Human Development 2008;51:80–89
DOI: 10.1159/000113157

Human Development

Reflections on J.V. Wertsch's 'From Social Interaction to Higher Psychological Processes,' *Human Development,* 1979

Geoffrey B. Saxe

University of California, Berkeley, Calif., USA

Key Words
Genetic explanation · Language games · Numerical cognition · Numerical representation · Regulation of behavior · Sociogenesis

Abstract
In his 1979 *Human Development* article reprinted in this anniversary issue, James Wertsch presented an approach to genetic analysis of the shifting regulation of problem-solving behavior in early childhood. In my reflections on Wertsch's seminal contribution, I discuss ways that subsequent inquiry built upon ideas he elaborated in the 1979 article, using my own work as an illustrative case. One strand of my discussion focuses on method. Wertsch's treatment involved lab-based studies, and I discuss how, in my research on early number development, I coordinated laboratory methods similar to Wertsch's with field methods. The second strand broadens the scope of Wertsch's approach to genetic analyses. Wertsch presented a compelling case for the utility of genetic analysis in investigations of the emergence of forms of problem solving. I discuss the importance of extending genetic explanation by incorporating sociogenetic analysis of the reproduction and alteration of collective systems of representation in the social history of communities. As an illustration I present my research on numerical representations used by a remote Papua New Guinea cultural group. I conclude by considering the utility of a genetic analysis of collective forms of representation and the functions these forms serve, in ontogeny as well as in social history.

I was delighted to receive the Editor's invitation to reflect on James Wertsch's 1979 *Human Development* article, 'From social interaction to higher psychological processes.' Though Wertsch framed his manuscript as a corrective to the mistranslations and varied interpretations of Vygotsky's work, the article is much more than this. Wertsch's contribution was a creative extension and development of two related ideas at the heart of Vygotsky's seminal writings.

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0018–716X/08/0511–0080$24.50/0

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Geoffrey Saxe
UC Berkeley
4315 Tolman Hall
Berkeley, CA (USA)
Tel. +1 510 643 6627, E-Mail saxe@socrates.berkeley.edu

The first idea is the place of language (and by implication, other collective systems of representation) in Vygotsky's treatment of mediation. Wertsch points out that Vygotsky's focus was not language with a capital 'L' – as a formal system of phonetic/phonemic units and syntactic rules and dictionary definitions – but rather language as lived speech, as children use it as interlocutors in communication with others through participation in what Wittgenstein [1972] referred to as a 'language game' in his *Philosophical Investigations*.

The second idea, which builds upon the first, is about the critical role that genetic analysis played in Vygotsky's treatment of higher cognitive functions. In the microcosm that Wertsch used to explore cognitive development – mother-child interaction in the joint solution of the cargo truck puzzle – he presents an intriguing analysis that traces older children's conscious self-regulation in planning and anticipation to younger children's early communications in speech and gesture with adults. In his genetic analysis, following Vygotsky and drawing upon Wittgenstein, Wertsch argues that the higher cognitive functions of planning and self-control have their origins in the reconstruction of talk with others as children become players in the language games of their communities.

Wertsch's article had a long reach. To provide some sense of the article's penetration into academic scholarship, I ran a citation index search and found hundreds of 'hits' spread over more than 50 journals. The journals had their intellectual roots in varied disciplines, including anthropology, sociology, applied linguistics, as well as many differentiated subfields of education (early childhood education, cognition and instruction, literacy, educational psychology), and psychology (including developmental, atypical development, clinical, neuropsychology, and school psychology). Further, and as might be expected, the article was cited by authors publishing in interdisciplinary journals, like *Human Development*. My own reflections on Wertsch's manuscript are necessarily personal, extending back in time to just prior to the article's publication.

Personal Reflections

My first read of Wertsch's manuscript was in 1978, a preprint of the published article. I had recently returned from my first field trip to Papua New Guinea, where I investigated the development of numerical cognition among the Oksapmin, a people who traditionally use a 27-body-part counting system. Wertsch's manuscript resonated with an analytic tension with which I had wrestled in the field as I framed methods for studying the development of numerical cognition in Oksapmin children. The tension was between sociocultural accounts of cognition, like Vygotsky's mediational perspective, on the one hand, and structural developmental accounts, like Piaget's genetic epistemology, on the other. As I structured research questions in the Oksapmin world, I appreciated the importance of structural, epigenetic accounts of domains of cognition, like Piaget's, in which the child constructs categories of knowledge out of sensorimotor actions and progressively coordinates them into operational structures, a process regulated by coherence-building, equilibratory mechanisms. But I was also troubled by the structural reduction of culture-specific aspects of number to mere 'content' – like the representational forms that had emerged in the social histories of cultural groups. In structural developmental ac-

counts like Piaget's, the focus was on structures of operations, not representations. The focus on mediation, in Vygotsky's approach, provided more analytic room to understand the interplay between particular social histories of human communities, including forms of representations and collective activities in children's construction of numerical thought.

