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Sociocultural Perspectives on Semiosis

Introduction to Section 1: Luis Radford

This part deals with semiosis understood as the continuous production of signs and significations. The part comprises five chapters. There are two elements that tie them together. First, they share a general interest in exploring the social, cultural, and historical dimension of semiosis. Second, they resort to a Vygotskian concept of the sign.

It is worth recalling that, in the main Western semiotic traditions, signs have been understood as entities that *represent* things. Ferdinand de Saussure (1959), for instance, suggested that a sign is the union of a *signified* (i.e., the meaning or the concept) and the *signifier* (the sound-image).Vygotsky took a completely different route. Although Vygotsky's concept of signs evolved from a rather instrumental view—developed at the end of the 1920s where the sign was conceptualized as a psychological tool (Vygotsky and Luria 1994)—to a more social-relational one envisioned at the end of his life, a common point in Vygotsky's concept of signs was that signs are not entities to represent things or ideas or knowledge. In Vygotsky's view, the most streaking feature of signs is the orientating role that they play in the social life of the individuals, allowing them to organize and reorganize their interactions with other individuals and their deeds in the historical world. In a notebook containing notes written toward the end of his life, and referring in particular to language, Vygotsky's noted that

> Language is not the relation between a sound and the denoted thing. It is the relation between the speaker and the listener, the relation between people directed toward an object, it is an interpsychic reaction that establishes the unity of two organisms in the same orientation toward an object. (Vygotsky in Zavershneva 2010, p. 25)

Vygotsky's concept of sign leads to a complex and multilayered concept of semiosis. Revolving around the context of mathematics teaching and learning, each chapter explores different aspects of it.

Chapter 1, written by Luis Radford, explores a key question of subjectivity: how through cultural-historical activity people simultaneously are produced and

co-produce themselves as individuals in the making, as unfinishable projects of life. The chapter starts with a metaphor where individuals are considered as dynamic agentic signs and goes on to explore the role of rules in a preschool setting around a mathematical game. Through an analysis of the children's game, where emotions and actions are fueled with tensions resulting from the cultural normative character of rules and the subjective enactment of them, the children come to position themselves and to be socially and historically positioned. The analysis suggests that responsibility and empathy (*pátheia*) appear as two essential intertwined threads of the fabric of subjectivity. While the former points to a culturally and historically evolved relation to the Other, the latter signals a truly human listening, based on a pre-conceptual, emotional understanding of the misery and agony of the other through which we recognize ourselves and the fragility of our human nature.

Chapter 2, written by Wolff-Michael Roth, deals with the later Vygotsky's conception of signs and delves into the relational nature it conveys. Like pointing gestures, the sign emerges as a relation where one person acts on another and only later as something to act upon oneself. Roth starts by drawing a parallel between commodity exchange and word use. He uses this parallel to illustrate, through an example with young children, the birth of a relation between a sign vehicle and its (ideational) content, while showing how this first relation yields place to a new relation. The parallel between commodity exchange and word use allows Roth to stress an often missed key point in semiotic analysis: that the relation between sign vehicle and its content or suprasensible character is not merely an idiosyncratic product but reflects a social relation: "a reflection of societal (i.e., universal) relations that exist as societal relation of material things (e.g., sign vehicles)." This conceptualization of signs is hence far away from the representational conceptualization. It is relational through and through. The chapter closes with an interesting suggestion, namely the possibility of abandoning the idea of sign mediation that Roth explores by resorting to a Spinozist-Marxian materialist approach.

Chapter 3 in this part, written by Ulises Salinas-Hernandez and Isaias Miranda, deals with the understanding of the Cartesian graph associated with the motion of a tennis ball in an inclined plane in a technological environment. The authors turn to the theory of objectification (Radford 2008) where the students' understanding is considered to be the result of the manner in which mathematical knowledge appears progressively in the classroom through the students' and teachers' sensuous, semiotic, and material activity. Through a fine-grained semiotic analysis, Salinas-Hernandez and Miranda show how the students' understanding of the graph undergoes a lengthy process of objectification that is correlated to various moments of classroom activity. These various moments of activity are not independent of each other. They can be conceptualized as the successive transformation of an initial moment. The initial moment is characterized by an *abstract* stance where the graph is imagined as a straight line. The initial moment of activity is transformed into another moment and so on until of more *concrete* moment of activity is reached: one where, through sensuous corporeal, symbolic, linguistic, and kinesthetic actions, the mathematical variables and the axes provided by the software become objects of attention and consciousness.

