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Teams Do It Better!

Toni C. Antonucci

University of Michigan

Abstract

I propose that interdisciplinarity and respectful team science become the norm for studying human development. This is not as simple a wish as it may seem because we tend to be trained in a single discipline. We tend to know much less about the theory, methods and findings of other disciplines. We often respect them less and minimize their contributions. It is now abundantly clear, however, that humans develop on multiple levels. Human development occurs from neurons to neighborhoods, cells to societies, and genes to geography. It is fundamentally evident that every level influences the others and all combine to constitute human development. While we may specialize, certainly a reasonable personal choice, it is critical to recognize and respect the contributions of other disciplines to the study of human development. This may best be achieved by recognizing the contributions of other disciplines and working in multidisciplinary teams.

Keywords

Team Science; Innovation; Respect; Interdisciplinarity; Multiple Methods

The Evolving Science of Human Development

We can be proud of the science of human development. We address important issues, seek to provide answers to important questions, and are committed to understanding and optimizing human development. Nevertheless, we tend to be disciplinarily myopic, assuming that whatever our own discipline happens to be is the most critical to the study of human development. This is especially curious since human development itself includes multiple disciplines, e.g. biology, education, genetics, neuroscience, psychology, and sociology.

There was a time when this approach might have been justified. We knew much less about human development overall and not that much more about each of the disciplines mentioned above. Communication was slow, journal articles took years to be published and books took even longer. Annual conferences were the quickest way to learn about the latest research, if you were lucky enough to get to the conference and the people in your field were there too presenting their cutting edge findings. Fortunately, we live in different times now. Information is rapidly, if not instantly, available and in many forms. Print and online forms of journals and books are common. Email, skype and other electronic forms of communication make it possible to share research findings around the world almost as quickly as you might with a colleague across the hall. Substantively, it is much more generally recognized that intra-individual development occurs on many fronts, i.e. within

many subsystems, and that each of these can and does influence the other (Antonucci & Webster, 2014).

Urie Brofenbrenner (1979; Brofenbrenner & Morris, 1998) might easily be identified as the child developmental scientist who most clearly presaged this view with his ecological theory of human development. He argued that development was influenced by five levels: microsystems, involving the biologic, family, or other factors most immediately influencing the child; mesosystems, referring to the interconnections between microsystems such as between the family and the child's peers; the exosystems, which links the broader social setting of children with their more immediate, e.g. home, context; macrosystems which includes the cultural or societal context within which the child lives and its influences on the child's individual development; and finally, chronosystems, the chronological patterning of individual and historical experiences which combine to uniquely influence the development of the child. Basically these systems describe the multiple levels more recently described with phrases such as neurons to neighborhoods, cells to society and genes to geography.

Although rarely considered together, Baltes' (Baltes, 1987; Baltes & Smith, 2004) life span theory of developmental psychology has many similarities. He described biological, environmental and bioenvironmental (i.e. the interaction of biological and environmental factors) influences on development. He, too, considered conceptions of development from multiple levels. The first he described as individual e.g. personological, maturational, dialectal and social learning. He also described environmental influences as ontogenetic or age-graded, evolutionary or history-graded, and non-normative, i.e. influenced by unique individual experiences or circumstances. And a third influence on development was bioenvironmental which essentially captures the ongoing interaction of individual and environmental influences.

Interestingly, both these men were themselves influenced by multiple cultures, both born outside the U.S.- Brofenbrenner in the old Soviet Union and Baltes in Germany - and then lived in the U.S. for some time. Both crossed at least two cultures, an experience much less common during their time, when communication was slow and transportation even slower. It is likely that these men experienced at a personal level how initial life trajectories, i.e. as originally prescribed, were fundamentally changed by life circumstances, their move to a new country, which changed their life and career trajectories. At the time these theories were conceived we did not have the methodological tools to examine the new theoretical insights but much has changed in the half century since these theories were first conceived. New tools have provided means to expand and explore the insights resulting from the evolving science of human development.

