

## **Pre-school children discerning numbers and letters**

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### **Abstract**

Research on learning has shown the importance of the learner's possibilities to discern what differs as well as what is similar when meeting new phenomena. But how does this kind of understanding develop when young children try to understand their environment in natural settings? The results of Tolchinsky's research (2003) about young children's understanding of numbers and letters before being taught are considered in this study. Tolchinsky's results showed that children can separate cards that can be read from those which can not be read. Even more, the results showed that children did not separate cards with numbers in the same way. In this study the point of departure is variation theory, and Tolchinsky's results are seen through the perspective of what children do discern, what they discern simultaneously and what kind of variation they seem to need to discern. The aim of this study is to describe in what ways pre-school children seem to discern letters and numbers, what kind of similarities they discern among these phenomena and what kind of variations of the targeted phenomena they are aware of. Three children, aged 4, 5 and 6, have been interviewed when sorting cards with letters/words and numbers. The cards offered have been prepared to include some similarities and some differences, which enable the child to sort in many different ways. As Tolchinsky has found, the children rejected the card that only included letters that could not form a word; they could differentiate cards with numbers from those with letters/words, and no cards including numbers were rejected. In this study we also found how children used chain-complex when talking about the relations between the cards in terms of similarities and differences. Symbols such as the decimal point and minus sign were not commented on at all by the children and had no influence on their sorting.

### **Introduction**

Emergent literacy starts before children are being taught and develops in daily life (Teale and Sulzby 1986; Eriksen Hagtvvet 2002). Teale and Sulzby (1986) also claim the children's early literacy can be described in terms of generaliseable levels that the child can pass in different ways and ages. Eriksen Hagtvvet (2002) sees emergent literacy as a reaction against formalised instruction. Children learn about letters and numbers in interaction with their environment, they explore it and how other people handle reading and writing. However, why do some children become better readers and mathematicians than others? What do they discern in their environment and why do not all children discern the same things? Research shows that familiarity and strangeness have crucial effects on remembering. We recognise the appearance of those who are close to us irrespective of circumstance or situation. However, if one is to recall an unfamiliar face it must stand out in some way to be noticed and remembered (Stenberg, 2006). Learning to recognize seems to be affected by similarities and differences, and an ability to discern presupposes the child is aware of what differs and what is similar. Studies based on variation theory and the principle of contrast demonstrate that long-term learning is promoted if the teacher associates the unfamiliar with the familiar by applying different levels and forms of contrast (Al-Murani, 2006; Holmqvist, Gustavsson and

Wernberg, 2007). Vygotsky (1999) claims it is possible to learn concepts only if the pupil can both discern aspects which are similar to and those which differ from other phenomena. To demonstrate how this kind of learning develops, he refers to Sacharov's experiment with four groups of objects—geometrical figures of different colours, sizes and thicknesses. It was necessary for the pupils to understand that neither the colour nor the geometrical shape was critical. To define a group of connecting objects the pupils had to understand that the size and thickness were critical. Variation theory relies on the same kind of observations regarding how learning develops. Our study assumes that contrasts, as well as associations, are important for developing learning. This is an assumption we share with Vygotskij. "[...] it seems as if the associations of sameness have been replaced by associations of contrasts" (Vygotsky 1999, p 198, our translation). Both Vygotsky (1934/1999) and Fast (2008) define emergent literacy as a social activity. However, Vygotsky (1934/1999) differentiates between spontaneous concepts and non-spontaneous concepts. The former presupposes the latter, and Vygotsky (1934/1999, p 300) claims the spontaneous concepts make it possible for the child to develop non-spontaneous concepts at school. The ways children develop literacy seem to rely on their abilities to discern familiar aspects and relate the unfamiliar to those. This means, in order to discern something, we focus on certain aspects and not on others. If we are to focus on specific aspects they must be distinguishable from an invariant background, i.e. variation is necessary for discerning, discerning is necessary for experiencing. Pramling and Pramling Samuelsson (2008) have found the same results concerning mathematics, when they studied what 6-year-olds focused on when working with a mathematical story. "...what the learners themselves focus upon, rather than simply whether, or to what extent, the pupils learned a specific 'thing' or fact" (ibid p 70). The contrasts between what varies and what does not result in a discernible pattern. As Thorndike (1914) indicates, "...man is originally attentive to *sudden change and sharp contrasts...*" (p. 14). Bransford and Schwartz (1999) found that "[d]ata strongly supported the assumption that contrasting cases better prepared pupils for future learning" (p. 77). This study is not about school-teaching. Instead, the focus is on pre-school children and what they know about letters and figures before being taught. Every child is exposed to letters and figures every day, and has consequently developed some kind of understanding. But in what ways do young children discern letters and figures before being taught? And how do they discern or not discern the aspects of these phenomena?