Chapter 4 in this part, written by Anna Shvarts, tackles the question of joint attention using a dual eye-tracking setting. Shvarts investigates the manner in which five pairs of a Grade 1 child and his/her parent inter-coordinate perception with other semiotic resources—gestures, oral language, and mathematical signs—in the processes of objectification involved in the understanding of Cartesian coordinates. In the beginning, the child and the parent see the graph but they do not attend to it in the same manner. Although the meaning of the Cartesian coordinates is *there*, as an "ideal form" in culture, the child does not perceive it yet. The disclosing of the meaning, its progressive grasping by the child, occurs in processes of objectification embedded in the participants' joint activity. In such a disclosing, the semiotic resources move from what Shvarts calls *pre-semiotic means of objectification* to proper semiotic means of objectification (Radford 2003). One of the major contributions of this chapter is to reveal the dynamics of such a movement—how, for example, progressively, through semiotic resources, the participants achieve joint attention, how they adjust their evolving interpretations, and how they assume the initiative in the task.

Chapter 5, written by Debbie Stott, revolves also around the question of joint attention. She resorts to the theoretical constructs of the *space of joint action* and *togethering* (Radford and Roth 2011). While the former refers to an "evolving, tuning, and reciprocating of the participants' perspectives, making thinking a collective phenomenon" (p. 232), the latter rests on an ethical commitment to produce joint activity out of which ideal cultural-historical mathematical forms are disclosed to the students' consciousness. Stott draws also on the concept of attention catching (Meira and Lerman 2009), the *moment* when attention is caught during a mathematical activity involving more than one participant. She presents two episodes from interviews in an after-school math club and investigates how joint action is (or is not) produced. In particular, she is interested in investigating the moments of *poēsis*—i.e., the creative moments in which an ideal mathematical form becomes an object of the students' attention and understanding (Radford 2015). Stott's analysis provides insights into the way attention catching and togethering occur and are sustained by the participants; her chapter also sheds light on the question of how spaces of joint action evolve.

References

Meira, L., & Lerman, S. (2009). Zones of proximal development as fields for communication and dialogue. In C. Lightfoot & M. C. D. P. Lyra (Eds.), *Challenges and strategies for studying human development in cultural contexts* (pp. 199–219). Rome: Firera Publishing.

Radford, L. (2003). Gestures, speech and the sprouting of signs. *Mathematical Thinking and Learning, 5*(1), 37–70.

Radford, L. (2008). The ethics of being and knowing: Towards a cultural theory of learning. In L. Radford, G. Schubring, & F. Seeger (Eds.), *Semiotics in mathematics education: Epistemology, history, classroom, and culture* (pp. 215–234). Rotterdam: Sense Publishers.

Radford, L. (2015). Methodological aspects of the theory of objectification. *Revista Do Programa de Pós-Graduação em Educação Matemática da Universidade Federal de Mato Grosso do Sul (UFMS), 8*, 547–567.

Radford, L., & Roth, W.-M. (2011). Intercorporeality and ethical commitment: An activity perspective on classroom interaction. *Educational Studies in Mathematics, 77*(2–3), 227–245.
Saussure, F. (1959). *Course in general linguistics.* New York: McGraw-Hill.
Vygotsky, L. S., & Luria, A. (1994). Tool and symbol in child development. In R. V. D. Veer & J. Valsiner (Eds.), *The Vygotsky reader* (pp. 99–174). Oxford: Blackwell Publishers.
Zavershneva, E. (2010). The Vygotsky family archive (1912–1934). New findings. *Journal of Russian and East European Psychology, 48*(1), 14–33.