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Geospatial Tools and the Changing Nature of Human Spatial Thinking

Commentary on Downs

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Key Words

Human cognition has evolved so that we can understand and solve the types of problems that we confront regularly and that are vital to our survival. One type of problem involves knowing about and navigating large-scale space. To help us solve spatial problems, cultures, over the course of human history, have devised various symbolic and material ways of encoding and representing spatial information, including spatial language, maps, and models. These cultural tools are used to solve spatial problems such as communicating spatial information (e.g., directions), identifying locations, and wayfinding. They are highly valued in cultures and, as such, they are passed across generations.

Cognitive research has shown that tools of thinking have consequences for the way people think about and solve problems, and that these consequences may sometimes stretch beyond the specific aspect of functioning for which the tools were developed. For instance, research on literacy has revealed associations between different forms of literacy and memory [Scribner & Cole, 1981]. As Olson [1994] explains, "literacy is competence with a script; different scripts recruit different competencies" (p. 273). In other words, as people use a script, they practice and thereby develop skill in the competencies this practice entails. Moreover, some consequences may be readily apparent, whereas others may take a long time to emerge or may not be evident until the tool is widely adopted in a community [Cole, 2005]. Taken together, this research suggests that cultural tools that support and guide thinking can play a formative role in the organization and use of cognitive skills and that the effects of these changes can be immediate as well as long range [Goody, 1977; Vygotsky, 1987]. In addition, the tools that cultures devise and use to represent and support thinking are not static. Cultures change continuously and much of these changes are reflected in, and sometimes promoted by, changes in the tools that are used to support thinking [Gauvain & Munroe, 2012].

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In his engaging article, Roger Downs [this issue] draws our attention to relatively recent technological changes in the representation and use of spatial information. He is interested in technologies that alter how we imagine, communicate about, and experience large-scale space or geospace. The sweep and pace of these technological changes, which Downs correctly refers to as revolutionary, are truly daunting. His core argument, that these changes will affect the development of mind, human behavior, and people's understanding of and relation to the world, deserves considerable thought and study. As Downs explains, the effects of these changes are wideranging and touch on many aspects of cognitive and social functioning. This point is consistent with earlier research that has revealed the significant role of representational and communicative forms on the development and implementation of spatial skills [Gauvain, 1993; Liben, 2009]. It is also true, as Downs notes, that the magnitude of these changes will be difficult to study. Innovative geospatial tools are being adopted at an astonishingly quick rate by people and communities around the world. Even people living in geographically remote communities are adopting them, and this process can introduce massive changes to the ways in which people understand and use the space around them. For instance, mobile or cell phone use is increasing in rural regions of the developing world [Mpogole, Usanga, & Tedre, 2008]. Although most people report purchasing these phones for social reasons and emergency contacts, the phones are also used to help people carry out activities that are spatial in nature. The availability of mobile phones can help villagers, especially those living in widely spaced regions, make better decisions important for their livelihood, such as being able to communicate with one another about where to find clean water that is desperately needed for livestock and household use.

Downs's article is especially instructive in its coverage of the large set of geospatial tools out there, many of which are already established and others that are on the "near" horizon. The word near is significant here because, as Downs points out, the introduction of new technologies, along with advances to currently available tools, is rapid. In this light, it may be worth adding emotional consequences to the cognitive and social consequences that Downs outlines. Extremely rapid, large-scale change can produce a breakdown of traditional cultural systems, difficulty for individuals to adjust to the changes, and, in some instances, an increase in psychopathology [Bodley, 1982; Munroe & Munroe, 1980].

