The duck is the biggest-kindergartners talking about measurement and magnitudes

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This paper deals with aspects of language learning in settings planned for mathematical learning by kindergarten teachers. Using qualitative and linguistic analysis tools, we reconstruct patterns of language use and the language sensitive organization of kindergarten teachers. We mainly focus on the children's language use, particularly on semantic deviations in utterances in relation to the mathematical negotiation process.

Keywords: Language usage, measurement, early childhood education.

Introduction

The importance of language for cognitive (subject-specific) learning processes is undeniable and well established with regard to research in early mathematics education. Scientific language proficiency is seen as an important factor for successful education and schooling. There are still unsatisfied needs for Germany to appropriately support children with disadvantageous starting conditions (for example migration, socio-economic background, developmental speech disorder), in order to give them an equal chance to participate in education processes (Gogolin & Lange, 2010).

Early education in kindergarten, which puts emphasis on supporting language education, could provide a remedy. Prediger (2015) suggests that academic language education processes start as early as possible, to design them age-appropriately and to orientate it to specific contents. However, Germany is particularly lacking language education approaches that integrate subject-related learning processes and not only selective training single academic language terms. Rudd, Satterwhite and Lambert (2010) describe how mathematical learning and language learning can be combined in (natural) kindergarten situations. They introduce the concept of Math-Mediated Language (MML). This means that mathematical learning is embedded in dialogues, which include mathematical as well as linguistic knowledge (Rudd et al., 2010). They give examples for different mathematical topics, e.g. how to foster complex counting strategies by modeling them in concrete situations or by requesting them from children using corresponding questions. Even though the concept of MML emphasizes mathematical learning in kindergarten, it points to the need that kindergarten teachers consider both the mathematical context and linguistic effort involved in the dialogues – and address this connection in their planning as well as in spontaneous situations. Thus, MML deals with the integration of language education and subject learning in everyday activities for kindergartners.

MML requires a certain amount of language awareness. For pre-service early childhood educators, Moseley (2005) found out that their perceptions of MML is restricted to technical terms and basic mathematical terminology. In our qualitative-empirical project, we are interested in kindergarten teachers' language awareness in everyday situations. We put our focus on the support of language

learning in settings planned for mathematical learning. This idea corresponds to the underlying idea of supporting language development within the subject (Leisen, 2013; Prediger, 2013; Prediger & Wessel, 2013) as it is discussed in the schooling context. Often, these concepts trace back to the Immersion Model for bilingual education for children with migration background in school contexts (e.g. Cohen & Swain, 1976).

Kindergartners are not only 'subject learners' but, independently from their language background, always 'language learners'. Hence, they sometimes have difficulties expressing complex facts and their language productions often show deviations from the standard language (Volmert, 2005). In this paper, we want to deal with deviations from standard expressions that can have an impact on mathematical learning processes. Since we are dealing with spoken language, which often includes aspects of dialectal variation and language change phenomena, it is not always trivial or even possible to decide whether one utterance is correct or not. In German for example, there are nouns with locally varying genders (cf. der Joghurt: male or das Joghurt: neuter, both possible in standard German; and in eastern parts of Austria die Joghurt: female).[1]

In principle, mistakes can be divided into lexical (neologisms and wrong pronunciation), syntactical (wrong conjugation or flexion, word order) and semantic (inappropriate choice or combination of words) ones. In this paper, we concentrate on semantic deviations, which we list as a separate category since the meaning of utterances does not always depend on the choice of single words or grammatical constructions alone. Meanings rather tend to exceed verbal boundaries, which also has to be taken into consideration when looking at inappropriate utterances (Brandt & Keuch, in Press).

In particular, our aim is to reconstruct the empirical language in use, to detect aspects of language support, and to show the connection to specific meanings and concepts that are negotiated in certain situations. In our prior analyses, we found different kinds of language support and correction strategies (Brandt & Keuch, in Press). Similar to Moseley's results (2005), when using language in everyday situations, kindergarten teachers put special emphasis on technical terms and only a limited focus on complex language structures. Thus, in this paper we will concentrate on semantic aspects of the empirical language and the corresponding questions:

- What kind of semantic deviations can we identify in the field of measurement?
- Which impacts for negotiation processes about measurement can we deduce from these deviations?

