the interdependent nature of organisms and their environment. Already in 1895 James Mark Baldwin argued that evolutionary changes can be directed by cognitive accommodation (Cairns, 1992) which is “the principle by which an organism comes to adopt itself to more complex conditions of stimulations by performing more complex functions” (Baldwin, 1906, p. 454f.) In 1899, Baldwin published his influential book entitled “Social and Ethical Interpretations of Mental Development: A Study in Social Psychology” illustrating the importance of the social context on individual human development. In this
work, he explicitly argued for a synthesis of metaphysics and psychological science, and attempted an integration of genetic concepts within the disciplines of psychology, sociology, biology, and philosophy. Cairns (1992) remarks in his consideration of Baldwin's contribution for today's Developmental Science that Baldwin's work was "the first systematic effort by a psychologist to use developmental ideas to bridge the gap between the study of social institutions (i.e. sociology) and the study of individual functioning (i.e. psychology)" (p.17).

At about the same time, at the end of the 19th century, other scientists started to voice the need for an interdisciplinary framework to conceptualise development. Clarence Luther Herrick, for example, the originator of psychobiology (Gottlieb, 1987) also demanded an academic unity of multiple disciplines engaged in human development. Clarence Luther Herrick's academic merits stem from what actually was at that time recognized as discrete and barely linked disciplines. While he studied and taught an integrated approach of behaviour, psychology, and the nervous system, he very explicitly premeditated the idea of a scientific interface of anatomy, physiology, ecology, anthropology, neurology, psychiatry, social sciences, psychology, and philosophy (Herrick, 1955). The following statement (as cited by Gottlieb, 1987, p. 4) summarizes Herrick's idea of interrelatedness of scientific disciplines:

When the anatomist, busy with his cross-sections of vital phenomena, can realize that the morphologist and embryologist are studying longitudinal sections of the same wave, then the descriptive psychologist can construe the data of present consciousness with the total-life history of mentality, when metaphysics agrees to speak the same language as physics, our scientific millennium is certainly on its way (Herrick, 1904).

A few decades later in the beginning of the 20th century, Lev Sem'yovich Vygotsky, another developmental theorist concerned with the interplay of social contexts and cognitive development, formulated an integrated approach based on ideas taken from socio-cultural theory, anthropology, and cognitive sciences into a new approach on cognitive development. Valsiner (1988) stresses that Vygotsky, although known as a soviet psychologist, was highly influenced by continental European psychology, psychopathology, evolutionary theory, and contemporary cultural anthropology. Vygotsky's theory—most easily being placed in the contextualist view—suggests that cognitive and behavioural development varies greatly from culture to culture and that the cultural tools that are being used have an effect on cognitive development independent of biological predispositions. He proposed basically three ways by which development takes place: imitative learning, instructed learning, and through processes of collaborative learning. All these processes are dependant on the interrelatedness of social environment and cognition. According to Vygotsky, adults or more mature peers assist individual development, a process in which the zone of proximal development is of eminent importance ("the zone of proximal development [...] is the distance between the actual development level as determined
by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers’ (Vygotsky, 1978, p.86, italics in original), a concept that stands for the interrelatedness and complexity of cognitive development.

From our discussion above it is apparent that early Developmental Science is rooted in the ideas of theoretical assumptions based in the organismic tradition (e.g., J.M. Baldwin and J. Piaget), the psychobiologists view (e.g., C.L. Herrick) and the contextualistic orientation (e.g., L.S. Vygotsky) on development. However, the understanding of development proposed in the current Developmental Science also draws on contributions that were provided by scholars who more clearly focussed on the “social component” of development. George Herbert Mead, for example, whose thinking on development was strongly influenced by his intellectual background in philosophy and social psychology, constructed a stage-based theory on identity development, which entails the proposition that an organism progresses through consequential social interaction patterns, using increasingly sophisticated modes of communicating. The reading of his theory elucidates that even though Mead was not interested in describing the acquisition of certain cognitive skills as Piaget or Vygotsky did, nor did he aim to explain processes within the human nervous system like Herrick, he added significantly to developmental thought through emphasizing the importance of the person-context component of development. Theories on social learning provided important insights into the construction of the comprehensive framework for Developmental Science as well. Albert Bandura (1967) followed the integral idea that observational learning from human models drives development. That is, children observe others, imitate behaviour, and therewith proceed in their development by interacting directly or indirectly with their social environment. Bandura’s model of learning - initially known as the ‘social learning theory’ - was later renamed to ‘social cognitive theory’ which manifested his account for the interaction of social environment and cognitive capabilities, another characteristic firmly established in modern Developmental Science.