New Tools and New Insights

The field of epigenetics offers an excellent example. At one point we considered genes and their effects to be immutable. Genes that were associated with physical or psychological characteristics were thought to be preset at birth. The identification of the human genome was anticipated with great promise. We would be able to identify an individual's genetic composition and thus have a complete understanding of their biology and consequent

behavior. We now know that this is simply not the case. Where it was once assumed that genes would explain everything, we now understand that genes can and are influenced by environmental factors.

The emerging fields of epigenetics and those studying gene expression have fundamentally altered our understanding of how genes affect behavior. For example, we now understand that just because a gene is present does not mean that it will be expressed. It is clear that environmental factors, i.e., non-genetic factors, can influence their expression. Epigenetics research shows that molecular changes in the organism that are the result of experience modifies gene expression. Interestingly, this does not mean that the gene itself is changed. Suomi (2004; 2006) has shown this with animals. The behavior of different groups of monkeys with the same genetic structure can vary significantly as a result of different environmental exposure and child rearing experiences. Meaney (2001) and others have shown, experimentally in rodents, that experience can alter which genes are expressed and at what level. These changes may even be passed across generations. Maternal childrearing, as an example, affects child stress sensitivity via its effects on the relative expression of specific genes. The evidence is beginning to accumulate with humans as well (c.f. Wanke, Partridge & Antonucci, 2011). One particularly powerful example is that of Shanahan and Boardman (2009) who demonstrated that genetic risk factors for poor school performance and academic achievement (as assessed by the presence of DRD2 gene) could be substantially overcome with social resources including parental involvement, high socioeconomic status and high quality schools. These findings have fundamentally changed our views of genetics and of human development. They show a biological, molecular pathway through which experience affects genes and provide a mechanism to understand gene x environment interactions.

Foundations of Team Science

These examples, of Bronfenbrenner's ecological theory, Baltes' life span theory and the empirical evidence briefly summarized above, clearly demonstrate the importance of considering multiple levels of human development even before very sophisticated methodological tools were available. New methodological tools are rapidly emerging and providing vehicles to examine the insights garnered from theories of human development both old and new. Let me elaborate on how this relates to team science. Bronfenbrenner, a child psychologist interested in human development, and Baltes, a life span developmental psychologist interested in human development, were able to both experience and observe the multiple influences on development. Although professionally active during a time when the nature vs nurture debate was at its zenith, they, nevertheless, recognized that this simple dichotomy did not accurately or sufficiently describe how people develop. In another interesting parallel, their own lives were essentially examples of team science even though both were basically trained as psychologists. As noted above each was born outside the U.S. but spent some formative part of their career in the United States. They work in more than their countries of origin; they both lived through great advances in methodology from simple to advanced understanding of the scientific method, e.g. from the universal use of convenience samples to representative samples and experimental methods, as well as simple

to advanced analytical tools, e.g. from correlations and ANOVAs to structural equation and multilevel modeling.

I believe it was these experiences that gave Bronfenbrenner and Baltes the vision to see that multiple perspectives and disciplines could contribute to our understanding of human development. In essence, they had the unique experience of having lived team science because they both worked in multiple teams and cultures and were thus exposed to multidisciplinary perspectives. It was not by chance that Bronfenbrenner was founding director of the College of Human Ecology at Cornell University – a fundamentally multidisciplinary, team approach to the study of human development. Bronfenbrenner, because of his interest in child development, in addition to developmental psychologists, also worked with educators, social workers, health care providers and policy makers. Baltes, as Director of the Max Planck Institute of Human Development, another fundamentally multidisciplinary institution, in addition to developmental psychology, turned to medicine, psychiatry, sociology, and social policy to inform the Berlin Aging Study, a multidisciplinary longitudinal study of human development during the latter half of life. They, and we, benefitted from the serendipity of their own lives in a time when this was a unique, but not necessary, advantage. My wish is that we all embrace this approach and do so through team science. I would argue that it is no longer a luxury of individual life circumstances but rather a critical requirement for scientific study.