Research design

The data basis for our analysis consists of mathematical situations designed by kindergarten teachers and taken from the project erStMaL (early Steps in Mathematical Learning) (Acar Bayraktar, Hümmer, Huth, & Münz, 2011). Methodologically, our project is based on grounded theory (Glaser & Strauss, 1967). We figure out the negotiation of meaning in the interaction processes through the interaction analysis (Krummheuer, 2007), which is a sequential analysis and is organized as an extensive turn-by-turn interpretation. Further, we determine linguistic features

[1] Duden, 2013; 26. Aufl., Dudenverlag, Berlin.

that originate from a linguistic valence analysis (Herbst & Götz-Votteler, 2008) by looking at the relation between verbs and their objects (Brandt & Keuch, in Press)[2]. Our aim is to create a category system of difficulties and deviations, and their corresponding reactions and support from the kindergarten teachers. According to qualitative content analysis (Mayring, 2000), these categories are generated inductively. Based on these analysis methods, we will present case studies that point out the empirical language use in this partial corpus in the following paragraph.

In this paper, we refer to five situations, which kindergarten teachers designed and realized to support mathematical learning. Besides the general topic *measurement* and the involved children, there were no content-related or structural prompts for the realization of mathematical situations.

Situation	*Teacher*	*Children*	*Magnitude*
A	Doris (MA[3])	Nikola (f): 4;2 / BL[4]; Orania (f): 3:10 / L1 (Greek); Regina (f): 4;4 / L1; Uwe (m): 3;11 / L1	length
B	Sabine (MA)	Mona (f): 5;5 / L1; Omara (m): 4;11 /L2 (Tamil); Sadira (f): 5;11 / L2 (Urdu); Theresa (f): ? / L2; Oslana (f): 5;3 / L2 (Croatian)	length and volume
C	Berna (L2 /unknown)	Bella (f): 6;0 / L1; Can (m): 6;0 / BL (Turkish); Denis (m): 6;0 / L1; Friedel (m): 6;0 / L1	length
D	Johanna	Ona (f): 5;6 / L2 (Turkish); Tamila (f): 4;10 / L2 (Pasto / Afghan)	length
E	Linda	Irvin (m): 5;0 / L1; Torben (m): 5;5 / L1	weight

Table 1: Basic information on the focused situations

Difficulties and deviations in language usage

Example from situation D: The kindergarten teacher and the two girls are building towers with colored rods and building blocks of different sizes. One tower of the teacher's construction falls down, which she comments on: "huu jetzt is es gefallen \" (huu now it has fallen). Ona takes up this structure: "deiner war nicht gut meiner hat nich gefalln." (yours was not good mine has not pleased). Her utterance is grammatically correct. However, using the auxiliary "hat" (to have) instead of "ist" (to be) like the kindergarten teacher for the perfect tense, Ona expresses the meaning of 'pleasing' instead of 'falling'. Certainly, this was not Ona's intention. Thus, semantic deviation can only be determined by focusing one's attention to the context.

[2] For more details see our analyses in the next paragraph.

[3] MA: trained in mathematics.

[4] L1 means, the child learned and uses German as a first language; L2 means, the child learned another language than German as a first language, now learns, and speaks German as a second language; bilingual (BL) means, the child learned German and another language as first languages and now uses both languages at home.

According to Bishop (1988), "measuring (...) is concerned with comparing, ordering, and with quantifying qualities" (p. 34). Comparing, ordering, and quantifying qualities ask for a differentiated language usage, including certain technical terms and grammatical structures. In the next sections, we illustrate semantic deviations in this context. That means we look for language productions that are syntactically correct but their initial meaning does not fit with the context of actions.

Verbal constructions with *to measure*: Measuring (yourself) with something or someone

In Brandt and Keuch (in press) we explain how linguistic valence (Herbst & Götz-Votteler, 2008) can be used to explain the emergence of a cognitive concept of measuring and the acquisition of case endings in relation to the verb *to measure*. With the verb *to measure*, you normally use a subject (someone who measures), something that is measured (the accusative object) and a tool you use for measuring (the dative object). There are, however, situations in which children as well as kindergarten teachers use this expression in a slightly different way.