When I returned from my first field trip to the Oksapmin, I found that Wertsch's article presented a reading of Vygotsky that I appreciated, one that pointed to an area of rapprochement between Vygotsky's writings and some aspects of Piaget's genetic epistemology. Wertsch's 1979 interpretation privileged *both* the constructive, coherence-building activities of the child (similar in some respects to Piaget's treatment of equilibration) and the cultural-specific language games of the child's community. Wertsch's coordination of these two foci was a welcome and striking contrast with the social learning and empiricist interpretations of Vygotsky that populated academic hallways of that time – ones that read Vygotsky as a copy theory of knowledge positing direct internalization of the historically elaborated knowledge forms by the child. Towards the end of his article, Wertsch writes incisively about an alternative as he points to a mechanism that accounts for shifting patterns in the regulation of activity:

> [W]e would like to suggest that the progression from one level to the next in the zone of proximal development is largely the result of the child's effort to establish and maintain coherence between his/her own action and the adult's speech. … For the child … the coherence between speech and action must be created rather than assumed. One of the major ways that it is created for the child is by carrying out the behaviors specified by the adult and then building a coherent account of the relationships among speech, definition of situation, and behavior. This means that it is not the case that the child first carries out the task because she/he shares the adult's definition of situation. It is precisely the reverse: she/he comes to share the adult's definition of situation because she/he carries out the task (through other-regulation). (p. 20)

In his treatment of the cargo truck puzzle, Wertsch's focus was on the child's developing metacognitive control of behavior. He used Wittgenstein's language game to understand the dynamics and character of the child's changing cognition that led to planning and anticipation in problem solving. As I read Wertsch's analysis, I appreciated that his use of the language game metaphor could well be extended to knowledge forms themselves, not only issues of anticipation and planning often identified with self-regulative metacognitive processes. The extension was loosely linked to an emerging concern in my own work – a concern for comprehending young children's developing understanding of number in terms of a dialectic between forms of numerical representation and the numerical functions that children use those forms to serve in daily practices.

As an illustration of the link, consider the similarity between Wertsch's account about presuppositions in interpreting directives in the language game of puzzle solving and the presuppositions that lead the expression 'four' (a lexical form) to serve different numerical functions in talk. If a mother points out buses in the street to a child, she might intend that 'four' take on a nominal function, if she points to the bus that is the bus traveling route number 4. She might intend that 'four' take on an ordinal function, if the area to which she points is the fourth bus to pass by. Or, she might intend 'four' to take on a cardinal function, if she points to four buses intending to treat them as a group. These varied pointings of 'four' are ostensive definitions,

indexing the same visual world. But these pointings and the different numerical functions that the same form serves, in an important sense, can be understood as participating in different language games and take on meanings linked to those games.

In my reflections below, I articulate two points of contact between Wertsch's 1979 article and my own empirical work on numerical cognition. Both are concerned with genetic explanation. The first focus is on methods, with an eye towards relations between lab studies and field studies as material for genetic analyses. The second is concerned with the scope of genetic explanation, with particular focus on the origins and alterations of language games in the social history of communities, not only the development of the child.

Methods: The Lab and the Field

Wertsch's methods were closer to the laboratory than to the field. Rather than going to homes, parks, and other places where mothers and children interact, he presented mothers and their children with a puzzle in a standard setting with instructions on what to do with it. There are clear advantages to this methodological choice. The lab setting enabled his careful analysis of the shifting relations between mothers' directives and their children's puzzle-solving activities. But what a laboratory study cannot address is the relationship between the lab activity and practices that occur in daily life. For example, to what extent are puzzles like the cargo truck a context for mother-child tutorial interactions? How might activities like puzzles and associated language games vary across social class and cultural groups? How might the difficulty of the puzzle affect regulative processes – might we find a child in dyadic interaction with her mother to be engaged in 'other-regulated' activity for one kind of puzzle and 'self-regulated' activity for another? In any setting, what evidence would enable us to make claims that the activity of the mother plays a causal role in the self-regulation or the construction of knowledge in the child?

