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Construal of perspective in graph comprehension: A cognitive semiotics of scientific literacy and objectivity

The history of scientific objectivity has been described as a heterogeneous and overlapping development of different "epistemic virtues" such as "true-to-nature" depictions and "mechanical objectivity" of scientific instrumentation (Daston & Galison 2010), but on a "micro" level of representational practices we should be concerned with the detailed analysis of the role of language and cognition in scientific discourse and practices. A semiotics of science was stipulated by Charles Morris – to some extent following C. S. Peirce – but never realized as an empirical investigation of specific sciences. A *cognitive semiotics of science* has been proposed (May 2016) to scrutinize different phenomena in the construction and communication of meaning in science, including the semiotic functions of instrumentation and the role of representational forms such as graphs, diagrams and notational systems.

In Cognitive Grammar (Langacker 1999; Verhagen 2007) *perspective* is a construal operation on meaning across language, perception and reasoning. In cognitive science and educational research problems in graph comprehension have been documented since the 1980-ies, but although these problems are rooted in language and cognition across multiple forms of representation, they have not been considered systematically as a domain of semiotic research. Construal of perspective is not only a key issue in the construction of scientific objectivity, but also plays a role in "didactic transformations" of scientific content through analogies and simplifications. Examples from mechanical physics (kinematic graphs) and physical chemistry (reaction kinetics) will be used to exemplify how "didactic transpositions" involving changes in perspective such as *imagined first-person perspectives*, may lead to misconceptions.

The role of construal operations has not only been underestimated in educational research, but also in the philosophy of science. In recent approaches such as "scientific perspectivism" (Giere 2010) and the analysis of embedded "thing knowledge" of scientific instruments (Baird 2004) we see an emergence of "quasi-semiotic" theories of scientific practice, but without a semiotic analysis of representational forms and levels of meaning construction.

References

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