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"The brain is so we can listen and see the colour of the dress"

The ideas four year old children have about the inside of our bodies

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Abstract

The paper explores what kind of ideas four year old children have about their body; that is, the location, structure and function of bones and certain organs. Twenty pre-school children were chosen to take part in the research. They were asked to make two drawings each, one of the bones and one of the organs. The children were interviewed about the functions of the bones and organs. The children were also given a cracker and a glass of water and asked to describe the way the food goes from mouth and onwards. The results show that most of the children draw bones as lines throughout the body. The heart and the brain are the first organs they know and they also know that the food we eat goes from the mouth and into the stomach but their understanding of what happens in and beyond the stomach is very vague.

Introduction

The inspiration for the study that will be presented in this paper comes from an interest in the ideas young children have about objects and the world around them and the dialogue they use to explain certain concepts and phenomena. I have often wondered about children's understanding of these concepts and phenomena and in particular what kind of understanding lies behind the words or phrases they use. I have been especially interested in the ideas young children have about the human body. In this paper I will focus on these ideas, ideas about location, structure and the function of bones and certain organs and how young children (preschool children) present these ideas through drawings and discussion.

Theoretical framework and prior research

Extensive research into children's alternative conceptions has stimulated considerable interest in "constructivist" views of learning (Hodson and Hodson 1998). From the constructivist point of view children construct their ideas largely reinterpreting bits and pieces of knowledge – some obtained from first-hand personal experience, but some from communication with other people – to build a satisfactory and coherent picture of the world (Selley 1999).

One strand of constructivist view of learning derives from Vygotskys focus on the dialogue between the individual and his social environment and the language and the culture that the individual is a part of. According to Vygotsky the element of culture

is essential in the process of the construction of knowledge. It can be the culture of the society the child lives in, the culture of the home or the culture of the school (Cole and Wertsch 1996, Fosnot 1996, Vygotsky 1986, Kozulin 2003). Culture has a great impact on what is processed and taught and then learned in school, a view discussed by Cole and Wertsch (1996) and Kozulin (2003). Kozulin emphasises that this should not be overlooked as each culture has its own psychological tools and situations in which certain tools are appropriated. These can be symbolic artefacts like signs, symbols or texts that help individuals to master their own perception, attention and memory (Kozulin 2003). Daniels (2001), like Cole and Wertsch (1996) and Kozulin (2003), talks about the importance of cultural, historical and social influences as a basis of individual development in Vygotsky's ideas where cognition is seen to be situated in specific social, cultural and historical circumstances (Daniels 2001).

Children have their ideas and interpretations concerning certain concepts or phenomena even though they have never had any formal instruction on these concepts whatsoever. They form their ideas and interpretations on the basis of everyday life and experience (Driver, Guesne and Tiberghien 1985). According to Farmery (2002) children build up "scientific" knowledge that may be very different from that which we would wish them to develop from a range of sources outside the school environment. They are also constantly changing and evolving their ideas and knowledge as they adapt to various contexts (Kesby 2007). Thus, to understand children's ideas and knowledge one has to look into the social and cultural context which they live in (Einarsdóttir 2007).

A number of studies have been undertaken on the understanding and the development of children's ideas about scientific concepts (Carey 1985, Driver et al. 1985, Tunnicliffe 2004, Helldén 2004). In some studies children's drawings were used to get access to their ideas about various things and phenomena in nature (Haney, Russel and Bebell 2004, Osborne, Wadsworth and Black 1992). Some of the studies focused on children's ideas about the human body (Carvalho, Silva, Lima and Coquet 2004, Osborne et al. 1992, Óskarsdóttir, 2006, Reiss and Tunnicliffe, 1999a, 1999b, 2001).

Children's ideas about the bones in the body

Reiss and Tunnicliffe have undertaken extensive research on children's ideas and understanding about the body. In one of their studies, 102 children, aged 5–11 years were asked to draw the bones in their bodies. The drawings were analysed on a ranking scale of seven levels, made by Reiss and Tunnicliffe, which each reflect different levels of biological understanding about the bones (Reiss and Tunnicliffe 1999a). Results showed that about 1/3rd of the youngest children, five and six years of age had little or no knowledge of the bones according to their drawings as they drew the bones as simple lines or circles all around the body. In Óskarsdóttir's study about the ideas that six year old children have about their bodies (2006) a seven level scale developed by Reiss and Tunnicliffe (1999a) was used to analyse the drawings of the bones. Fourteen of twenty children drew the bones as simple lines or circles all around the body as the youngest children in the Reiss and Tunnicliffe study had done (Reiss and Tunnicliffe 1999a). This was also the case in a Nordic study where 119 six to seven year old children from six of the Nordic countries that had not had any formal teaching about the human body were asked to draw the bones

in their body. The ranking scale of seven levels, made by Reiss and Tunnicliffe was used in the study. Most of the children drew bones as simple lines or circles but not the whole skeleton with the bones connected to each other (Óskarsdóttir, Stougaard, Fleischer, Jeronen, Lützen and Kråkenes 2011).