Such questions – partly empirical and partly conceptual – influenced my subsequent project on social processes in early number development in the early 1980s, not long after Wertsch's article appeared. Most research on cognition during the period was lab based and paid little systematic attention to sociocultural processes that supported the development of categories of knowledge; number was no exception. Were young children participating in collective practices in which they were constructing and accomplishing numerical goals? Were they drawing upon cultural forms of number representation to serve particular numerical functions to accomplish these goals in collective practices? Were parents' actions in such activities leading children to acquire new forms of representation? Were they supporting the child's construction of new functions for numerical forms? If so, how? Such questions required a coordination of field and laboratory methods guided by a concern with genetic analysis and explanation.

Our project was set in a neighborhood in Brooklyn, New York [Saxe, Guberman, & Gearhart, 1987]. The neighborhood was largely Caucasian and contained families that were both working and middle class (as defined by standard indices). We sampled about 80 families that contained either 2 1/2-year-olds or 4-year-olds from each socioeconomic group.

Prior research on early number development revealed that young children in the United States show considerable numerical knowledge [Fuson, 1988; Gelman & Gallistel, 1978; Saxe, 1977, 1979; Schaeffer, Eggleston, & Scott, 1974]. Based upon this work, we identified four principal functions for number words that varied in their numerical complexity in young children's development, functions that had implications for children's construction of numerical goals in collective practices. These functions included: (1) nominal reference (using number words in naming activities), (2) cardinal/ordinal representations of single sets, (3) comparing and reproducing sets numerically, and (4) arithmetical transformations of numerical values. We also identified varied strategic forms that children used to serve these functions, like strategies to achieve an accurate count, to represent cardinal values of a single set, or various strategies to compare or reproduce sets.

To document the way children's use of these forms and functions might vary across social class and children's age, we developed a wide range of methods. These included interview techniques with mothers that were used to elicit rich descriptions of the activities with which her child was engaged, as well as their retrospections and projections of prior and possible future activities. These descriptions were then analyzed with schemes that coded both their content (e.g., games of mothers' and children's own invention, store-bought games), and more importantly, their goal-structure complexity based upon our prior analysis of the cognitive functions involved in the activities. For instance, we identified activities in which goals were principally ones of nominal reference (e.g., identifying and pushing numbered elevator buttons – level 1), representation of cardinal values (e.g., counting coins to determine their amount – level 2), comparing the numerical values of two collections (e.g., comparing two collections of pennies – level 3), and arithmetical (e.g., adding and subtracting checkers to find their sum – level 4). The findings of these interviews revealed that across our age and social class groups, children regularly participated in practices involving number, practices that had goal structures of varying levels of complexity. Younger children tended to be engaged with activities of level 1 and 2 goal structures; older children tended to be engaged with activities with higher-level goal structures. Working-class 4-year-olds tended to be engaged with social activities of less complex goal structure than were their middle-class peers, reflecting social class differences in children's numerical achievements. Further, mothers' retrospections and projections about past and prospective activities pointed to ways that they were supporting both continuities and discontinuities in form-function relations in their children's development. For example, in their narratives about prior and prospective activities, mothers revealed ways that they supported their children's use of number word forms that their children had already acquired to serve new numerical functions, like their children's extension of number words (previously used to serve principally nominal functions) to new functions, like the representation of cardinal values of sets. Mothers also described the introduction of new number words to serve functions children already showed some facility with, as when they introduced new count words in the context of comparing two sets that the child would in turn use to represent only single sets.

Our next step was to ask how numerical goals emerged for children during play with their mothers, and whether these emergent goals differed for younger and older children. To this end, we videotaped mother-child pairs during their engagement in two prototypical activities: one containing a goal structure that required a cardi-

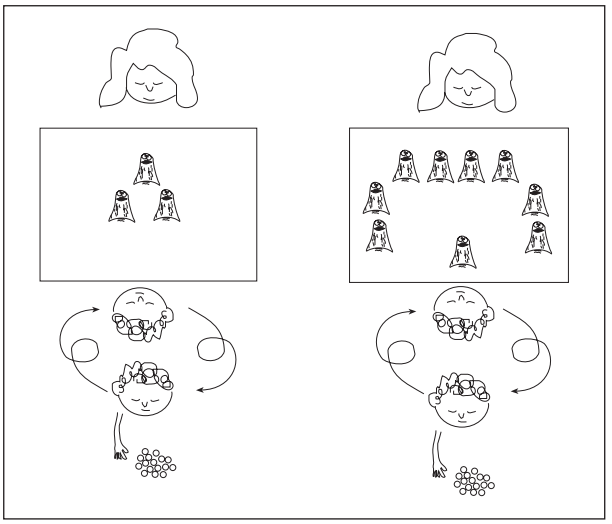

Fig. 1. Number reproduction activity with 3 and 9 Cookie Monsters.

nal representation (level 2), and the other involving an activity with a numerical reproduction goal structure (level 3), each at two levels of difficulty (lesser or greater set sizes). We also videotaped children accomplishing the activity in solitary play.