### Theoretical Background of the Study

This study is based on variation theory. Variation theory is rooted in three concepts (Holmqvist and Mattisson 2008). The first is *discernment*. Polanyi's (Carlgren 1999) research on gestalt psychology bears some similarities to the discernment aspect of variation theory, as well as to Thorndike's (1914) research on discernment. Gestalt psychologists are especially concerned with the focal and background knowledge necessary to focus upon a particular phenomenon. The second concept of variation theory is *simultaneity*. Part of something can at the same time constitute a complete unit in itself, and a complete unit can be part of something larger. In the example of a written word, it is necessary for the child to discern both the letter as a letter as such *and* the letter as a part of a word; such simultaneity is essential when reading. The third concept of variation theory is *variation*, i.e. opposites and deviations. Understanding a phenomenon is the result of observing how it deviates from the normal pattern. In order to understand what 'cold' is, one must have experienced heat. It is not possible to experience joy without experiencing its opposite, sorrow. The way children discern numbers and letters depends on what kind of variations and similarities they are able to discern. Hence discernment, simultaneity and variation are intertwined. They are necessary components in all learning situations if children are to become aware of new phenomena or develop new abilities. If you look at this geometrical shape (Figure 1) you might discern it as a square:

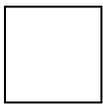


Figure 1

If you see the shape above simultaneously with another (Figure 2), rather similar shape, you might focus on some other aspects, such as the original square is unfilled or white, big and has thin contours. By discerning the original square simultaneously with the second one, the observer is exposed to variation, which offers more possibility to discern more aspects.

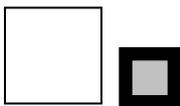


Figure 2

Tolchinsky (2003) describes research results showing how very young children (4 years) are able to differentiate between numbers and letters, between readable and non-readable words

and how the numbers of the letters influenced the child's estimation about whether the word is readable or not. She also describes how the children translated size into number of letters, e.g. they draw bigger letters for bigger objects, an aspect not critical for writing. It is as if the children have some kind of understanding about numbers and letters before being taught. This shows how children, by being exposed to different kinds of variation, create knowledge that seems to be rather developed about phenomena in the environment. This can explain the results found concerning what children know about letters and numbers without being thought.

### **Aim and Research Design**

This study is based on variation theory (Marton and Booth 1997; Runesson 1999; Holmqvist 2004) and the aim is to study in what ways pre-school children seem to discern letters and numbers, what kinds of similarities they discern among these phenomena and what kinds of variations of the targeted phenomena they are aware of. Variation theory is non-dualistic; the study of a phenomenon can not be divided from the person observing the phenomenon. The results are based on the unique ways of experiencing a phenomenon described by an individual, an intertwined description both of what the observer discerns and the phenomenon. The one presupposes the other and reflects each individual's understanding of the phenomenon. Variation theory focuses upon the different ways a phenomenon can be discerned, rather than on other structures or artefacts that influence learning, e.g. socioeconomic preconditions, linguistic factors, gender, work routines etc. This is not to say that such factors are insignificant. However, even if we find these variables important, the way a child experiences numbers and letters is worthwhile to describe as isolated knowledge to understand what is possible to know at the age of the respondents. Three children, aged 4, 5 and 6, have been interviewed when sorting cards with letters/words (Figure 3) and numbers (Figure 4).