In an extensive study, the English Primary SPACE Project (Science Processes and Concepts Exploration), children were grouped by age into infants (5–7 years old), lower juniors (8–9 years old) and upper juniors (10–11 years old). The children in the study tended to draw bones that they could feel so they were aware that there were bones in arms and legs (Osborne et al. 1992). This was also pointed out by Carey (1985) that reviewed a number of studies on children's ideas about the body. According to her, four, five and six year-old children are familiar with the external body parts, like legs, feet, arms, nose, eyes, ears and hair.

Children's ideas about the organs in the body

Reiss and Tunnicliffe also designed a similar seven level scale for different levels of biological understanding about organs and organ systems (Reiss and Tunnicliffe 1999a, Tunnicliffe and Reiss 1999). Results from their study of 158 children, aged 5–11, that were asked to draw what was inside their bodies, excluding the bones, showed that by the time the children were eight years old they mostly had a broad knowledge of the internal structure of the body and were aware of a wide variety of organs although they did not know how the organs were connected or how they were part of an organ system (Reiss and Tunnicliffe 2001).

The Nordic study of 119 children before formal teaching about the human body showed that most of the children did not include any connections between the organs on their drawings. The majority of the children however knew about the brain and the heart as these were the predominant organs the children drew (Óskarsdóttir et al. 2011). This was also the case in Óskarsdóttir's study (2006) where all the six year old children drew the heart and twelve of twenty drew the brain. Thirteen of the children drew veins all around the body and seemed to know the blood circulation to a certain extent and the role of the heart in it, that is, that the heart pumps blood to the veins and to the rest of the body.

In the SPACE study the youngest children (5–6 years old) were able to name and draw the organs that are more easily sensed (the heart beating, the lungs breathing, etc.), and the predominant organs named by all children were the heart, stomach and brain (Osborne et al. 1992). According to Carey (1985) young children look at the brain as a place where thinking takes place which is in tune with the ideas of the six year old children in Óskarsdóttir's study but their ideas about the function of the brain were for example: "The brain controls everything" and "The brain makes us think" (Óskarsdóttir 2006). According to Carey (1985) however, it is not until the age of 10 that children appear to understand that the body contains a number of organs which function together so we can live. Carey calls the ideas the younger children hold "psychological" ideas in contrast to "biological", According to her, by the age of 9 or 10 children understand more in terms of biological principles and she describes how intuitive biology emerges from an intuitive psychology between the ages of 4 and 10. She describes "intuitive psychological" ideas as being based on "intentional causality" and says they are psychological because they are explained in terms of beliefs e.g.: "the heart needs to beat" and "the

tummy needs to digest the food" but do not see this biologically. Hatano and Inagaki (1994), and Inagaki and Hatano (1993) conversely suggest that by the age of 6 children have acquired a form of biology as an autonomous domain which is separate from that of psychology but until about that age children talk about the organs as independent creatures that have needs and initiative.

Children's ideas about digestion

A number of studies have examined children's ideas about digestion. According to Tunnicliffe (2004), ten year old children seem to have better understanding of the digestive system than of the excretion system. Children aged 5–7 years link food to growing, being strong and healthy and to living in general (Carey 1985). Young children (preschool children) seem to relate the stomach to breathing, blood, energy and strength. By the age of seven they start realising that the stomach helps to break up or digest food and later they understand that food is transferred elsewhere after being in the stomach (Carey 1985, Driver, Squires, Rushworth and Wood-Robinson 1994). Young children are aware that the body changes as you grow and that not eating leads to the body becoming thin (Rowlands 2001).

In a study undertaken by Carvalho et al. (2004) children aged 5–8 years old were given a cookie to eat and were asked to draw the cookie in the stomach. A high percentage of the youngest children (5 and 6 years old) represented the entire cookie inside the stomach. They knew that the cookie went through the body even though they did not know the exact way and they were unable to draw the digestive system. This was also the case in Taxeira's (2000) study of digestion. A study by Toyama (2000) of children aged 4–8 on thinking about digestion and respiration, however, suggests that by the age of 4 or 5 children seem to have a sufficient insight for accepting some material transformation of food in which "food goes to various parts of the body and turns into our bodies" (p. 229). In a study on children's conceptions on the structure and function of the digestive system (Teixeira 2000) children of age 4, 6, 8 and 10 were interviewed. Each child was given a bar of chocolate and asked to eat it and draw the way the chocolate passes through the body. The results indicate that children possess biological knowledge as an independent knowledge domain from the age of four. These results suggest that biological insights about transformation of food are accepted by children earlier than previously was claimed, for example by Carey (1985).