Multidisciplinary, Interdisciplinarity and Team Science

It is perhaps useful to distinguish the terms multidisciplinary and interdisciplinary and to establish how they relate to team science. We begin with the term multidisciplinary. As the term suggests it refers to the presence of multiple disciplines. The advantage of a multidisciplinary approach is that it allows people with different disciplinary perspectives and expertise to address the same problem, in this case human development. This is helpful and often provides unique insights within each discipline. The result is likely separate and distinct perspectives. The interdisciplinary approach also addresses a question from multiple disciplines but attempts to integrate the disciplinary perspectives and to better understand how each discipline interacts with others to influence the outcome, in this case human development.

Team science allows individuals to work together to inform the question at hand. Teams could work in a multidisciplinary or an interdisciplinary fashion. It is likely that both are useful and that which is most useful depends on the nature of the question and the stage of research. Regardless of which approach is adopted, it is clear that it cannot be successful if the scientists did not conduct high quality research in their own field and be mutually respectful of the science and scientists in other fields. This can be difficult since scientists from different fields have fundamental differences at many levels. They speak different languages, make different basic assumptions, use different tools, and interpret evidence differently. These are both the great advantages and the great challenges of team science. In order for such teams to work, its members must make extraordinary efforts to communicate and to do so in a respectful, open, accepting, and non-threatening manner. It is not a simple

task but the rewards are great in that such team work often results in innovative thinking and leads to breakthroughs in problem solving and understanding fundamental concepts.

Relatedly, we have seen much lip service paid to multi-method approaches to science. Examples include using quantitative and qualitative techniques to acquire data; including different types of samples, such as special convenience samples and representative population based samples. And of course, new techniques have opened new doors to the examination of hormonal responses to events through the use of biomeasures, and the examination of brain changes as the result of specific experiences or stimulation. The plethora of measures, methods and techniques now available to scientists of human development is extraordinary. No one scientist could be expected to be expert in them all. However, one scientist might benefit from evidence accumulated through each approach should they all address a topic of interest to that scientist. Working in teams offers the possibility of benefiting from all these advances without the necessity of being expert in all. Since the number and speed with which new methods are emerging is likely to increase rather than decrease, it seems critical that we endeavor to benefit from them.

We are at an exciting cross road in the study of human development and we will make the greatest breakthroughs by working across disciplines and in teams. This is not something that always comes naturally e.g. we train our graduate students within disciplines, we tend to hire faculty within departments, and funding agencies are usually disciplinarily specific. Here is where to make progress we will need to break down these barriers and build new bridges to better communicate across disciplines, paradigms, and methodologies.

Building Bridges

Team science can help us optimize what we can and should be learning about human development. I argue this on basic scientific grounds but also on humanitarian and policy grounds. We now understand that all forms of development are influenced by multiple factors, including, but not limited to, physical, psychological, social, cognitive, cultural, and economic factors. Failure to recognize this will not only limit the advancement of the science of human development but also has the important additional disadvantage of creating misinformation. This would be the case, for example, if we assumed a certain capability or behavior was genetically based when, in fact, the environment had suppressed the expression of the gene normally associated with that behavior.

In the case of social relations, a topic I have been fascinated with for quite some time, it has not always been recognized as a critical part of human development. Social relations is a classic example of a field that is affected by multiple levels, can be informed by multiple disciplines but also can enhance understanding in many disciplines. Developmental psychologists began by identifying the importance of social relations for infant and child development; note the tremendous volume of research on mother-child attachment. Most early work was strictly observational, as researchers observed mothers interacting during random interaction periods. A great methodological advancement was offered by Mary Ainsworth (Ainsworth, Blehar, Waters & Wall, 1978) who introduced the Strange Situation as a way to observe children in a standardized setting. Later, this work was extended to older