We already warned the reader that the list of influential thinkers who contributed to the advancement of Development Science is nearly endless. Of course, there are many more scholars besides the above-presented theorists, which contributed to the origin and advancement of a science on developmental processes. From the works of Sigmund Freud (1904/2002), for example, stems the supposition that normality and abnormality cannot be strictly separated but are rather two extremes of one continuum. His daughter Anna Freud (1966), a psychoanalyst herself, also strived to describe developmental progressions, which were supposed to depict behaviour between normality and pathological disorders. The substantial meaning of childhood experiences on later adjustment was further explored and elaborated by John Bowlby (1969) who focussed specifically on the mother-child relationship.

The impact of psychopathology, as a discipline concerned with the investigation of causes and patterns of abnormal behaviour attempting to provide insights into the longitudinal perspective of behavioural changes rather than a momentary descrip-
tion of behaviour has also been substantial. The study of abnormality “draws on many specialties, such as developmental, clinical, and cognitive psychology, genetics, psychiatry, epidemiology, biology, and education” (Achenbach, 1992, p.629). However, unlike the sciences of psychopathology, Developmental Science views behaviour - borrowing from the Freudian idea of a behavioural continuum - as only one of many aspect of human behaviour and hence the explanation of abnormal behaviour is just as important as so called “normal” behaviours within this framework. With the goal of depicting long-term behavioural changes and identifying consequences on human behavioural development, it is an integral part of Development Sciences to explain all of the various aspects of human behaviour.

Within the previous sections of this paper we aimed to approximate only a few outstanding developmental theorists and discussed their influence and contribution to what we consider contemporary Developmental Science. It has become evident that not a particular worldview is characteristic of Developmental Science but that organismic, contextualist, and mechanistic paradigms provide significant and extremely valuable insights on the explanation of human development. Apart from that, our little review also puts to the forefront that the call for an integrated and multidisciplinary approach as Developmental Science aims to be is not a product of recent theoretical considerations. As mentioned above, more than a century ago, scientists did not only incorporate different research traditions into their own work, but Clarence Luther Herrick moreover insisted explicitly on the need to transform these ideas into scientific practice. Herrick was the first to suggest establishing a centre for developmental research that was unrestricted by disciplinary boundaries: an idea that died with him in 1904 (Gottlieb, 2004). To conclude our reflection on the historical roots of Developmental Science, the last section of this paper includes an overview of recent institutional work, publications and also a growing appreciation of Applied Developmental Science.

In the 7th decade of the last century the first serious attempts were made to establish a centre of interdisciplinary work on developmental issues by Zing-Yang Kuo, a Chinese psychologist who demanded the foundation of a multidisciplinary research centre of development. According to Kuo such a centre should integrate work within the disciplines of psychology, endocrinology, neurophysiology, embryology, zoology, ecology, and anthropology, and therewith contribute to the investigation of behaviour and its ontogenesis in biochemical, structural, and environmental contexts (Gottlieb, 1972). Kuo himself spent a large amount of his research career on the investigation of embryonic developments of chickens and was recognized as a great scientist not only by psychologists but also biologists. It took however more than 20 years until Kuo’s idea was transferred into academic practice when finally in 1987 the Carolina Consortium on Human Development was established by faculty and researchers of three neighbouring universities in North Carolina that aimed to bring together scholars from various disciplines and universities with a shared interest in researching and teaching development. From this consortium emanated the first research institution dedicated to an interdisciplinary research on human development, namely the Center
for Developmental Science (CDS) at the University of North Carolina in Chapel Hill, United States. Since the centre’s establishment in 1994, it encompassed a great variety of different scholars in the fields of anthropology, behavioural genetics, developmental psychology, developmental psychobiology, education, epidemiology, experimental psychology, internal medicine, behavioural neurobiology, nursing, paediatrics, psychiatry, public health, and sociology (CDS, 2007). As stated, the CDS took over the pioneering task in institutionalising the approach of Developmental Science and many of recent advancements in promoting the principles of Developmental Science would gone by unnoticed without the continual engagement of its’ members. For example, their commitment to Developmental Science lead to the publication of the first book entitled “Developmental Science” in 1996 (Cairns, Elder & Costello, 1996). This book comprises contributions from various research fields like psychobiology and psychopathology and provides a first systematic account of the relation of cognitive development and culture, discussing the impact of social change on development, therewith clearly demonstrating the multifaceted nature of Developmental Science. In addition the journal “Developmental Science” which tenth anniversary issue was just published in January of this year grew out of the CDS. With a focus on human developmental cognitive neuroscience the journal includes many empirical studies and theoretical discussion on important topics within Developmental Sciences.

