

# PARENTS' SUPPORT IN MATHEMATICAL DISCOURSES

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*In our empirical research, we are concerned with parents' support in everyday mathematical discourses. The leading questions for the qualitative analysis are the following: What can be identified as the parents' main support focus? And what do the different foci display regarding the underlying mathematical culture? In this paper, we provide an insight into two case studies that refer to game situations. The analyses lead to the distinction between a support focus on structured learning and one on the game itself. Altogether, the current results of this on-going project show how differently children can be integrated in mathematical discourses at home, assuming that these differences influence their mathematical development.*

## INTRODUCTION

In mathematics education research, the understanding of mathematics as a cultural practice, which cannot be separated from its specific context, is more and more prevalent. Regarding this culturality of mathematics, two complementary views of learning mathematics can be recognised. On the one hand, learning mathematics means that one becomes part of the mathematical culture, which permeates one's social environment (Bishop, 1988). On the other hand, mathematical learning processes are also an intended acquirement of an apparently unchangeable faculty culture with its specific set of terms, structures, and principles (Prediger, 2003). In our opinion, these two descriptions supplement each other and serve as a useful framework for mathematics education research.

From this cultural perspective on learning mathematics, we have to focus on processes beyond those at school as well. Learning mathematics is not limited to school. "In fact, students are from the beginning of their life a member of a community that extensively employs embodiments of mathematical knowledge." (van Oers, 2001, p. 59) As a result, we should not only pay attention to teachers or administrators, but to parents as well (Warren & Young, 2002). In the majority of cases, they are one of the most important figures in a child's life, serving as a mentor, a model, and providing aid for the child. Because of this importance, parents cannot be ignored with regard to mathematics education. Although this point of view is increasingly accepted by the scientific community, a lack of research is noticed over and over: "Studies of the processes by which parents encourage early numerical development in the context of parent-child interactions during routine, culturally relevant activities at home are scarce." (Vandermaas-Peeler, 2009, p. 67) By means of our study, we intend to make a contribution to this issue. We focus on everyday mathematical discourses between parents and preschoolers and try to learn more about the mathematical culture that children encounter at home. Thereby, we are particularly interested in the support structures that parents provide for the young

learners. What can be identified as the parents' main support focus? In other words, what seems to be their central goal by supporting their children?

In the following pages, we shed light on our theoretical framework, present our methods and, finally, discuss some results.

## **THEORETICAL FRAMEWORK**

In studying early years mathematics, we necessarily do so with a certain conception of what learning mathematics is all about. In our opinion, children do not encounter mathematics itself, but a cultural practice that is recognised as mathematical by capable members of the belonging culture (Sfard, 2002). In other words, we regard mathematics itself as a social construction and, consequently, learning mathematics as a social construction, too. This idea of learning is explicitly described in Sfard's theoretical work. She defines learning mathematics as “(...) becoming fluent in a discourse that would be recognized as mathematical by expert interlocutors.” (Sfard, 2002, p. 5) Pursuant to this latter definition, adults are of prime importance for the child's development because they can spur mathematical discourses. According to the interactionistic fundamentals, we assume furthermore that, in such discourses, the interlocutors also negotiate what mathematics itself is all about. Naturally, the results of such negotiation processes can differ a lot, e.g. in regard to the above distinction (Prediger, 2003; Bishop 1988). Thus, mathematics can be an integral part of the cultural practices used naturally in one's social environment or it can occur as a separated set of symbols and rules, which, firstly, is disconnected from one's everyday life.

### **Home Mathematics**

Leder (1992) describes by means of two detailed case studies how differently children can be integrated in mathematical discourses at home and which influence these different discursive frameworks have on the child's mathematical competence. In her analysis, Leder emphasises that it is especially beneficial when parents involve their children in varied mathematical situations, when they pose numerous high cognitive level questions along the way and when they encourage the children to autonomy.