Different methods used to get access to children's ideas

In few of the studies mentioned here drawings were used as a research method to get information about children's ideas about their body e.g. main bones and organs. In the SPACE research (Osborne et al. 1992) interviews were also used to get information about the children's ideas which gave more detailed information about their ideas. In Óskarsdóttir's study (2006), mixed methods were used e.g. classroom observation, children's drawings, classroom discussion, individual interviews and diagnostic tasks to get information from as many sources as possible. Schiller and Einarsdóttir (2009) point out the importance of using multiple methods in research with children. However, one must bear in mind that no method is neutral; neither drawings nor interviews can be taken as simply showing children's understanding and knowledge. According to Einarsdóttir (2007): "different methods can shed light on different aspects and give a new breath of understanding" (p. 207). Different children also have different ways of

expressing themselves and choose different methods to present their views and knowledge. According to Einarsdóttir different methods used by the same child often shows different results (2007). This was also discussed in Óskarsdóttir's study (2006) where different methods used by the same child (e.g. drawings and interviews) did not always give the same information.

In the study presented here both drawings and interviews were used to get insight into the ideas of four year old children about the human body. It is important to have in mind that health and wellness is one of the six learning areas presented in the Curriculum Guidelines for Preschools in Iceland (2011). They emphasize that preschool children should learn about and adapt a healthy lifestyle, balanced diet, the importance of resting, hygiene and exercising. Therefore it is of interest to get insight into their ideas about the body.

Methods

Twenty four year old children in one preschool in Reykjavík were chosen to take part in the research. The formalities and ethical clearance were obtained. A letter was sent to The Icelandic Data Protection Authority and to the Educational Office in Reykjavik for permission for the research. I also sent a formal letter to the head teacher of the preschool and to the parents of the children where they were informed about the research.

The children were asked individually if they wanted to participate, that is, to make a drawing and talk to the researcher. All of them agreed. The researcher was given a small room in the preschool to talk to the children individually and they were asked to make two drawings each. Two pictures of the outlines of the body had been chosen for the task. One of them was used for the drawings of the bones and another for the drawings of the organs. In the first drawing the children (individually) were asked to draw the bones in the body and in the second drawing they were asked to draw the organs in the body. While the children drew, the researcher asked them about the drawing and about the function of the bones and organs they drew. All the interviews were audiotaped and written up afterwards. The children were also given a cracker and a glass of water and asked to describe the way the food goes from mouth and onwards. It can take the child a long time to draw and explain his or hers ideas. Here, the child's fine motor skills have to be taken into account as children's fine motor skills can be differently developed, even though they are at the same age (Einarsdóttir, Dockett and Perry 2009, Reiss and Tunnicliffe 1999a, 2001). It took each child approximately 15–20 minutes to draw both pictures. The interview took place as they drew and afterwards but no interview lasted longer than 30 minutes depending on the drawing capacity, interest in the subject, concentration and how open the children were, as one must bear in mind that children's linguistic skills can be different while some children are more eager to express themselves than others.

These following questions guided the interviews with the children:

Why do we need bones?
How would we be if we had no bones?
Can you tell me about the organs inside the body?
Where does the food go after it has been in the mouth/after we swallow it?
Why is it important to eat healthy food?

The interviews were audiotaped and transcribed and themes and sub-themes were identified.

A seven level scale developed by Reiss and Tunnicliffe (1999a) was used when analysing the children's drawings of the bones (see Table 1).

Table 1. Reiss and Tunnicliffe's levels of bones (Reiss and Tunnicliffe 1999a).

Bones – skeleton	
Level 1	No bones.
Level 2	Bones indicated by simple lines or circles.
Level 3	Bones indicated by "dog bone shape and at random or throughout body.
Level 4	One type of bone in its appropriate position.
Level 5	At least two types of bones (e.g. backbone and ribs) indicated in their appropriate position.
Level 6	Definite vertebrate skeletal organisation shown (i.e. backbone, skull and limbs and/or ribs).
Level 7	Comprehensive skeleton (i.e. connections between backbone, skull, limbs and ribs).