Though building the foundation for an institutional engagement in research on human development without the boundaries of traditional disciplines, the CDS is not the only institution following the aim of an interdisciplinary study on development. A number of other research centres were established, written work published, students trained to be developmental scientists and journals founded to be an outlet for their excellent work.

Another excellent example of the effort to institutionalise developmental sciences is the Department of Developmental Science at the University of Iowa that describes its research aim as follows: “Development comprises biological growth, the organizing of neurons within the brain, the increasing complexity of mental representations, the emergence and assembly of novel behaviours, and the important role played by social and cultural goals and contexts. Developmental science seeks to understand this process at all of these levels.” (Department of Developmental Science at the University of Iowa, Departmental website, 2007). However, centres for research on Developmental Science emerged not only within the United States of America. Lead by Lars R. Bergmann, the Stockholm Laboratory for Developmental Science in Sweden looks at human development with a holistic approach and includes biological, mental, and behavioural factors besides considering environment-related social and physical aspects. „The strength of the laboratory lies in its combination of a unifying integrated holistic theory of human development, vigorous research based on three large longitudinal data bases and an ambitious program for methodological research” (SLDC, Departmental Website 2007). Another European centre that successfully approaches Developmental Science was founded
in 2003 under the leadership of Rainer K. Silbereisen is the Centre for Applied Developmental Science at the Friedrich Schiller University in Jena, Germany, (CADS, 2007).

Applied Developmental Science experienced notable attention during the last decade with encyclopaedias (2004) and handbooks (2002) published, a journal Applied Developmental Science that is released four times per year since 1997, and other research departments such as the Institute for Applied Research in Youth Development at Tufts University headed by Richard Lerner (see http://ase.tufts.edu/iaryd/about.htm) or the Unit “Developmental Science and Applied Developmental Psychology” at the Free University of Berlin headed by Herbert Scheithauer (see http://userpage.fu-berlin.de/~hscheit/). Just like Developmental Science, Applied Developmental Science sees its roots in manifold disciplines “home economics/ family and consumer sciences […], human ecology […], comparative psychology […], and developmental psychology” (Fisher & Lerner, 2004, p. xli) and aims at an “integration of perspectives from relevant biological, social, and behavioural sciences” (Fisher & Lerner, 2004, p. xlii). The clear distinction to general Developmental Science is however the emphasis on “enhancement of the life chances of the diverse individuals, families, and communities” (Lerner, Fisher, & Weinberg, 2000, p. 24), in other words the actual application of development related knowledge in preventative and interventional practices.

In summary it is noticeable that much appreciated and valuable work towards an integrative framework of developmental science has emerged during the last two decades. We hope that we can extend this approach by the launch of the European Journal of Developmental Sciences and contribute to the strengthening of true interdisciplinary research by placing equal importance to work originating in different disciplines studying various aspects of development. We want to encourage researchers to take on the challenge of viewing life and its changes from a broader view than the narrow focus any single discipline tolerates. Current Developmental Science still benefits from theories and research that has originated more than a century ago but a lot of effort is needed to engage in work that crosses disciplinary and institutional boundaries. The aim of this new journal is to bring together work from a great variety of disciplines and cultures and continue on fulfilling the goals of Developmental Science that James Mark Baldwin, Clarence Luther Herrick, and Zing-Yang Kuo among others proposed and requested of science many years ago.

References


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