Focussing to a greater extent on interactional aspects, Benigno & Ellis (2008) state that parents support the child's mathematical learning primarily through regulating the level of involvement. Thus, while promoting the idea of the social origins of numeracy, Benigno & Ellis point to the fundamental relevance of interactional aspects in home mathematics.

In a qualitatively laid out study, Street, Baker & Tomlin (2005) deal with just this issue in detail. They point out that children's experiences with interactional patterns are dramatically different. In terms of mathematical discourses at home and at school, the researchers explain that, for some children, there is a gulf between these contexts: “The school replicates the Primary Discourse of middle class homes whilst

it presents children from other backgrounds with a Secondary Discourse.” (Street et al., 2005, p. 7) At this point, we can clearly see the connection between early mathematics, discourse practices and mathematics education. According to the study just cited, many children are restricted in their prospects to succeed in mathematics education because they are confronted with a problem of discourse: The switch between home and school discourses can be a source of difficulty because of different values, rules and patterns.

All these results indicate that the parents' support in mathematical discourses is of prime importance for the children's mathematical development. This is the reason why we focus especially on the support structures. As a supplement to the presented findings, we aim for a very detailed analysis of the object of research. What is the parents' main support focus in mathematical discourses with their child? And what do the different foci display regarding the underlying mathematical culture?

## **Support**

Wood, Bruner & Ross (1976) revealed by a seminal study that the key function of support is to arrange a situation that allows the child to participate as a competent community member. “This scaffolding consists essentially of the adult 'controlling' those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence.” (Wood et. al, 1976, p. 90)

With regard to the issue of language acquisition, Bruner (1983) devised a theory that points out how parents support their child's learning. Thereby, he coins the concept of 'formats', which refers to standardised interaction patterns. Such a format is provided by capable interlocutors with the objective of adjusting the child's utterances more and more to the cultural conventions. At the same time, the format enables the child to participate in discourses and ensures that the child becomes a competent interlocutor by taking increasingly responsibility and becoming more and more independent.

It was Rogoff (1990) who introduced an advancement of Bruner's theory, namely the concept of guided participation. Much more than Bruner, Rogoff pushes the interactional equality of adults and children to the spotlight: “The mutual roles played by children and their caregivers rely both upon the interest of the caregivers in fostering mature roles and skills and on children's own eagerness to participate in adult activities and to push their development.” (Rogoff, 1989, p. 209) In Rogoff's theory of learning, the process of becoming a competent participant in a specific type of discourse is called ‘appropriation’ (Rogoff, 1990). That way, she emphasises the fact that learning takes places within social activities and is something different than a cognitive individual performance. In the process of appropriation, the child “(...) can carry over to future occasions their earlier participation in social activity.” (Rogoff, 1989, p. 213) In other words, in her opinion, learning is a process of transformation of individual participation in cultural activities. Because of this

analogy to interactionistic fundamentals, we regard the concept of guided participation as especially valuable for our theoretical framework. How can we describe the guidance that children are confronted with in mathematical discourses at home?

## **METHODS**

Pursuing this central question, we intend to study everyday mathematical discourses between parents and their preschoolers.

### **Sample**

For this reason, we currently conduct a study with ten German families who were all contacted with the aid of the children's kindergartens. Predominantly, these families belong to the well-educated middle class.

The beginning of the study has been about one year before the children started school. Thus, they were about five years old.

The parents agreed to take part in the project, which means that we visit each of them five times and videotape all the sessions. Four visits are arranged during the child's last year as preschooler, the last one will take place some weeks after the child has started school.

### **Materials**

In order to spur everyday mathematical discourses between the parents and the preschoolers, we arrange situations that are as open as possible. However, to simplify the sessions, we offer materials to the families (cf. Shapiro, Anderson & Anderson, 1997; Vandermaas-Peeler, 2009). These materials serve as impulses for mathematical discourses and should be more or less typical for the familial context. On this account, we chose picture books and games as materials for our study, which are indeed a common part of most middle-class families' everyday life.