When analysing the children's drawings of the organs an eight level scale was used, modified by Óskarsdóttir (2006) but built on Reiss and Tunnicliffe organ scale (see Table 2). The scales were primarily used to denote children on different levels according to their drawings but not to indicate their level of cognitive development.

> ***The child said he had seen a skeleton of an old dead man in a museum.***

Results

In this chapter the findings from the research are presented. First children's ideas about the bones in the body, then their ideas about the organs and at last their ideas about the digestion.

Table 2. Modified levels of organs, built on Reiss and Tunnicliffe organ scale (Reiss and Tunnicliffe 1999a).

Bones – skeleton	
Level 1	No representation of internal structure.
Level 2	One internal organ (e.g. brain or heart) placed at random.
Level 3	One internal organ (e.g. brain or heart) in appropriate position.
Level 4	Two internal organs (e.g. brain, heart or stomach) placed at random.
Level 5	Two internal organs (e.g. brain, heart or stomach) in appropriate positions but no extensive relationships indi cated between them.
Level 6	More than two internal organs in ap propriate position but no extensive relationships indicated between them.
Level 7	More than two internal organs in appropriate position and one organ system indicated (e.g. gut connecting head to anus or connections between heart and blood vessels).
Level 8	Two or more major organ systems indicated out of digestive, circulatory, gaseous exchange and nervous systems

The bones in the body

Seventeen of the twenty children were on *level 2* according to their drawings e.g. drew the bones as simple lines or circles (see figure 1). However, four children drew the ribs or, according to their explanations, something that was supposed to indicate the ribs. One child was on *level 3* as he or she drew the bones as "dog bone shape" but that same child also drew the ribs. The children

on *level* 2 who drew the ribs should perhaps rather have been placed at *level 4* (one type of bone in its appropriate position) but because they drew the bones as simple lines or circles they were placed at *level 2* but pointed out that they drew the ribs. An additional level on the scale would have been useful in these cases. However, two children were clearly on *level 4* as they were better aware of the skeleton and drew the ribs very clearly. One of them explained that the bones were all connected but the other one drew few types of bones.

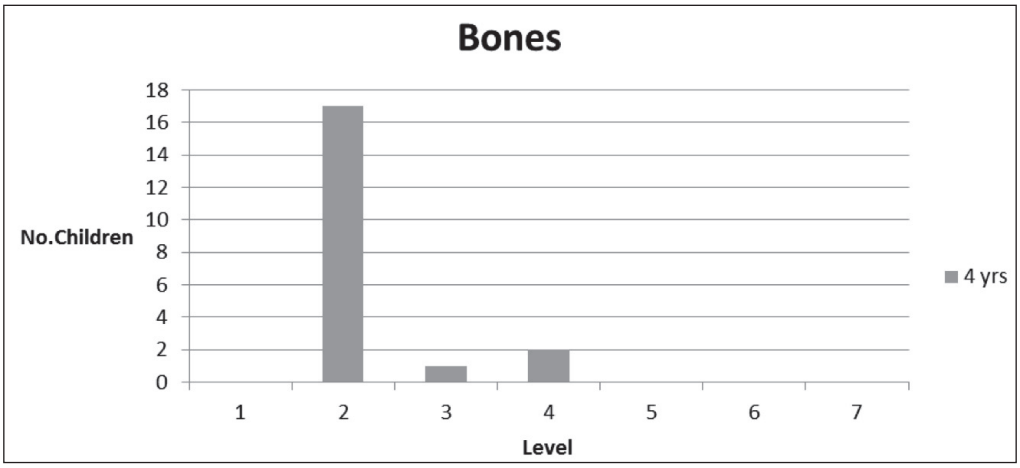
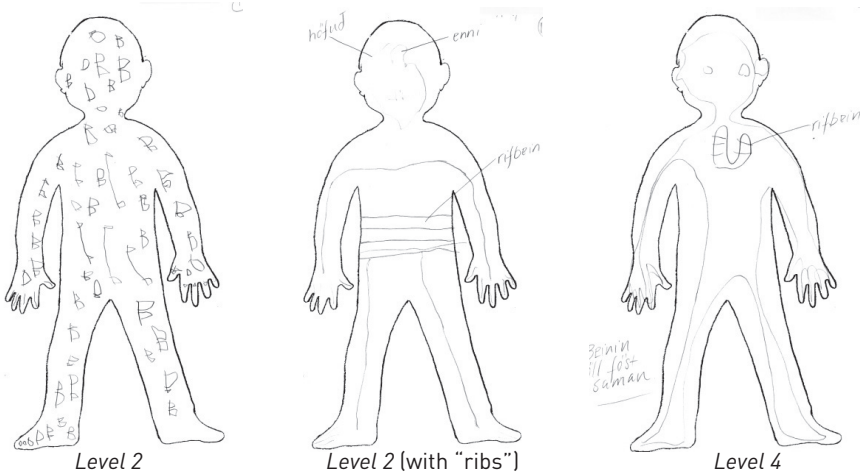


Figure 1. Children's knowledge of the bones according to the Reiss and Tunnicliffe bones scale (Reiss and Tunnicliffe 1999a).

