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The use of structure as a matter of language

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Introduction

Recent research shows that structure plays an important role for the arithmetical development and the development of number sense (Lüken, 2012; van Nes, 2009). In this context, using structure for identifying the cardinality of a set of objects is a main achievement of children's competence in the early years (Clements, 1999; Schöner & Benz, 2018). The ongoing study presented in this poster focuses on language to foster children's structure abilities. The aim is to explore which language children (can) use to talk about structures when determining the cardinality of sets.

Theoretical Background

The use of structure to determine the cardinality of a set of objects is defined as *conceptual subitizing* (Clements, 1999; Sarama & Clements, 2009). Structuring a set of concrete objects into subsets which can be determined easily and used to determine the cardinality of the whole set of objects is an important mathematical ability and should be learned and fostered during the early years (Clements, 1999). In a recent study Schöner and Benz outline that many children aged between 5 and 6, who are able to perceive and use structure to determine the cardinality of a set, "often lack the words to describe their constructions and approaches" (2018, p. 141). The most common way to describe their approaches is counting (Schöner & Benz, 2018). It seems like children are missing language to describe structure and their use of it. In order to be able to foster conceptual subitizing in the everyday interaction in kindergarten, we want to explore which language children (can) use to talk about structures in sets of objects and their use of this structures when determining the cardinality of sets. This is an important issue, because language and communication play an important role in the learning process of children. Communicating about mathematical concepts can foster the insight into the abstract mathematical notion (Maier & Schweiger, 1999). Furthermore communication can facilitate a deeper reflection on the mathematical structures and structures that may still be implicit can become explicit (Maier & Schweiger, 1999). Thus, talking about structures in sets of objects possibly helps children to interpret numbers as wholes which can be composed to larger wholes.

In order to analyze the specific language requirements for describing the process of conceptual subitizing, we refer to Sfard's (2008) approach of reification. With a view to mathematical discourses, she distinguishes between two types of discursive entities: mathematical processes and mathematical objects. According to Sfard (2008, p. 47), mathematical objects can be understood as reified processes: In a discursive transformation mathematical processes can be reified into mathematical objects. We can use this approach for analyzing how children describe structures in sets of objects and their use of this structures. Thus, one example of the distinction between processes and objects is that of natural number. We can talk about numbers by talking about the

process of counting (e.g. “one, two, three,...”) or we can talk about numbers as static objects which can be manipulated as wholes in new processes (e.g. “four times three”) (Sfard, 1991, 2008). In terms of determining a set of concrete objects the *talk about numbers as objects* is prerequisite for describing conceptual subitizing. Children who subdivide the whole set in structured subsets which can be recognized and manipulated as wholes (e.g. *three* and *four*) and composed to a larger whole (e.g. *seven*) need a specific kind of language: In order to describe conceptual subitizing in discourse, they need *language for talking about numbers (subsets) as objects* and *language for the new process “linking”*. Thus, they talk about numbers as objects which can be used and manipulated in a new process.

Method

This theoretical analysis of the language requirements leads to two distinct questions:

How do children talk about objects and processes while they determine the cardinality of a set of objects? How do children adopt ways of describing from the discourse with an adult?

To answer this questions, preschoolers, aged 5 to 6, will be interviewed individually. The interview will be divided in to two parts: At the beginning of the interview, the child will constantly be encouraged to describe his or her process of determining the cardinality of a set of concrete objects. Depending on the child’s talk about the objects and processes, the interviewer will make adaptive offers of language.

References

- Clements, D. H. (1999). Subitizing: What is it? Why teach it? *Teaching Children Mathematics*, 5(7), 400–405.
- Lüken, M. (2012). Young children’s structure sense. *Journal für Mathematik-Didaktik*, 33(2), 263–285.
- Maier, H. & Schweiger, F. (1999). Mathematik und Sprache: Zum Verstehen und Verwenden von Fachsprache im Mathematikunterricht. *Mathematik für Schule und Praxis*, 4 (1 ed.). Wien, Austria: Öbv & hpt.
- Sarama, J. & Clements, D. H. (2009). *Early childhood mathematics education research: Learning trajectories for young children* (1 ed.). New York, NY: Routledge.
- Schöner, P. & Benz, C. (2018). Visual structuring processes of children when determining the cardinality of sets: The contribution of eye-tracking. In C. Benz, A. S. Steinweg, H. Gasteiger, P. Schöner, H. Vollmuth, & J. Zöllner (Eds.), *Mathematics education in the early years. Results from the POEM3 conference 2016* (pp. 123–143). Cham, Switzerland: Springer.
- Sfard, A. (1991). On the dual nature of mathematical conceptions: Reflections on processes and objects as different sides of the same coin. *Educational Studies in Mathematics*, 22(1), 1–36.
- Sfard, A. (2008). *Thinking as communicating: Human development, the growth of discourses, and mathematizing*. New York, NY: Cambridge university press.

van Nes, F. (2009). *Young children's spatial structuring ability and emerging number sense*.
Utrecht, The Netherlands: All Print.