Shapiro, Anderson & Anderson (1997) found that picture books are an appropriate context in which to engage children in mathematical activities. Although the researchers actually did not focus on mathematics in their study, they noticed that some of the mothers attended to mathematics during reading sessions with their children.

Vandermaas-Peeler (2009) used both kinds of material, books and games, when studying mathematical discourses. She comes to the conclusion that parents and children initiate more mathematical exchanges during playing.

Altogether, we consider picture books and games as an appropriate impulse for mathematical discourses in families. For this reason, we bring different books and games to the families and let them choose. All materials contain mathematical aspects that could become topics of discourse, but we do not give any further advice for the playing, the reading or the discourse in general. The families may arrange the sessions as they wish to. According to this, they are also free to use their own books

and games. However, we assume that, in general, basic everyday practices and discourse structures of supporting the young learners emerge even in contact with potentially strange material.

### **Data Analysis**

As a first access to our issue, we identify those sequences in the video that obviously display parental support activities. More precisely, we choose those sequences in which the common playing or reading interactions are interrupted in order to solve an emerging problem. For a start, only these sequences are transcribed and subject to an analysis of interaction. This method is based on the conversation analysis (ten Have, 1999) and was, in reference to the interactional theory of learning, devised by the working group around Bauersfeld (Voigt, 1995; Cobb & Bauersfeld, 1995). Focusing on the evolvment of the topic(s), the analysis of interaction reveals how meaning is negotiated in the discourse between the parent and the preschooler.

This analysis of interaction serves as a foundation for a second step. With regard to our central question about the parents' support, we intend to finally concentrate more on the issue of support itself. Bearing Bruner's (1983) theory of formats in mind, we aim at describing the interaction patterns that provide assistance for the child. What are the characteristics of the mathematical guidance that children get familiar with while talking to their parents?

Our study is laid out as a comparative set of case studies. Thereby, we will choose just a few families for a detailed analysis. The decisive criterion when choosing the "focus families" is their variety in terms of our research question and theoretical perspectives. By this means, we can complete our study by a comparative analysis.

### **CURRENT RESULTS**

In the following, we provide an insight into our first two case studies. As described above, we chose two dyads that are absolutely different concerning the parents' support. That way, the variety of parents' support foci comes to the fore and, at the same time, different ways of integrating mathematics into everyday family discourses shine through.

In both examples, the parent and the preschooler are playing a game of dice called "Max Mümmelmann" [1]. Each player's goal is to collect six cards with the numbers from one to six. On each card, the number and a bunny with the accordant set of dots on its coat are pictured. According to the rules of the game, bunnies with numbers from one to four are the four bunny children, the five is the mother and number six is finally the bunny father. Who has got a whole bunny family at first, wins the game.

In the following examples, the dyads are concerned with the issue of already collected and still missing cards. They interrupt the normal playing activities in order to reflect just on this issue. Thereby, the dialogue partners touch on the subject of the number sequence. Thus, as sorting the cards by numbers, they gain an overview of the current score.

## Example 1: Kiara

This first episode is from the first playing session with Mrs. Falkberger and her daughter Kiara (5.1 years old). Kiara is still missing the card with number five. Her other cards are lying in front of her, sorted by numbers [2].

Kiara: (looking at her cards) I'm still missing the six!

Mother: No, what are you still missing?

Kiara: Hum.

Mother: What comes after four?

Kiara: (4 sec.) Wait!

Mother: One, two, three, four?

Kiara: **Five.**

Mother: Exactly.

Looking at the cards that she has already collected, Kiara states that she is only missing one card: "(...) the six!" However, her mother negates this claim and demands a correction from her daughter. In doing so, she shows that she knows the right answer herself and that she is confident that Kiara knows it as well. Maybe, that is the reason why Mrs. Falkberger is not responsive to Kiara's utterance.