On figure 2 there are examples of children's drawings of bones and the levels they reach according to the Reiss and Tunnicliffe scale (1999a).



Level 2 *Level 2* (with "ribs") *Level 4*

Figure 2. Examples of drawings of bones and the levels they reached according to Reiss and Tunnicliffe's scale (Reiss and Tunnicliffe 1999a).

The role of bones

All the children said that they had bones so they would be able to move. Some children said the bones were for keeping the skin in a certain place. Other examples were that the bones were so you would not hurt yourself; so you could play; so you were not very soft and so you could stand upright. One child said that the bones were hard and that we had bones everywhere and that all the bones were connected with joints. He said that old people had a skeleton. The child said he had seen a skeleton of an old dead man in a museum.

When asked how we would be if we did not have any bones the most frequent answer was that we would not be able to move. Other answers were: "we would just jump up, we would be so light"; "We would not be able to stand"; "we would just be crawling"; "we would just be statues" and "if we had no bones we would just be soft and lazy".

One child said: "If we would not have bones we would just be a costume or a baby but you get real bones when you grow up".

Children's ideas about the organs

None of the children knew the word organ so instead of mentioning that word it was referred to it as what is inside our body that is important so we can live. If that was not clear enough, the researcher clapped to imitate the rhythm of a heartbeat. All the children drew the heart on their drawings of the organs. When analysing the drawings on the eight level organ scale three children were on *level 2* with one internal organ (the heart) placed at random. Four children were on *level 3* (drew the heart in an appropriate position), see example on figure 3.

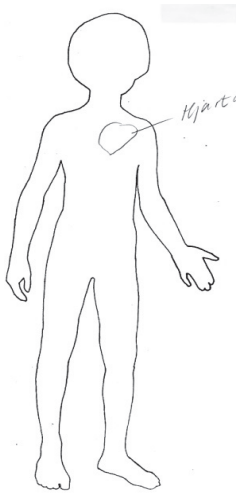


Figure 3. Example of a child's drawing that is on *level 3.*

Three children were on *level* 4 (two internal organs (e.g. brain, heart or stomach) placed at random). All three drew the stomach but the other organ they drew was the heart, the brain or the lungs. Six children were on *level 5* (two internal organs (e.g. brain, heart or stomach) in appropriate positions but no extensive relationships indicated between them). Three children were on *level 6* (more than two internal organs in appropriate position but no extensive relationships indicated between them). One child was on *level 7* (more than two internal organs in appropriate position and one organ system indicated (e.g. gut connecting head to anus or connections between heart and blood vessels)). Figure 4 shows the levels the drawings are on according to the eight level modified scale (Óskarsdóttir 2006).

> ***"If you did not have a brain you would not be able to think."***

The child that scored at *level 7* is a boy (four years and ten months old when the research took place). He drew a heart, lungs, veins, stomach and intestine and a clear connection from mouth to the bottom that is, the way the food goes (see figure 5). He said that

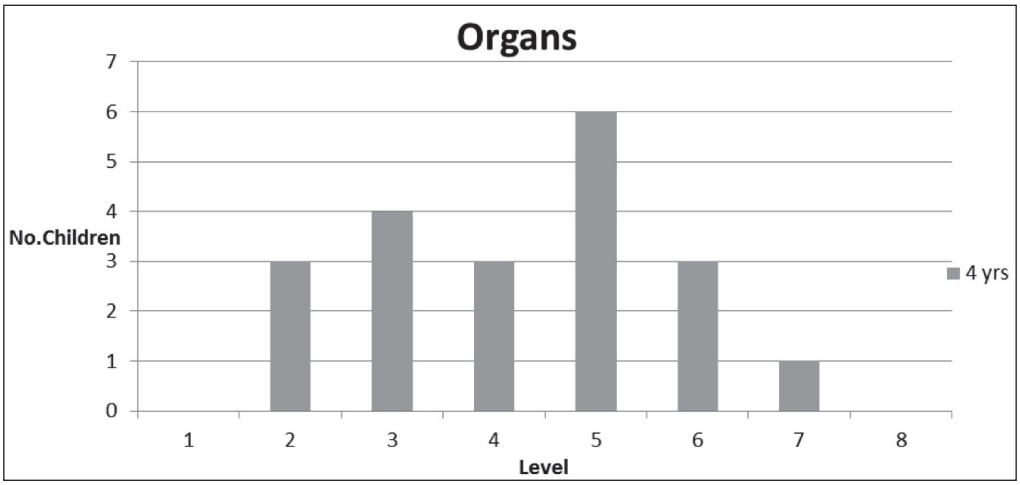


Figure 4. Children's knowledge of organs according to the eight level modified scale (Óskarsdóttir 2006).