The main question Downs asks is how cultural changes stemming from the widespread use of geospatial technologies are related to human development. The use of these tools affects, on a daily basis, the work people do, the way children are cared for and educated, and the nature and strength of the links between the community and the world beyond the community. Thus, when children participate in cultural activities, they are introduced to conventional ways of thinking and acting. As a society adopts new resources and practices, children are exposed to the changing modes of acting and interacting that ensue. Thus, both inside and outside the home, technological changes have direct relevance to processes of human development. This entire process is based on the fact that knowledge of space is inextricably tied up with our experiences in space and with other people and material tools that help us understand and use space. Although some of this knowledge is attained on our own, other people convey much information about space that helps us to organize and use this knowledge. There are also complex systems of meaning and practice associated with human spatial knowledge, along with forms of representation, communicative conventions

and material tools, many of which Downs discusses, that were devised by culture and that support the development and use of spatial knowledge. Thus, as children learn these technologies and how to use them, they are also learning about their culture and what it values in this area of learning. Development emerges from the experiences children have with these symbols and tools, and with other members of their culture. Learning this information is a dynamic process. These experiences do not simply expose children to external stimuli to which they learn to respond. Rather, as children engage in activities, they construct, negotiate, and then carry forward this newly acquired meaning in their own actions [Lawrence & Valsiner, 1993]. It is in this way that children contribute to maintaining and to changing the culture itself [Gauvain, 2009].

Downs's argument touches on several important aspects of human development, and theoretically it is rooted in social constructivism. He uses several theoretical approaches to cognitive development to frame out his position, including Piagetian and neo-Piagetian ideas on the development of spatial thinking and sociocultural views on the role of cultural symbol systems and tools in the development, organization, and use of knowledge. In addition, he makes use of research on social development – in particular, the development of the self. He then uses this theoretical base to describe the potential benefits and pitfalls for human development as children adopt these geospatial technologies.

It is here that the article provides an expansive and rich set of ideas – a roadmap of sorts – that charts out further study for researchers interested in the development of spatial thinking. Scholars interested in the more general issue of the relation between cultural tools and human activity could also do well to follow many of these suggestions. A risk in these inquiries, of course, is that the technology of focus could change substantially or be obsolete by the time the research is publically available. In this regard, researchers would be wise to consult related research, such as that examining the impact of literacy and media such as television on development, in order to identify critical ingredients in the technology that may transcend these changes. Downs provides many helpful suggestions along these lines, including how declarative, procedural, and metacognitive knowledge of space may be integrated with geospatial technologies. Yet some other lessons from this earlier research, especially about the effects of television on development, may be important to heed. Recall that many early studies on television focused on negative aspects of this technology such as whether the time a child spends watching television interferes with other activities considered more important for development. It took several years and the appearance of certain educational television programs (e.g., *Mr. Roger's Neighborhood*, *Sesame Street*) before the benefits of this technology were explored. In hindsight, this research suggests that, from the outset, both the benefits and problems related to a technology are important to examine. Similar to television, the types of technologies that Downs discusses in his article are not likely to disappear. Understanding their potential and being aware of the risks they pose are both important issues to discover. If the near future includes developmental research that reveals both benefits and problems with these technologies, then Downs is to be thanked for helping lead the way.

The many benefits are outlined quite clearly in the article, as are several of the serious potential negative outcomes. On this point, three potential downsides seem particularly important to investigate, and findings would have relevance beyond geo-

spatial technologies. The first pertains to what Downs refers to as metacognitive knowledge, which includes how a person learns to use geospatial technologies to access spatial information and to evaluate the utility of this information. As much as one can learn about a space via technology, there will undoubtedly be a point when the user will need to trust the source. Research on the development of trust, which has largely focused on forensic matters, would be interesting to incorporate and extend into the realm of information technology [Harris, 2012]. After all, one can never ascertain for sure if the information available is correct or best for the activity. And because this type of spatial information is often used in planning activities, children (and adults) need to be able to trust the source to carry out their future actions. Both the processes of gathering and evaluating this type of information need to be understood better. In the unrelenting information stream which we live in today, it will be important to help children understand how and when to be circumspect about the information they obtain from geospatial technologies, how to check and evaluate the source, and how to monitor their progress in case the information is wrong or not helpful.