When Kiara hesitates there upon, her mother immediately gives her a direction: "What comes after four?" She obviously acts on the assumption that Kiara is able to produce the successor of a number without reciting the whole sequence that leads to it. According to Fuson (1988) and her theory about the acquisition of the number sequence, Mrs. Falkberger's question requires the breakable chain level, where single elements of the sequence can be produced separately. Thus, Mrs. Falkberger only points out where the right answer can be found ("after four"). Thereby, she establishes the number sequence as a suitable tool for the problem at hand and, at the same time, she is excepting more global, survey-like strategies from the discourse. Hence, Mrs. Falkberger does not emphasise that Kiara is missing a card with a certain number to complete her bunny family, but that, now, the successor of number four has to be found.

In answer to this hint, Kiara waits quite a long time before she continues talking. Maybe, she is thinking about the solution of the problem that her mother posed: Which number comes after four? In this case, the mother's assumption that Kiara can count from any point in the number sequence would certainly be wrong. However, it is also possible that Kiara thinks about her own question again: What is the card that she is still missing? In this case, she would at least for now ignore the mother's aid. After all, she asks for some more time to reflect on the question in her mind: "Wait!"

It is a striking fact that Mrs. Falkberger does not respond to Kiara's request at all. Instead, she expands her help. On following the interpretation presented above, one

could assume here that Mrs. Falkberger starts doubting Kiara's knowledge about the number sequence. Thus, she counts up to four and invites her daughter just to continue and to give, in this way, the right answer. In fact, by beginning the count at one, Mrs. Falkberger facilitates the task. According to Fuson (1988), her new question requests a lower level of counting competence, namely the unbreakable chain level. Thus, she seems to assume now that Kiara can view each number word as distinct but cannot begin a count at any point other than one.

At that time, Kiara indicates the solution of the problem: "Five." Her stress on this single word may be an expression of self-confidence. In the end, she identified which card she is missing. Thereby, she seems to accept the previous discourse structure by giving an answer that fits perfectly in.

### **Intermediate Result: Kiara**

Mrs. Falkberger accepts the initial impulse set by Kiara, but, then, follows her own idea of support. She is hardly responsive to her daughter. In fact, she integrates Kiara in an interactional pattern that reminds us of traditional mathematics lessons. The expert interlocutor is the one who decides about the appropriate strategy and directs the discourse accordingly. Mrs. Falkberger is the one who poses the questions and Kiara is obliged to answer. This structure is typical for interaction patterns, which Bauersfeld (1978) describes as funnel patterns. Thereby, the 'teaching person' expects a specific answer and constricts the possible course of actions for the learner until the latter can give the requested answer.

Altogether, in this case, the mathematical practice does not appear as an integral part of the playing activities. The support that Mrs. Falkberger provides for her daughter consists in a separate discourse about the number sequence, which is no longer directly related to the concrete game situation. At this point of the discourse, five is only the number after four, but no longer the number of the specific card that Kiara is still missing. For this reason, this short sequence gives an impression of what it means to support a child in acquiring an apparently unchangeable faculty culture with its specific set of terms, structures, and principles (Prediger, 2003).

### **Example 2: Paco**

The second episode is from the first playing session with Mrs. Czipin and her son Paco (5.4 years old). Paco has already collected the cards with numbers three and six, which are lying in front of him.

Paco: (drawing a card with number two) Oh yes! I've got two children now.

Mother: (pointing at Paco's card with number six) And this is the father. Look, you can arrange them in sequence.

Mother: (arranging Paco's cards in sequence: 2, 3, 6)

Mother: Look, two, three. (pointing between the cards with number two and number six) Then, you're still missing four, five, (pointing on the left side of his card with number two) and here still the one.

Mother: (rolls the dice)

Paco draws a card with number two. He seems to be happy ("Oh yes!") and sums up that he has already collected two children, which means that he has two cards with numbers smaller than five. His utterance can be taken as an interim conclusion and as an indication of success.