In situation C, measuring the children's body lengths occupies most of the situation. The children lie down on the floor and have the position of their head and their feet marked with chalk on the floor. Subsequently, the distance between those two chalk lines is measured with different devices:

Berna	you can actually measure it with all those things here
Can	wait . I measure it with the chalk \ here it starts (draws a line from one limiting line to the other)
Berna	so Can / now wait \
Can	sooo \ (.) up to my line \
Berna	up to your line

While Can's utterance is syntactically correct, his actions do not fit with its meaning. If he was measuring a certain length with the piece of chalk he carries in his hand, he would aim to find out how often that piece of chalk fits into that length. The group had used a building block before in a similar way. What he does, instead, is to draw a line from one point to another. Since he incorrectly uses the verb *measure* in this context, probably synonymously to *draw* or even *connect*, we consider his utterance as a semantic deviation.

In German, as well as in other languages, certain words used as a collocation in combination with certain prepositions or complements can have a different meaning than the original word, often metaphorical or figuratively. For the verb *measure*, if used with a reflexive pronoun, it gets the meaning of competing with someone (in any possible way, not limited to magnitudes). In situation B, the kindergarten teacher Sabine asks Oslana to stand back-to-back with Sadira and compare their sizes. She accompanies her request with the words "Willst du dich jetzt mit der (.) Sadira messen?" [Do you want to measure yourself / compete with Sadira?]. Sabine does not seem to notice the ambiguity in her utterance on the one hand and the children do not seem to notice the figurative meaning on the other hand. In the course of the situation, Sabine leaves out the reflexive pronoun. She now asks Omara "Whom do you want to measure with?" While the meaning is probably relatively clear due to the unambiguous situation, the dative object is no longer a measuring tool but a person, which could lead to confusion. One could also argue whether the sentence is really any

longer syntactically correct. Mona (the only child whose mother tongue is German in this situation) finally takes up Sabine's sentence structure and says, "I want to measure with you". In contrast to the usual valence, the dative object ("with you") does not represent the measuring device but it rather works as an adverbial phrase, expressing the kind or manner how the activity of measuring shall be done.

The use of personal pronouns with comparisons

In almost all situations, the groups address (direct) comparisons of sizes. When it comes to someone's own body length, competitive situations emerge quite often. For the children it is important to know "Who is taller than the other?" or "Who is the tallest?". This aspect of rivalry is especially obvious in Situation E, when Irvin and Torben compare different things with a beam balance. The kindergarten teacher has prepared different building blocks and plastic figures, which possess certain weight proportions. The main idea of Linda's arrangement seems to be producing balance with these special objects. Both children use one scale together and each child fills the balance pan on their side. In their first attempt, in Irvin's balance pan there is one green stone and two blue ones in Torben's balance pan. The scale is in balance. The kindergarten teacher asks the children to compare the stones:

Irvin	ahh / that that is small and I am big /
Linda	right \ this is a bit smaller / and this is a bit bigger \

Irvin's sentence structure is perfectly correct from a syntactic point of view and in principle as a statement as well, since Irvin really is big in contrast to the building block on the scale. However, he probably wants to express that the green stone on his side is "big" in contrast to the blue stone on Torben's side. In this sense, Linda paraphrases his statement. She indirectly corrects his verbal expression (Brandt & Keuch, in Press), by formulating the relational connection "smaller – bigger" on the one hand, and the personalization "I'm big" connected with the pointing gesture to the actual object of comparison. While Torben uses correct possessive pronouns with corresponding comparisons ("then mine are / heavier\"), Irvin consequently uses the personal pronoun and therefore figuratively makes himself the object of comparison. Finally, Torben picks it up. With the following utterance, Irvin and Torben alike refer to the fact that the content of 'their' balance pan is heavier. Nevertheless, through the context of actions, both children are able to understand each other:

Irvin	then I'm heavier \
Torben	now I'm stronger hihihaha \
Irvin	yooo I'm the strongest \
Torben	no / I'm stronger \
Irvin	there I'm heavier \

Using the words *strong* and the related forms of comparison *stronger* and *the strongest*, the children focus on the idea of competition. However, at least Torben would be able to express himself correctly in such situations. Irvin as well uses the correct possessive pronouns at the end of the situation to explain, why "his" balance pan with the smaller (and therefore lighter) piece of cardboard is up: "Because this is very big / and mine is very small \" – interestingly this is a

situation in which he would not be the ‘strongest’. This competition, generated through language, gains momentum and prevents the original request to balance out the different objects through skillful placing.

Scale values and their verbalization

In most situations, the kindergarten teachers measure the children‘s body length and name and record them in different ways (some write them down, others document them with woollen strings, (Brandt & Keuch, in Press). When you capture body length with standardized measuring tools, you read the numbers on the measuring tools as a scale value. With measuring tools, the scale value indicates the corresponding measuring value based on a certain scale unit; for ordinary leveling boards or carpenter’s rules, that is centimeter.