d	K
det	dddd
mos	liten
dgtkti	s

*Figure 3. Letters and words*

3	33
45632	0.456
45.78	0
10	-35

*Figure 4. Figures and numbers*

The cards have been created using the concepts of variation theory, and have been prepared to include aspects of similarities and differences predicted to be important for the children's possibility to discern. One such critical aspect is the difference between the letter O and the number 0, which is possible to understand if the child is aware of the part-whole relationship between letters in a word on one side and numbers on the other side. The cards also include single letters (d, K) and letters in a group, both letters making readable words (det [it], liten [small] mos [mash]) and letters not making readable words (dgtkti, dddd). The numbers are both single and in groups; some numbers can be found on more than one card; the minus sign and a decimal point (comma in Sweden) are included on one card each. The cards were cut into 16, shuffled and given to the children. During the interview, the children were asked to sort the cards into two heaps, to see if the results presented by Tolschinsky (2003) about the childrens' abilities to differentiate between letters and numbers were replicable. The design offers the child opportunities to sort in many different ways. Their reasoning during the activity is also described, in terms of what the children in fact discern, what similarities they discern and what kind of variation they are aware of. The interviews have been video-recorded, transcribed verbatim and analyzed. The analysis of children's ways of handling letter and number cards in this study is also influenced by Vygotsky's research. According to Vygotsky's theories, development consists of three steps, which in turn can be divided into

phases. Analysis of the data is inspired both by Vygotsky's research and variation theory, as the latter can explain the former—how discernment affects the development of concepts.

## Result

All three children were asked to sort the cards into two heaps, an open question intended to give them opportunity to reason about the similarities and differences found on the cards the way they liked without being influenced. The cards have been constructed in a way that makes it possible to see different kinds of similarities, and the children were free to discern any of them.

### Making Pairs—Discerning Similarities

The first way the children understood the task was as a pair-matching task. Instead of dividing the cards into two heaps, they paired the cards two by two, as Tilda (4) did.

Excerpt 1:

I: If you now would have to split these cards into two heaps ...how would you divide these cards then?

You may take them and move them around in any way, we'll see if you can put them in two heaps.

T: [Adds "dddd" and -35 in one heap, and 45.78 and "d" in another]

I: Mmm, now you have two cards in two piles. Do you have...are they similar to each other or something?

[Puts the cards so all can be seen] Or did you only put them two and two?

T: Mm.

Sanna (5) interprets the instruction in the same way. But she also discerns the letter d as an upside down p, which gives her problems.

Excerpt 2:

I: Well, if you now were supposed to sort out these cards in two heaps. Can you do that? [Sanna puts the card with 45,632 on top of the card with a K] and explain why you put them together, why they do fit?

[Sanna adds the card with 33 on top of the card with 45.78]

S: Upside down! [points at "d" and "det" (it)]

I: These two? Yes, it's strange. [turns the cards upside down]

S: And now *this* is upside down! [points at "t" in "det" (it)]

I: Is t upside down now?

A: Yes.

I: Yeah. So one is upside down on the one side and the other is upside down on the other. Yes, it seems a bit strange.

S: Mm. I guess I will let it be like that. [Adds "det" (it) at the top of "liten" (small), and "dddd" at the top

of "mos" (mash)] And there are two, one. [Adds 10 on top of "d", 0 top of 0.456 and tops -35 with "dgtkti"] Two there, too.

I: You have, can you explain how you were thinking?

A: No.

I: No, what was it you thought you were supposed to do?

S: Do not know...

I: Have you, how many did you put in each heap.

A: Two, two, two, two ... [counting cards].

Even William (6) starts by pairing the cards two by two, without caring about what is on the cards. He tries to sort them in pairs based on their size; he discerns the size instead of the content.

Excerpt 3:

I: If you have to split these cards into two heaps. One heap with some cards and one heap with the other cards, trying to find the ones you think belong together in the different heaps, if you had one heap and mom got one heap. How would you have divided them up?

W: Hmm. I really do not know.

I: No. You may do as you think is right, there is no correct answer, you may decide by yourself, that these should be --

W: Should I split up in different heaps?

I: Yes, if we say two heaps, or imagine two bowls. Then you would put some cards in one bowl and the other cards in a bowl. Try!

W: I do not know how to do

I: Well, start as you think.

W: Am I supposed to do like this? [Adds "mos" (mash) to "10"]]

I: Yes, you can do it like that. Do you think they belong together in some way?

W: They, they are not the same, but the cards are the same size.

I: The cards have equal size, it is true. Could you put them in other ways? There are lots of different ways you can do it.

W: I probably do not know.