children, adolescents, adults and older people. To conduct this work new tools had to be and were developed. At the same time sociologists were observing how people interacted in families and organizations. Botts (1957) interviewed husbands and wives in London about their daily routines and social relations. She identified how social networks shaped gender roles in families. Anthropologists were also examining social relations but were more likely to take a system or societal perspective. Consider the example of Barnes' (1974) ethnographic study of a remote Norwegian fishing village. This classic work contributed important information about how social relations helped people through harsh winters and difficult times when half the village was out at sea for months at a time. And finally, physician epidemiologist Cassel (1976) identified social relations as critical to an individual's ability to resist disease, for the first time proclaiming to the medical profession that social relations influenced an individual's or host's resistance to disease, i.e. physical health. While coming from different disciplinary perspectives each informed our understanding and knowledge of social relations. Each research endeavor used a different methodology and benefited from recent (at the time) advances. The confluence of attention from different disciplines, while involving different methodologies did not involve especially new or high technology methods, clearly gave us a broader picture of how social relations affected and were affected by other aspects of human development.

Recently, we have seen the examination of social relations reach entirely new psychophysiological levels. Aided once again by new methodological strategies which allow the assessment of, for example, cortisol by assaying saliva, telomeres through histochemical assessments of whole blood, or neuronal\brain activity through functional magnetic resonance imaging, we have been able to examine social relations on vastly different dimensions. We can now explore how people respond to interpersonal stress at biological, genetic, and neurological levels. At the same time epidemiologists have been able to identify the ways in which geography, characteristics such as neighborhood safety, can influence an individual's behavior and social relations. Unsafe neighborhoods can make it impossible for people to leave their homes and interact with or help their neighbors. Environmental scientists have identified toxins in certain environments which influence, read threaten, normal child development. We now know about the effect of lead and asbestos on cognitive development and alertness. As the findings above illustrate, respectful team science can lead to advances in the science of human development and can limit misinformation. While it would be impossible for one person to be an expert in all of these disciplines and methodologies, it is clear that we obtain a much fuller picture of the social relations if we can incorporate these multiple influences into our study of human development.

Advancing the Field

Historically we have been hampered by disciplinary myopia and methodological limitations. Team science will permit us to benefit from the contributions of multiple disciplines as well as increasingly sophisticated new and diverse methodologies. This will allow us to examine human development at multiple levels, separately and integratively. At the basic science level, we cannot but help know more about any human development phenomenon of interest. At the policy level, it will hopefully make clear to policy makers specifically, and citizens more generally, that individuals AND society are responsible for optimal human

development. As an example, while some may be born with certain genetic structures, it is non-genetic factors, e.g. the familial (security), neighborhood (safety) and environmental (toxin) levels, which might have the most important influences on optimizing human development. Team science will lead us to create a clearer picture of those factors influencing human development. It can potentially map pathways for solving major problems, maximizing human development, increasing resilience, offsetting vulnerabilities.

It is also worth mentioning that developmental scientists can make important contributions to societal concerns with which they are not often associated. Examples include national security and defense, engineering and robotics, conservation and sustainability of national resources. It has long been recognized that it is necessary to recognize individual factors in human development to create the best training program for soldiers. As we are confronted with radical terrorists in many parts of the world, it is clear that understanding and redirecting their behavior will best be achieved through an understanding of their life span development. In the engineering fields where great technical breakthroughs are being made and robots offer great promise for improving the health and well-being of vulnerable populations, it is increasingly care that these breakthroughs will be of no benefit unless we understand the psychology that reduces the degree of mistrust people often feel with new inventions and makes people comfortable using them. And finally, while our natural resources have been threatened for some time, recent changes in societal views concerning sustainability has been impressive and led to considerable behavior change.

Clear Map for the Future

Team science, incorporating multiples disciplines, perspectives and methods, offers the best potential for clarity in addressing the important problems we face. Respect for each discipline and its contribution is critical for team science to work. Education in the future must celebrate team science and the importance of high quality multidisciplinary research. Universities must facilitate and promote more interdisciplinary (team) approaches to education. Funding agencies, conferences, and publications should give priority to research that involves multidisciplinary and interdisciplinary teams. Policy makers need to recognize, respect, and consider the contribution of team science when crafting legislation and identifying government priorities. These steps will advance science as well as create a society that maximally benefits from the contributions of developmental scientists.

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