When using measuring sticks and carpenter’s rules, the kindergartners on the one hand are confronted with measuring units (meter and centimeter), whose meaning they rarely comprehend and only hesitantly take over into their active vocabulary (Brandt & Keuch, in Press). On the other hand, they also have to deal with numbers that exceed their actively mastered range of numbers. The kindergarten teachers seem to be willing to make the numbers consciously perceivable as scale values with different circumscriptions and complements. In the following example, the focus on the meaning of the scale becomes obvious, when Doris refers to the animal symbols on the leveling board:

Doris	okay / look here \ one meter are you \ (.) hee \ one one meter one \ up to there \ [unintelligible] at the monkeys right \
Nikola	up to here \
Doris	exactly at the monkey \ and Uwe / (.) at what have you / [unintelligible] [at the sea lion\]

The kindergarten teacher therefore uses the animal symbols here as scale values; the connection with the local preposition “up to there” points to the distance from the floor to the symbol as a representation of the body length. The children take up the animal symbols on the leveling board for their comparisons of size:

Regina	the biggest ehm \
Uwe	is the duck

The generated verbal co-construction is a grammatically correct utterance: The duck is the biggest one in relation to a (not further specified here) selection of reference objects. This statement, however, is neither correct for the mentioned animal symbols (sea lion, monkey, duck) nor their real counterpart. Still, Uwe does not formulate a ‘wrong’ statement. A few minutes before, Nikola determined that the duck stands for the scale value 116 (Regina’s body length). Therefore, Uwe related with “the duck” to the corresponding scale value without using the corresponding local preposition. Regina is indeed the tallest child, as Doris confirms shortly after “Regina has [unintelligible] is the tallest”. The statement “The biggest is the duck” stands for the comparison of body length and gives an answer – at first with reference to the measured values – to the question: Who is the tallest? Concerning the linguistic means, Uwe treats the scale value ‘duck’ syntactically

like a representation of the measured length: “The biggest is 116 centimeter.” Interestingly, we also find comparable deviations in the language usage of our kindergarten teachers:

Sabine	now I measure you \ that means the hand is now on this / (.) und you are one meter and ten centimeters \ look \ and you are exactly (.) as big as this red number is \

Here as well Sabine is eager to make the numbers comprehensible for the children. On the carpenter’s rule used in this situation, the scale values are marked in red every ten centimeters, while all other numbers are black. The red number thus references the measured body length. Similar to Uwe, Sabine syntactically uses the red number as a representation for the measured size value 110 centimeters.

Conclusion

In this article, we looked at semantic deviations concerning verbal constructions with *to measure*, the use of personal pronouns in comparisons and the verbalization of scale values. Each of the analyzed sentences were syntactically correct, the semantic deviations, however, emerge from prepositions, pronouns; and additions and omissions of phrases. In everyday situations and action settings, these sentence constructions rarely lead to misunderstandings. In the analyzed situations too, the action flow is preserved. However, it remains unclear which conceptual understanding of measuring, comparing or scale values the children develop, which goes beyond the actual action context. The vague and imprecise use of *to measure* immediately concerns the meaning of measure as an activity, as well as the associated behavior patterns in relation to measuring devices. “Measuring” becomes the hypernym for the whole situation and is not delimited from other activities. By means of personalization, the comparison in the balance beam situation becomes a competition, and the semantic deviation becomes a play on words with its own dynamics. For linguistically less competent children, the pun might not be accessible and therefore they do not get a chance to improve their linguistic competences. The negotiation process related to the mathematical content stays at the surface, since it is overlapped by the play on words.

Ambiguity and change of meaning by using different prepositions as well as adding or omitting certain objects can lead to confusion in more in-depth negotiation processes. With regard to the development of less context-dependent language registers, one has to look critically at the observed reactions by the kindergarten teacher. Although all kindergarten teachers show pedagogical as well as didactic competences, in relation to our investigated difficulties and deviations we only observed minor language awareness. On the one hand, we just find a few reactions to semantic deviations in the children’s language productions. On the other hand, even our kindergarten teachers produce such deviations. Especially for learners of German as a second language, figurative language constitutes a specific problem. In this area, we still perceive a major challenge in order to establish educational equality via early education.

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