I: No. Are there any cards that you think belong together?

W: Which do ... You mean what cards I think are the same size?

When Tilda (4) is asked to make two heaps instead of pairing the cards, she gets confused.

Excerpt 4:

I: If we do this Tilda, if you'll try to add those that look like each other in one heap, and the others who are similar in another heap. How would you then be able to put them together? You can do it in lots of ways,

so it is you who --

T: But there is no more like that or more like that or more like that or more like that. [Points at all the cards]

I: No

T: But there are those, [adds the "d" and "dddd"] so they may well be in the heap, but there are not two like [points at 45.78] and not two like [points at -35]

I: No, there is no one exactly the same as one another, it is quite right.

T: No, but they are a bit the same, but there is more. And this is a ... [puts up "d" and "dddd" again]

I: That's right, they must, I agree with you, they have to fit together.

T: Mm, but I do not know to fit together the other.

### **Similarities and differences**

Vygotsky (1934/1999) drew conclusions about what steps in children's thinking were needed to create new concepts. He calls the first step "the incoherent coherency", which describes the small child's thinking. The child uses concepts based on subjective associations. Vygotsky claims the child's thinking is a "product of syncretic mixtures of images underlying the child's words" (Vygotsky 1934/1999, p. 191, our translation). The first phase of the small child's conceptual development is characterized by trial and error, the child tries and rejects, a result also found in this study when Tilda (4) sorts cards.

Excerpt 5:

I: Yes. Have you any ideas how you think they could fit together?

T: It is D, but I bent the card, this is in my name.

I: Mm. It is true.

T: But if you, yes, you put these cards there and put these there and something in the middle and then it might be...nothing. [Adds "45.78" above the "d" with a space between]

When Tilda gets the task to sort the letter- and number-cards into two groups, she experiments with them and finally rejects the result as "nothing".

This phase, the incoherent coherency, is succeeded by a reflection on subjective relations in which the child looks after similar objects as the child perceives them (Vygotsky, 1934/1999). The child notices the aspects of the objects that give the impression of being related. This relationship can be based on colour, form or substance depending on what the child chose to discern. When Sanna (5) sorted the cards, she discerned similarities between some aspects she noticed.

Excerpt 6:

S: They belong together ...

I: Yeah, what do you think? [Sanna adds the "d" and "dddd"] mm

S: R [takes up the "K"] Does it match in any way?

I: Well, there is perhaps no one that exactly fit together. But they might belong together as a kind of family. They may not be exactly the same, but they might fit together as a sort of family. [Sanna puts "k" on top of "dgtki"] Mmm, that is fine. It's a lot to think about here. [Sanna adds "-35" to "33"].

S: [Adds "45.78" to "45632", and the "10" and "0"] The two ... [adds the "det" with "liten" and adds "mos" and "0,456"]

Sanna matches cards where she can find one or many aspects that are the same (similarities). The contents of the cards seem to be irrelevant. She does not discern length or information such as the minus sign and decimal point. The subjective relationship does relate to form: "d" is associated with other ds. Thus "mos" (mash) belongs together with "0.456" as she does not discern the difference between the letter "O" and figure "0". Sanna discerns the form rather than the content.

The next step is the development of complex thinking, i.e. grouping into objective contexts. The connection may be of various kinds, and the only criterion is that a connection actually exists. The difference between complexes and concepts is that a concept is based on objects that are grouped on the basis of a single connection, while a complex may contain several different connections.

When Tilda has thought ahead and left the trial-and-error phase, she sorts the cards to form what Vygotsky calls a chain-complex, a step in the development of mastering concepts. Tilda rejects a card, which she puts in the middle.

Excerpt 7:

T: There are no more like the [ 'K'], but they may also fit [addresses 0 and 0,456]. It is O, there, and there, they might fit in the middle [between the heap with letters and the heap with numbers as she does not differentiate O from 0] . Then maybe ... They should be like this. Now it is so oblique ... [sort cards]

I: That's great, Tilda. Does anything else fit?

T: They fit together [taking up 10 and "mos"]

I: Yes, can you tell me how they fit together?

T: It is an O there and an O there, O there and a ... [points at "10", "mos" and "0.456"]

I: Okay. And then you put it there [pointing at the right side], and these in the middle [points at the middle] and these here [points at the left side].