if we did not eat we could not live; the food would go into the legs and all around the body but the leftovers turned into poop and pee. He also said: "The heart pumps the blood so it can go into the hands but a special bag keeps the blood. The lungs are so we can breathe".

Most of the children said the heart was necessary so we could live. Some linked it with blood: "Blood comes from it"; "It gives you blood" and three children said that the heart pumped the blood. Two children (on *level 6* and *7*) seemed to know that the heart pumps blood and the blood goes all around the body. One child on *level 4* said that we had veins all around the body and the veins came from the heart. Three children drew the lungs and said they were for breathing.

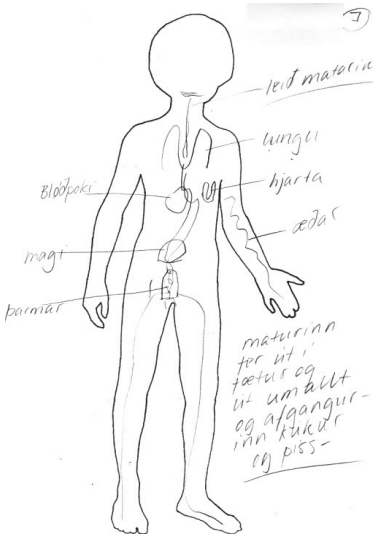


Figure 5. One four year old child scored on *level 7*.

Nine children drew the brain. When asked: "Why is the brain important?" they came up with a variety of answers. The most common answer was that the brain was for thinking and two children said that it controlled everything we did. Other examples: "If you did not have a brain you would not be able to think"; "The brain is behind the eyes, it is so we can listen and see the colour of the dress" and "The brain is so we will not die, so we will live and do all sorts of things and so we will not forget the things we do".

Children's ideas about the way food goes

Half of the children i.e. ten of them drew the stomach when asked to draw what was inside the body. When asked where the food went after swallowing it all the children said

it went to the stomach. Most of them had difficulties in describing what happened on the way from the mouth to the stomach although they realised that you have to chew the food: "So you will not choke"; "So the food does not stop in the throat, otherwise you will get strangled".

Most of the children said that after being in the stomach the food went to the toilet but then it had changed into poop. A common explanation was that the food goes from mouth to the stomach and then to the sea, also that the food changes to poop, it goes to the toilet and then to the sea. One child said: "The food goes to the stomach then it changes to poop and pee, changes to pee in the penis and to poop in the bottom. First you chew, then you swallow, then it goes to the stomach and changes to poop and pee". Another child said: "What you drink becomes pee and what you eat becomes poop". Three children drew something in the area of the intestines in addition to the stomach. Two of them drew the intestines but one of them did not know the name of it. The other child (on *level 7*) knew that it was called intestines. The third child said it was a bag that took the food after it had been in the stomach.

The interviews showed that the children seem to know that the food goes somewhere else than to the stomach even though they could not explain it and did not show it in their drawings. Their explanations were e.g.: "The food goes to the stomach but also somewhere else"; "The food goes to the stomach and also to the legs, hands and to the head"; "The food goes everywhere inside you and then you poop". The child on *level 7* said: "The food goes from the mouth to the throat, then to the stomach and then to the intestines and to the legs and all around the body. The water I just drank becomes pee and the cracker becomes poop".

The children seem to be aware of the importance of eating healthy food for growing: "You need healthy food to get big and strong." Two children related eating healthy food to their teeth: "You need healthy food for your teeth"; "So you will not get sore and ugly teeth". Two other children said that you needed healthy food to live and yet other two said that it was important to eat healthy food so you can move. One of them said: "The food goes to the stomach but also to the hands".