His mother directly adds that Paco already has the father as well. Thereby, she picks up his language. She does not speak about numbers, but about (bunny) family members. Subsequently, she suggests arranging the cards in sequence and switches, thereby, to numerical language. As she does not explain why it could be useful to sort the cards by numbers, it is possible that she acts on the assumption that Paco knows about the usefulness of this procedure. Alternatively, it is entirely conceivable that Mrs. Czipin does not focus on the issue of understanding or even learning at all. Maybe, she is not interested in ensuring that Paco knows all about the game's details; in fact, it could be her focus to provide him only with the directly relevant information and to enable him, in this way, to participate in the game. Thereby, she integrates a useful mathematical pattern as a matter of course. She does not emphasise the number sequence as a separate issue; in this case, the practice of sorting by numbers appears rather as a common element of the social environment.

This latter interpretation fits well with the fact that Mrs. Czipin, in the following, arranges Paco's cards in sequence herself. She does not use the opportunity to initiate a discourse about the right order of the cards; instead, she supports her son by doing and saying those things that she obviously regards as necessary or at least as helpful.

Finally, Mrs. Czipin completes this sequence by rolling the dice, which means that she goes on with the normal playing activities. At least by now, we can see that her focus is evidently on ensuring that the game can quickly go on and that Paco can participate in it as an equal player.

### **Intermediate Result: Paco**

Mrs. Czipin sets an impulse that fits with Paco's interim conclusion. She raises the issue of arranging the cards in sequence and, then, carries out what she herself has proposed. In this sequence, the ongoing playing activities are only marginally interrupted. In our opinion, the cause for this perception might be Mrs. Czipin's support focus. She primarily assures that the game can smoothly go on. For this reason, she does not initiate any separate discourse about mathematical aspects with questions and answers, and a right solution in the end. In fact, she integrates a mathematical issue as a natural part of the discourse. For this reason, this short sequence gives an impression of what it means to support a child in becoming a part



of the mathematical culture, which permeates one's social environment (Bishop, 1988).

## CONCLUSION

What these two examples show first of all, is the striking difference in parents' support foci. So far, these two cases serve us as prototypes of two opposite foci. Mrs. Falkberger's focus seems to be on structured learning (Example 1). Thus, Kiara is integrated in an interactional pattern that provides her with the role of a student, whereas her mother is the competent interlocutor who poses the questions and assesses her daughter's answers. Thereby, Mrs. Falkberger uses mathematics as a tool for a specific problem that arises from the game situation. However, the cultural practice of sorting by numbers is indeed applied, but isolated from the concrete issue of a missing card.

On the contrary, Mrs. Czipin's focus seems to be on the game itself (Example 2). Paco has not to signal demand for support; his mother provides him with useful hints anyhow. But she does not expand such sequences to explicit learning situations. She rather limits her support to the directly game-relevant aspects. In this case, the mathematical practice of sorting by numbers is an integral part of the game situation and is not discussed separately.

What additionally arises from these results is that the category of middle class has to be taken into account with care (cf. Street et al., 2005). As the analyses above display, there seems to be no standard discourse of middle class homes that can be regarded as a mostly uniform context for mathematics learning. Although our families belong without exception to the German middle class, they display a remarkable variety concerning their support systems and ways of integrating mathematics into their everyday discourses. Provided that parents' support in mathematical discourses is of prime importance for the child's mathematical development, we should bear in mind that the belonging to the middle class does not allow any prediction of an individual's mathematics achievement or failure.

## NOTES

1. Rüttinger, J. (1996). *Max Mümmelmann*. Ravensbrugg: Ravensburger Spieleverlag.
2. Transcription rules: (1) **Bold text** marks stressed utterances. (2) (Text in parentheses) refers to non-verbal actions. (3) (x sec.) indicates a pause of x seconds.

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