T: It may well be on top of that. [Adds "10" above "0,456" and "mos" above "10"] But the "K" can not be there. [Removes the "K"] Yes, it is "K".

I: No, all might not belong.

T: Yes. Maybe we can use it. It may well ... fit better with that. [Adds 45632 next to 0.456]

I: Yes, maybe you can find any cards to match with it? (7min)

T: It can be there with one [adds "K" above the "dddd" and "33" above "45632"] and it can be there with one. Some may be one and one.

I: Mm, they can. I understand ... Mm.

Tilda makes a chain-complex based on the number "0" with the word "mos" (mash) on top. From that she puts on one side figures and on the other letters. Tilda has not yet developed understanding regarding the content of the cards, but the chain-complex shows her ability to distinguish letters from numbers, where the number zero represents a hybrid between the figure "0" and the letter "O".

In the final step of the development of conceptual understanding, pseudo concepts develop according to Vygotsky. Pseudo concepts are similar to the concepts adults use, but differ as the child connects concrete objects and the part in concrete thinking, instead of a purely abstract process. The child will achieve a result similar to a concept, but the path is based on thinking in complexes.

Excerpt 8:

I: Are there any other cards that you think could be related? What is on them?

I: We talked about it before?

W: Yes, but there is no one like this. [Picks up the "s"]

I: No, there is no one who is exactly the same. That is right. Everyone is different.

W: But there are two letters in all cases. These. [Picks up "s" and "d"]

I: Yeah, exactly. Mm. It was good thought. Can you find more cards related to them?

W: Hmm ... Yes, this. [adds "K" with "d" and "s"]

I: Mm

W: Here, there were many [taking up "det"]

I: There were many letters.

W: If there are many characters, then you can put lots of them in one heap. [Adds "small" and "dddd" in letter heap]

I: What have you left?

W: It's just numbers and - yes, this one! [Refers to "dgtkti" and adds it in the letter heap]

I: There was another one.

I: Okay. Then, let's look at these [divides "10" and "mos"]

W: Well, there was one [Picks up "mos"].

I: There was one other, yes. Which heap are you going to put it in?

W: What?

I: Where do you think you could put it?

W: Yeah, there. [Points at the letter heap]

William splits the cards into two piles, letters and figures. The split coincides with the concepts of letters and figures, but the sorting is rather based on similarities between the cards than on the meaning of the two concepts. William uses perspicuous figurative thinking rather than abstract thinking.

As the children have not yet developed abstract thinking, sorting cards in pairs was difficult as they found it hard to find similarities. They tried to find exactly the same content on the cards, but when isolated aspects of the content were focused on they found some similarities. One such similarity used by the children was the figure 0 and the letter O.

Excerpt 9:

T: But if I, yes, IF you take this card and this and take that one and something in the middle then it might be...nothing. [Adds 45.78 above the "d" with a space between]

I: Well, such things happen..

I: If you just look at this one, [points at 45.78], can you find something that would fit with another card?

T: [picks up -35] Perhaps they are not exactly the same, but we have, of course, *they* [points at 5] are the same, so we can ehh, they are a bit the same and so.

I: Yeah, exactly, that's possible. Can you find any more cards you could have in that heap? If you find a heap here for them [Puts the "d" and "dddd" away], and you will find a heap there. [Puts away -35 and 45.78] Do you find more cards that might fit into the heaps?

T: There are no more like the [ 'K'], but they may also fit [addresses 0 and 0,456]. It is O, there, and there, they might fit in the middle [between the heap with letters and the heap with numbers as she does not differentiate O from 0] . Then maybe ... They should be like this. Now it is so oblique ... [sorts cards]

I: That's great, Tilda. Does anything else fit?

T: They fit together [taking up 10 and "mos"]

I: Yes, can you tell me how they fit together?

T: It is an O there and an O there, O there and a ... [points at "10", "mos" and "0.456"]

Finally, Tilda has found a pattern consisting of cards with letters, cards with figures and cards with the hybrid (the figure 0 and the letter O , which she could not differentiate).

The card that really caused problems was the one with letters combined with a non-readable word, which Tolchinsky (2003) also found in her research.