We found that in our analyses of mother-child videotaped interactions, the goal structures took form and shifted over the course of activities regardless of children's age. In a number reproduction activity, for instance, children were presented with a board containing pictures of either 3 or 9 Cookie Monsters (a model set) and a cup. The child had to get just the same number of pennies as there were Cookie Monsters in the picture, from a collection about 5 feet away (fig. 1). We found that the mothers of older children (who performed at higher levels in their unassisted performances) attempted to structure the task at more superordinate-level goals, and the mothers of 2 1/2-year-olds attempted to provide directives that supported children's construction of less complex goals. Further, it was possible to document the dynamics that led to different goal structures emerging for children. When mothers provided goal directives that the child was not successful in accomplishing, mothers tended to shift to a less complex numerical goal directive; in contrast, when children successfully accomplished a goal directive, mothers tended to shift to a more superordinate numerical goal directive. In an important sense, in the same activity the mother was shifting the 'language game' through modulating her directives in relation to her child's actions. Reciprocally, children were also adjusting their own activities to their mothers. For instance, children who did not appropriately count one or both sets when unassisted (an important strategic component in the solution of the task) were likely to count with their mothers' assistance, adjusting their own goals to their mothers' directives. Further, children who did not successfully complete the task on their own were likely to do so with their mothers.

The observations, interviews, and analyses of videotaped interactions provided a window into the emergence of goals in practices: mothers were adjusting their goal-

related directives to their children's understandings and task-related accomplishments, and the children were adjusting their goal-directed activities to their mothers' efforts to organize the task. Further, as children's ability to produce numerical goals of different complexity levels changed with development, they were afforded new learning opportunities in the collective practices in which they were participants. In this process, children acquire the use of an expanded register of count words and generate functions for these count words in relation to the collective practices in which they participate. In these analyses of daily numerical practices across social class groups, Wertsch's cargo truck analyses served as one of several catalysts. It pointed to both the import of extending the growing body of lab-based work on number into the field, as well as supporting a genetic analysis of how achievements that have emerged over the social history of cultural groups – like number systems – become the children's own, interwoven with their own activities.

Genetic Explanation – Broadening the Scope

The focus of the lion's share of developmental psychology has been on ontogenetic change – shifts in children's cognition over the course of their development. Wertsch's concern with children's shifting participation in a community's language games or my own concerns with the shifting relations between children's use of numerical forms of representation and their functions in the Brooklyn study or in the Oksapmin world are examples. But where do new collective representations themselves come from in the social history of human communities? Just as the child's cognitions should be the target of genetic explanation, so too should historical changes in the character of collective forms of representation come to be used by individuals in communication and problem-solving activities. Upon reading Wertsch's manuscript in 1978, I had no inkling that my work with the Oksapmin in 1978 would lead me to engage with this question some 25 years later, as I returned on two additional field trips to the Oksapmin world. To provide a sense of this approach to analysis, consider a return visit to Oksapmin communities that I made with two of my graduate students and my 19-year-old son in 2001.

As a way station in the 2001 trip, we stopped in a mining town, Tabubil, about 100 km west of Oksapmin valleys. It was in this town that we met up with old Oksapmin friends who had come to seek Western-style employment. In the rapid flow of talk that cut across English and my limited understanding of Tok Pisin and even more limited Oksapmin[1], our conversation shifted to numerical topics, and it was at this point that I heard an Oksapmin word that sounded like *fu. Fu* was an expression that I had learned in my 1978 visit, but now it was used in a way that puzzled me. I asked about *fu,* and our companions explained that when preceded by a body part name, *fu* meant to double the value of the body part. They noted, for example, that when one points to the nose (the 14th body part in the Oksapmin sequence), *aruma,*

[1] Tok Pisin, sometimes referred to as Melanesian Pidgin, is one of Papua New Guinea's national languages, known and used throughout the country, except perhaps in the most remote regions. We occasionally use the expression 'Tok Ples,' which refers to the vernacular language of a specific cultural group in Papua New Guinea. In the case of the Oksapmin people, Tok Ples is the Oksapmin language.

