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Crossroads of phenomenology and activity theory in the study of the number line perception

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The research is a study of the productivity of a dual analysis of the same phenomenon from the cultural-historical activity theory (CHAT) and from the Husserlian phenomenological perspective. It analyses the eye-movements of children and their parents while they were operating with the number line. We also were focused on the interaction between children and parents while each parent was teaching the child and we analyzed it in correspondence with eye-movements. The implementation of the dual theoretical perspective to our eye-tracking data sources disclosed the subtle synchronization of intersubjective communication, already starting in the embodied, pre-reflective area of the cognitive experience. The two theoretical perspectives exerted a significant complementarity in bringing about the social and the subjective – intentional aspects of the phenomenon of learning.

Keywords: Activity theory, phenomenology, intentionality, eye-tracking, number line.

Radford (2010) considers the development of perception in mathematics education from a cultural-historical activity theory (CHAT) perspective and argues that only through social practice the “domestication” of a perceptive organ (an eye) can occur, and that the phenomenological approach towards perception as a system of intentional acts cannot explain acquiring of the new, culturally specific ways to approach objects. Our research shows the productivity of a dual analysis of the same phenomenon from CHAT and phenomenological perspectives. We analysed the eye-movements of participants while they operated with the number line. An SMI RED eye-tracker was used with sample rate 120 Hz. The task was to specify the point on the number line from 0 to 10 a grasshopper was sitting. There were 6 pairs of adults and pre-schoolers. We collected three sorts of data: adults’ perception; inter-

action between children and parents when we asked each parent to teach their child; and children’s perception. The results in our poster from qualitative analysis presented as series of pictures, which represent synchronized data of short time interval (0,5–5 seconds) tracks of eye-movements, speech oscillograms, audio transcriptions and pictures of gestures, taken by an external camera. Here is a space-saving summary of interweaving ways to address results from the two perspectives.

(1) Adults’ perception and teaching strategies revealed a vivid difference in how the parents detected the point on the number line themselves, and how they taught the children to do it. All adults either immediately grasped the answer by one fixation, or by a couple of fixations while they were counting from the midpoint or the last point. While teaching, most of our adults showed the child a strategy of counting from zero up to the point, making arc movements with their finger from point to point, and rhythmically counting or making pauses for the child to count. From the CHAT perspective that focuses on cultural practices and artefacts (Vygotsky, 1981) we need to interpret the adults’ kind of perception as *mediated* by previous knowledge and by the number line itself – which is a visual semiotic means that has sedimented the activity of counting. We can judge the way that adults performed counting as a developed perception that has a form of mental action that keeps only a general form of real action and misses the intermediate parts (Davydov, 1959). Following the Husserlian phenomenology by adopting the first person perspective in our analysis, we see the adults’ perception as *immediate*, where a number line is “taken for granted” (Husserl, 2001, p. 338), i.e., approached as a natural object of their living world without treating it as a product of previous mathematical work.

(2) In the teaching stage the attention of the children was strongly driven by a system of means used by the adult. Each pointing movement of the finger of the adult corresponded to a prosodic stress and to a fixation of the child's glance on a point on the number line; the adult made a theoretical perception possible through involving the child into *social practice*, "through an intense recourse to pointing gestures, words, and rhythm", as Radford (2010, p. 5) puts it. Now let us look more closely at the children's eye-movements. In one case the child followed the adult's movements precisely in counting from zero up to ten, but at the moment when her finger was passing the point where the grasshopper was sitting, the child found time to look at the written question of the task. In another example a child misperceived an adult's gestures: she was moving her eyes one point ahead of where the adult was pointing. But being in contact with the original task she managed to correct herself at the end of the counting: she was making two fixations on the same point where the grasshopper was, corresponding to two separate arc movements of her father's finger. Thus, being "moved" by the adult activity the children caught up the meaning of it through the goal, which was retained at a grounding level of the children intentionality. So, our data show that it is exactly a complex system of *intentionality* that makes possible the "crucial form of communication in which two consciousness meet in front of the cultural mathematical meaning" (Radford, 2010, p. 6) within the social practice. From a phenomenological perspective this meaning should not be perceived as a "ready-made entity" which a child is expected to follow; instead, only a serious and genuine move back to the intentional origins of this meaning gives us a real understanding of its constitutive potential (Husserl, 1970, 2001).

CONCLUSIONS

CHAT analysis focuses on cultural means and social practices, which necessarily mediate the transformation of perception, while phenomenological analysis aims towards understanding of the role of intentionality in acquiring new forms of immediate perception. Hence these two perspectives attempt to grasp two important aspects of the educational/learning complexity, and seem to be neither contradictory nor reducible to each other, but rather essentially complementary.

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