Excerpt 10:

T: This one is not supposed to be included [removes "dgtki"]. So we are taking ... It may be with them over there. They are three in this heap [puts together "0,456" with "10" and "0"]. We have to move them down here. Like this. Anyone which fits in with this one? Yes, they fit together [adds the "det" and "liten".

Two there. A K is not to be included because there are not two Ks. This we can put together with that one.

T: Wow. It may be with B [adds "dgtki" with "d" and "ddd"]. There is a B there, though it is not there. [Discern a d as a b].

I: Mm. Yes, it was another way to sort, and also good of course! There can certainly be many different ways to do it.

T: K can be with ... [adds "K" with "mos"] yes, maybe we can put it there in that pile. Yes, and it can be in the pile over there. [Moving "mos" and "K" to one pile] And they can be in one heap, over here [puts together 45632 and 45.78 and moves to the corner of the table]

At the end of the interview Tilda becomes stressed about the fact that she did not get all cards to fit together although she tries in different ways.

Sanna (5) found isolated similar aspects on the cards, parts of the whole, which guided her when sorting them.

Excerpt 11:

I: Well, there are perhaps none that exactly fit together. But they might belong together as a kind of family. They may not be exactly the same, but they might fit together as a sort of family. [Sanna puts "k" on top of "dgtki"] Mmm, that was good. It's a lot to think about here. [Sanna adds "-35" to "33"].

S: [Adds "45.78" to "45632", and the "10" and "0"] The two ... [adds the "det" with "liten" and adds "mos" and "0.456"]

I: Mm. If you now have to match these piles, fit in with any other, to find out if they are associated with some of the other piles. What do you then think fit together? [Sanna divides cards again] No, that is, you do not have to break them, you can still have them in these small piles. And see if you can find out if they fit in with any more.

S: that one. [Adds "det" and "10"]

I: This one and that one you think fit. [Points at "det" and "liten"] Anything else you could add? And if you don't think there is, just tell me. Because I do not know.

S: There are no more that fit. *They* belong together. [Points at 45.78 and 45632]

I: Do you have any heap that would be related to that heap? [Sanna looks at different cards] Mm. Can you instead just tell me how you know they belong together? [Points at the pile with 45.78 and 45632]

A: Four, four, four, five. [Pointing at signs of the cards]

I: Mm. And they? [Pointing at "33" and "-35"]

S: Three, three, three, five. [Points at the numbers]

I: And then? [Pointing to "the" and "small"]  
S: P. [pointing at "d" in "det"]  
I: Okay.  
S: But that one is upside down. [Turns the card around]  
I: Yes, it was ...  
S: G. F. [Pointing at "e" and "t"]  
I: And this is linked with that one?  
A: Yes.  
I: And? [Points at "d" and "dddd"]  
S: P, P, P, P, P.

William (6) discerns other connections, such as 10 and 0 is 100.

Excerpt 12:

W: /.../ may I add something else there [means next 10].  
I: Yes, what can you put there? [William puts 10 next 0]  
W: I think it is similar to one hundred?  
I: Yes, that is right.  
W: And now, I do not know what to do. [Picks a little at the cards]  
I: No. It is you who decides. Then you have made the heap complete. [Moving the letter pile sideways]  
Or? [Moves the heap back a bit]  
W: Yes [I puts away the heap]  
I: Then you have these left. What's on these cards you have left?  
W: Hmm. [adds -35 to 33 and 3] Hm. I may add that in some other heap because there are indeed ... [adds 45.78 to 0456, and also there 45632]  
I: Mm. Can you tell me, how do these belong together [pointing to the heap of 3, 33 and -35], have you thought about that?  
W: Do not know  
I: Well, I think you know. And it is not wrong, it's not why I ask, I ask only because I am curious./.../  
You may tell by yourself, how they belong, according to you? [Points at the same heap]  
W: Yes, because there is three there, three there, and threes there. [Shows on the cards]  
I: Yeah, and what about them? [Points at 10 and 0]  
W: Yes, because there is a zero there and a zero there. [Points at the cards]  
I: Sure. And those? [Points at the heap with 45.78, 45632 and 0.456]  
W: Them? [Points at the cards]

William had no problem with differentiating the cards with figures from the cards with letters.