Fig. 2. A woman exclaiming *fu* with fists raised as she completes a count of all 27 body parts.

and says *arum-hai fu*,[2] the meaning is to double the value of the nose (14), yielding a value of 28. Now this was perplexing. As an apprentice to the numerical practices of Oksapmin elders in 1978, I had learned that *fu* with fists raised meant a completion of all 27 body parts in a count (fig. 2). In fact, there were no arithmetical procedures for adding and subtracting body parts, and doubling body parts would have been a very foreign idea at the time. For me, a student of mathematical cognition, this was a remarkable turn of events.

These Tabubil conversations introduced a problem that framed the empirical work in Oksapmin in 2001: how do new collective systems of representation and associated mathematical ideas arise in the social history of a social group? Was this collective form of *fu* a historical descendent of the earlier *fu* that I had learned long ago? Or was this a new word form, perhaps borrowed from a neighboring group? Did someone reinvent *fu* as a way to represent values greater than those permitted by the indigenous number system? If any of these processes fit the case, how did new uses of the word come to spread, shifting in function in the social history of Oksapmin communities? These are questions about sociogenesis. I structured a series of empirical studies to address these sociogenetic questions, tracing the genetic history of *fu* in the Oksapmin world [Saxe & Esmonde, 2005a].

Our analyses of *fu* revealed a complex genetic story, one in which early uses of *fu* were transformed into current uses as people engaged in collective practices of economic exchange. This story is not reducible to ontogenetic mechanisms that Wertsch described in the 1979 article nor is it reducible to my account of the dynamics of form-function shifts in my own work on early number development. Indeed,

[2] Aruma in Tok Ples means nose, and nose is the 14th point in the body system (an ordinal). In Tok Ples, to turn this count position into a cardinal one adds a suffix, hai. Arum-hai fu thus stands for the cardinal value of 28.

such accounts do not provide mechanisms to understand the emergence of new language games in a community. Processes of sociogenesis – like the emergence and spread of innovations in semiotic processes in a community – require a different kind of mechanism [Saxe & Esmonde, 2005b]. In the account that I favor, I locate processes of sociogenesis in the reproduction and alteration of prior forms of representation as individuals engage as interlocutors in collective practices, making efforts to communicate meanings. In the case of *fu* in Oksapmin communities, new kinds of economic exchange involving a cash economy led to arithmetical problems in transactions; not only were these new kinds of problems requiring people's construction of new kinds of logico-mathematical relations, but the language community lacked specialized lexical forms that supported communication about such relations. In their efforts to get across intended meanings, people unintentionally drew on prior representational forms, using them in new ways. An unintended consequence of such local communicative efforts was that it seeded the propagation of new forms of communication, reproduced and altered in subsequent interactions in processes of propagation. In a forthcoming book on Oksapmin mathematics, I elaborate a model that continues to engage Wertsch's early concerns for genetic explanation, one that provides corroborative support for a model of sociogenetic change, but also includes the relation between sociogenetic, ontogenetic, and microgenetic processes in collective practices of communities. The framework connects with other scholars' contemporary work that engages with genetic accounts, including Sfard's [2007] recent book on thinking as communicating, epidemiological approaches to representation [Sperber, 1996], and evolutionary treatments of language change [Croft, 2000]. It also echoes Wertsch's explication of the importance of genetic explanation in understanding human cognition.

Closing Thoughts

What I found intriguing in Wertsch's treatment in 1978 I still find intriguing – his analytic approach engaged the question of how developments that have emerged in the social history of communities become interwoven with individuals' constructive actions. My early concern with number and the dialectics of form-function relations supported a different but commensurate approach to genetic explanation that involved the same general question. Later, my concerns expanded to issues of sociogenesis and microgenesis – ways of understanding how activity situated in collective practices both reproduce and alter historical achievements, providing continuity in collective representations and seeding discontinuities in their social histories.

But these are my own more idiosyncratic reactions to Wertsch's contribution. Wertsch's article was an early voice in discussions of constructs widely used today. These include discussions of distributed cognition, a construct that is a dominant interest in sociocultural accounts of cognition, as well as scaffolding, which has become a leading construct in educational practice. More generally, Wertsch's 1979 article extended the core ideas of Vygotsky's seminal works in productive and creative ways, providing a careful and reflective analysis that is as important today as when it was published.

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