Discussion and implications

The results show that the children in this study have similar ideas as the youngest children (five to six years old) in other research on the human body and most of them are familiar with the same organs as the children in other studies, that is the heart and the brain (Carey 1985, Carvalho et al. 2004, Osborne et al. 1992, Óskarsdóttir 2006, Reiss and Tunnicliffe 1999a, Reiss and Tunnicliffe 2001). The children in this study also draw the bones they feel (see e.g. Carey 1985, Osborne et al. 1992). One has to bear in mind that the children in this study are at least one year younger than the children in other studies mentioned in this paper. Seven of them draw ribs even though most of the children in this study scored at *level 2* (bones indicated by simple lines or circles), but ribs are probably the first bones children learn to know apart from bones in hands and feet. The children linked the functions of the bones almost entirely with movement and assumed that if we did not have bones then we would be soft and lazy. Their answers indicate that they think that babies do not have real bones because they cannot walk and move around like older children and adults but gradually we get real bones that make the skeleton, that is, the skeleton

develops as we grow and get older as the examples mentioned earlier showed: "If we would not have bones we would just be a costume or a baby but you get real bones when you grow up".

> *"The food goes to the stomach then it changes to poop and pee, changes to pee in the penis and to poop in the bottom."*

Like their drawings of the organs show, all of them drew the heart. This is in tune with the results of the SPACE study (Osborne et al. 1992), where the youngest children (five to six years old) drew the organs and body parts that they could see, touch or feel like the heart that beats. This was also the case in Óskarsdottir's (2006) study of six year old children where all the children drew the heart.

According to the interviews most of the children seemed to know that the heart was necessary for living. Some of them linked it with blood: "Blood comes from it" and "It gives you blood" and three children seemed to realise that the heart pumps blood that goes to the rest of the body. In Óskarsdóttir's study of six year old children the children seemed to know the blood circulation to a certain extent and the role of the heart in it, that is that the heart pumps blood to the veins and to the rest of the body (2006). The four year old children generally seemed to have rather vague ideas about the blood circulation, it was however obvious that at least some of them had started to form ideas and understanding about the blood circulation and the role of the heart in that process. The children also personified the heart like the examples mentioned before showed, which is consistent with the ideas put forward by Carey (1985) and also by Hatano and Inagaki (1994) and Inagaki and Hatano (1993) that conversely suggest that by the age of 6 children have acquired a form of biology as an autonomous domain which is separate from that of psychology but until about that age children talk about the organs as independent creatures that have needs and initiative.

Nine children drew the brain when asked to draw what was inside the body. The most common answers about the role of the brain were that it was for thinking and two children said that it controlled us. This is therefore in tune with the ideas of the six year old children where twelve children of twenty drew the brain and their ideas of its role were similar e.g. the brain controls everything and we use it for thinking (Óskarsdóttir 2006). The idea of a four year old child that says: "The brain is behind the eyes, it is so we can listen and see the colour of the dress" is interesting because here the child is connecting the senses to the brain. "The brain is so we will not die, so we will live and do all sorts of things and so we will not forget the things we do" is also an interesting idea because here the child clearly links the brain to the memory and the fact that we use it when we do something.

The ideas the children have about the importance of eating healthy food are also in harmony with other studies (see Carey 1985, Óskarsdóttir 2006, Osborne et al. 1992), i.e. we eat so we will grow and become strong and we have to eat to be able to live. Most of the children had difficulties in describing what happened to the food after swallowing it. Even though they ate the cracker and drank the water and drew the way the food went, they struggled explaining what happened in the mouth. Many of them said however, as the five to six year old children in the SPACE research, that you need to chew before you swallow to make the food smaller, otherwise you can suffocate. The children did not know which way the food

went after being in the stomach as the study of Carvalho et al. (2004) also showed. According to their drawings and their descriptions they seem to think that the food goes from the mouth straight to the stomach and from the stomach straight to the toilet as pee and poop and then from the toilet to the sea. This is in correspondence with the results of the SPACE study but there, most five year old children said that the food went to the stomach and then straight out of the body (Osborne et al. 1992). However, around the age of six the children seemed have started to know that the food went all around the body and about eleven years of age the children knew that the food changed in the stomach and nutritive elements from it spread through the body. According to Carey (1985) and Driver et al. (1994) it is around seven years of age that children start to understand that food transforms in the stomach i.e. digests and from that age onwards they start to understand that the food goes elsewhere after being in the stomach. This study however indicates (like Toyama 2000, Taxeira 2000) that children around four years of age have some ideas about the importance of the nutrition from the food for the body even though they have difficulties in explaining it. The fact that two of the children said it is important to eat healthy food to be able to move indicates that they know that food has something to do with health and energy even though they cannot explain how.