The second issue is dependency. Downs is correct in stating that for many people the affordances of geospatial technologies will be liberating. Many people will feel comfortable traveling to places and over distances they may never have considered before. They may also feel they can change their plans during an activity, and, therefore, be more spontaneous and flexible, which can be very satisfying. But as with all technology, there is a form of dependency in this process, both on the medium itself (e.g., is it in proper working order, are the batteries charged, is the wireless service operative, and is the contract in force) and on the information it contains. The former are practical matters than need to be learned and understood. The latter may seem similar to the previous point about trust in the message, but it is not the same. That is, it is not about the message but the messenger, including the medium itself and its design features. On this point Downs states that, "While users have options, the shape of the world is set by hardware and software designers. To the extent that we accept default settings of devices as given, our experience of the world is dictated by others" (p. 39). The questions then become: Who are these others, and what goals motivated them in the design of information and the form in which it is presented for users of the technology?

In times past, which in the current discussion may be at most a decade ago when geospatial technologies were in limited supply and use, this type of information was immersed in the process of socialization. And as such, it was regulated by the community. But geospatial technologies connect children to the world way beyond the community in many new and exciting and, also, unknown ways. In other words, the socialization process as we have known it, and as developmental scientists have studied it, is swiftly getting upended. And what happens next is very uncertain. Shepherd White [2003] discussed something like this predicament in a paper entitled *Developmental Psychology in a World of Designed Institutions*. This paper traces the historical development of schooling, in particular kindergarten, and other social institutions that increasingly inserted themselves into the lives of children and, in so doing, shaped childhood and child development. Thus, there is some evidence of social changes of this scale that we can look to for insights on the matter. But there is one important difference to discuss: The shaping of these earlier institutions was informed by professionals, including developmental psychologists and educators, and

most decisions were community based with many local constituents, especially parents, involved. However, the new landscape is quite different; it is one in which parents and other community members are not necessarily involved (or agentic) in the information children learn and that is used to guide their activities. It is here that design concerns regarding the medium itself loom large, and it includes the software and applications of the technologies as well as their mode of usage. On this last item, we return to Downs's comment about default settings. Although it is certainly an empirical question, it is likely that most children, and perhaps adults, use the default settings on these devices. In so doing, the benefits are clear; the ability to use the technology is streamlined tremendously. But in so doing, a person also makes a trade-off: He or she has taken on the designed form, and, as cultural and cognitive psychology has shown, this may include more than the person or culture bargained for.

The third and final issue pertains to social equality. Although there is great potential for socially liberating forces through geospatial technology, the fact remains that these technologies are expensive to obtain and maintain. As a result, their contributions to social experience and human development for people living in poor communities are quite different from those who live in more affluent settings. Global disparities in access to information and communications technology, including geospatial information sources, exist and are of particular concern because they lead to disparities in access to the opportunities derived from these resources. These patterns are pronounced in certain developing regions of the world, especially Africa. The rapid pace of changes in these technologies simply compounds this problem. And the fact that these technologies may very well lead, as both theory and research suggest, to changes in thinking and ways of understanding the geospatial world puts these disparities in a particularly ominous light. They also strike a somewhat paradoxical note; many of the very same tools that are fueling globalization are not available to large populations of the world. What this pattern portends for the future of these regions, including the children who live in them, is unknown, and research on this topic is surely needed.

The ecology of childhood is changing rapidly around the world. In his article, Downs provides a valuable account of how it is changing in relation to cultural tools that support the development and use of spatial thinking. How human development is shaped and directed by these changes are critical issues for current and future research. These changes will have consequences for human development because they alter many of the experiences of childhood. The fact that these changes are widespread globally and pervasive in daily life underscores the importance of understanding how they affect individual development and perhaps change cultures. Downs's call for research is both persuasive and constructive, and he offers much food for thought and study on this account. It is important that this research be framed in broad terms so that its contribution to our understanding of the role of geospatial technologies in human development can be understood in its own right as well as in relation to longstanding questions about the connection between cultural practices and human development.

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