Excerpt 13:

I: Mm. Yes. It is also the same. So, we do like this, we take these and these, and put them away for a while. [Puts away the letter heap] And now, you said there were letters on them, is it something existing on these [spreads the numeric cards]. What is available on these cards?

W: Numbers.

I: Numbers, etc.. Is it numbers at all?

W: Yes, all of them.

I: And these, which you already have divided into heaps before.

W: Yes.

W: But I thought it was fun, so I wanted to do it again.

William experiences the variation on the cards and thereby the possibility to sort in different ways. However, there is no variation in the two groups of cards; letters and figures, which he finally understands as the result of his different ways to sort, end up in the same two heaps.

Excerpt 14:

I: Yes, you may do that, then we will see if you get the same heaps, if you make new ones or if you keep them.

W: [Sorts cards] I just put them in the right place the way I want them. I already know how. I want to do something else now.

I: Yes, you can do in lots of different ways. [William adds 45632 to -35] That is the clever thing with the cards.

W: Yes, because there many who are the same.

I: Exactly. Are they also the same?

W: Hmm. Yes, it ... is. [adds 10 and 0]

I: You almost chose that [referring to 0.456]. Can you tell me how you were thinking?

W: You should take a seven - a zero in a place like this big card. [Adds 45.78 together with 45632 and 3 with 33]

/.../

W: Then I do the same thing.

I: Yes, maybe there is not more than one way to do it.

W: [Adds "liten" in the heap with "d", etc.]

When William had finished his sorting into two heaps, he was asked to see if he could find any figures in one of the two heaps.

Excerpt 15:

I: Mm. Can you tell ... You can find some figures on these cards [gives him cards]

W: No figures, no figures. [Goes through all the cards]

He was also asked to guess if there were any words on the cards, although he can't read. This question was too difficult for him to answer.

Excerpt 16:

I: No. Are there any words on the cards? What you think is a word? How do you think, you can check ...?

W: Actually, I can not read.

I: But ... what do you think is a word? Could this be a word? [Points at 's']

W: Well ... But I...

I: It is you who decides, don't look at me.

W: Sometimes when I worked with the computer, then I wrote. ... Yes, though I trained, but, I, I do not remember what it was, it was nothing. It was just that I had not written anything. It was not anything.

I: No. But if you guess: "Yes, this is probably a word" or "this can not be a word". What cards do you think would be the word?

W: What is this thing then? [Raises "dddd"]

## Conclusion

Assumptions about learning often include findings of differences and similarities when developing understanding. Research on pupils' learning at school has shown such results (Holmqvist, Lindgren, Mattisson and Svarvell 2008; Holmqvist and Mattisson 2008; Holmqvist, Lövdahl and Strömberg 2008), and this study presents results on what children seem to discern when seeing symbols they meet everyday, but have not yet been taught. Their ways of reasoning, when sorting those symbols, show what kinds of similarities and differences seem to be important when trying to make sense in an area that is not yet familiar. The aspects the children had discerned provide an explanation of how understanding develops without being told, what children possibly can discern and what pattern of similarities and differences of the phenomenon they focus on.

Pramling and Pramling Samuelsson (2008) describe, in their study of pre-school children learning maths, what happened when the children got pictures/drawings as aids for the instruction. The intention was to make the learning situation more playful, but instead it confused them: the pictures/drawings seemed to be an additional difficulty. It was hard for the children to sort out what was important to focus on in the learning situation, which made them pay less attention to solving the task. "Increasing the amount of information does not by logical necessity make it easier to manage for the learner. With increased amount of

information, for the learner to be able to distinguish between the critical and incidental information in order to solve the task will be further accentuated” (ibid p 77).

The results of this study show what the children discern when sorting cards with only letters/words and figures/numbers on, including the kinds of similarities and differences they are aware of. No other stimuli than the designed examples was presented. The children rejected the card including only letters that could not form a word (dgtkti); they could differentiate cards with numbers from those with letters/words, and no card including numbers was rejected. Cards including the letter O or the figure 0 caused problems for the respondents aged 4 and 5. Tilda (4) divided the cards in three heaps, one including letters/words, one figures/numbers and the third with O or 0. In this study we also found how children used chain-complex when talking about the relations between the cards in terms of sameness and difference. Symbols like the decimal point and the minus sign, however, were not commented on at all by any of the children and had no influence on their sorting.

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