The children were not shy using the words poop and pee but these words can hardly be seen in international research with children and is probably linked to the social and cultural context which they live in like pointed out by Einarsdóttir (2007). It is interesting but at the same time very normal that they conclude that what they drink becomes pee but the fast food we eat becomes poop. The influence of the social and cultural context which the children live in cannot be overlooked here as each culture has its own tools and situations in which certain tools are appropriated (Kozulin 2003, Einarsdóttir 2007). The children say that pee and poop go from the toilet to the sea which also has cultural or rather geographical links as the children in the study live in a country that is surrounded by the sea so their ideas are situated in specific social, cultural circumstances as pointed out by Daniels (2001) and Kozulin (2003).

It is surprising that this study indicates that there is not much difference between the ideas the four year old children in this study have and the ideas of five and six year old children in other studies have about same or similar issues. Most of them see the bones as lines all around the body and the ribs are the first bones they know apart from bones in legs and arms. The first organs they know are the heart and the brain and they know that the food goes to the stomach. Their ideas about the digestion are vague although they can explain in simple terms the way the food goes through the body and out. The heart pumps blood and you think with the brain and the senses are linked with the brain. The study therefore indicates that four year old children know that the human body has bones and organs that are important and have different roles to play in the body even though they have never had any formal instruction on these concepts whatsoever. They form their ideas and interpretations on the basis of everyday life and experience (Driver et al. 1985) and are constantly changing and evolving their ideas and knowledge as they adapt to various contexts as pointed out by Kesby (2007).

The research methods used in the study, that is, both the drawings and the interviews, were useful in getting information

about the children's ideas. The drawings and the interviews alone would not have given sufficient information so the two methods used together worked well in this study. One needs however to have in mind, as pointed out earlier, that no method is neutral, and neither the drawings nor the interviews can be taken as simply showing children's understanding and knowledge, and the methods used were not meant to indicate their level of cognitive development.

How long time it took to collect data from each child depended on their fine motor skills and drawing interest and also their interest in the topic, their concentration span and how open and sociable they were. Reiss and Tunnicliffe (1999a, 2001) and Óskarsdóttir (2006) address the importance of this and point out that children's fine motor skills and drawing abilities can restrain children's drawings to give the correct pictures of their ideas. It must also be questioned whether it is reasonable to denote children to distinct levels on the basis of their drawings. The use of scales, such as the Reiss and Tunnicliffe scales, can be useful when addressing specific content for different age groups, like in the present study, but can be refined and developed to be used routinely both as research tools probing different specialised areas. The scales could also be used as efficient diagnostic and assessment tools for the teacher. It is important to consider that children's actions (e.g., making drawings and answering interview questions) must be interpreted as situated activities, that is, as responses to problems as they appear to the child. One has to bear in mind that children's linguistic skills can differ; some children are more sociable than others and more eager to express themselves than others. To get as clear a picture as possible of the children's ideas it is therefore important to use more than one method when doing research with children and bear in mind that all children are unique so the same research method does not suit all.

The study presented here gives insight into the ideas four year old preschool children have about the human body and shows how it is possible to approach their ideas and understanding through drawings and interviews/conversations. But what more can be learned from the study that can be of use for preschool teachers when working with young children on issues regarding the human body? One must bear in mind that four year old children are very capable human beings that are a part of a social environment, the preschool, where language and culture plays an important role that is essential in the process of the construction of knowledge (Vygotsky 1986). The results indicate that children possess biological knowledge from the age of four and therefore it is important to provide them with biological activities that interests them. According to the results all the children knew that we have bones and knew the parts of the body that we can see or feel. All of them knew we have hearts and all of them knew that after we swallow the food it goes to the stomach. It is important to take these ideas further.

Young children are curious about their own body and learn early in their lives that it is necessary to eat healthy food and exercise to be energetic, big and strong. It is therefore important to use their curiosity and interest and extend their bodily awareness. The preschool plays an important role in upbringing and educating young children. Therefore it is important to have the children's ideas and experience in mind when planning the preschool curriculum and the daily activities in the preschool. It is also necessary to have in mind that health and wellness is one of the six learning areas pre-

sented in the Curriculum Guidelines for Preschools in Iceland (2011) so working with preschool children on issues regarding the human body is very relevant to extending their knowledge and awareness. In the light of the results of this study it is important for preschool teachers to find out about children's ideas and previous knowledge and experience when planning to work with the children on the human body and then decide what type of activities would be appropriate for the group and/or the individual child. It is, however, important to pay attention to one issue at the time i.e.: external body parts (hands, arms, feet, head, ect.); bones and muscles; the structure and location of specific organs e.g. brain, heart, lungs and stomach and the function of these organs. How to work with the children on these issues is left to the preschool teachers to decide depending on the group of children, their experience, interest and needs at the time.

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