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Children's conceptions of the brain: first steps.

Amauri B. Bartoszeck, Dept. of Physiology, Lab. of Neuroscience & Education, The Federal University of Paraná, Brazil.

E-mails: bartoszek@ufpr.br; abartoszeck@hotmail.com

Flavio K. Bartoszeck, Institute of Neuroscience & Education, Curitiba, Brazil. E-mail : flaviookb@gmail.com

Abstract

This study is concerned with the development of nursery and primary school pupils' conceptions of the human brain. It is based on a qualitative investigation involving a total of 1151 students between 4 and 10 years old in southern Brazil. Pupils presented with an outline were asked to draw what they think they have inside their heads. Various models appear tentatively to represent the brain according to their grades and age. Implications for science education are discussed.

Key words: biological conception, brain, mental images.

Introduction

Adults agree the brain is crucial for life, whereas children recognize that it is an important biological organ (Johnson & Wellman, 1982; Gottfried et al., 1999). Several studies have investigated the spontaneous development of students' conceptions about human organism (Reiss & Tunnicliffe et al., 2002; Frändberg et al., 2004).

Conceptions can be considered as a process for mental construction of the real world. The learner progressively transforms incoming information, by means of his sense organs and social relationships, into organized knowledge structures (Pines & West, 1986; Giordan & de Vecchi, 1990; Palmberg & Kuru, 2001). There are a scarcity of studies on children's conceptions of the brain (Clément & Mein, 1987; Savy & Clément, 2002). The objective of the present study is to analyse, by means of drawings, how the conception of brain develops from pre-school pupils up to 4th graders in a Brazilian sample.

Methods

Fieldwork was carried out in southern Brazil in the cities of Curitiba and Foz do Iguaçu, Paraná State at 10 Schools of Infancy Education (199 children, 4 to 6 years old) and 8 primary Schools (952 pupils, 7 to 10 years old). Children were told to write their names and age on a blank A4 sheet of paper and asked to draw, using an outline sketched on the blackboard, what they have inside their head. Many students spontaneously labelled the biological structures represented on the drawings.

A total of 1151 drawings were collected. Their distribution by grade level and gender is indicated on Table 1. Classification of the drawings to fit the "model" criteria developed by Savy & Clément (2002a), were done independently by the authors, and is represented on Table 2. Statistical analysis of the data to evaluate the significance of changes in grade level and gender is planned to be carried out in the near future.

Results

Few mental images (Fig. 1), "hydraulic model" (Fig. 2), "dog bone model" (Fig. 3), "enteric model" (Fig. 5), except in fourth grade, "epithelial model" (Fig. 6) were used by children in nursery school to fourth grade. On the other hand, there is a progressive increase in the representation of the brain as a "calotte model" (Fig. 4) and as brain hemispheres, specially at third and fourth grades (Fig. 7). However, a large proportion of the drawings collected were deemed unclassified according to the "model" criteria adopted (Table 2).

Nursery and kindergarten pupil's drawings are mainly classified as bone model, 50.0% and hydraulic model, 17.6% respectively. First and second graders represented the brain as a calotte model, 20.1% and 28.8% and as a hydraulic model, 15.6% and 12.8% respectively, whereas third and fourth graders depicted the brain as a calotte model, 50.3% and 53.7% respectively.

Discussion

Our data revealed the children from nursery school up to the 4th grade pupils do not make a clear distinction between the biological structure of the brain from thoughts represented as mental images, i. e. pictures of their thoughts as happy memories of vacations, parties and members of the family. They progressively draw models trying to explain what the organ is and its functions, but they still know it, but have a poor idea of its shape (Reiss & Tunnicliffe, 2001). For instance, the hydraulic model may suggest that thoughts circulate inside the brain and skull and the calotte model may refer to the position of the brain on the top of the skull. The calotte model may be shaped as an enteric gastric tubing structure and or as type epithelial tissue, where ideas circulate. The last representation is the most realistic and depicts the brain hemispheres and circumvolutions, as was also observed with French children (Savy & Clément, 2002). The authors believe that organizing science curricula contemplating neuroscience issues from nursery school up to the fourth grade would bring a meaningful improvement in the learning of elementary Biology.

Educational implications

For example:

- Hands-on activities to create brain models;
- To assemble toy brain parts into a skull case;
- Practical classes with sandpaper and wooden shaped objects to identify tactile stimuli;
- Visit to Natural Sciences Museum to examine jars of preserved brains of fish, toad, mouse, primate, human.



Figure 1. A drawing by a 10 years-old boy, 4th grade representing a mental image model (thoughts) of the brain.



Figure 2. A drawing by a 7 years-old boy, 1st grade representing a hydraulic model of the brain.

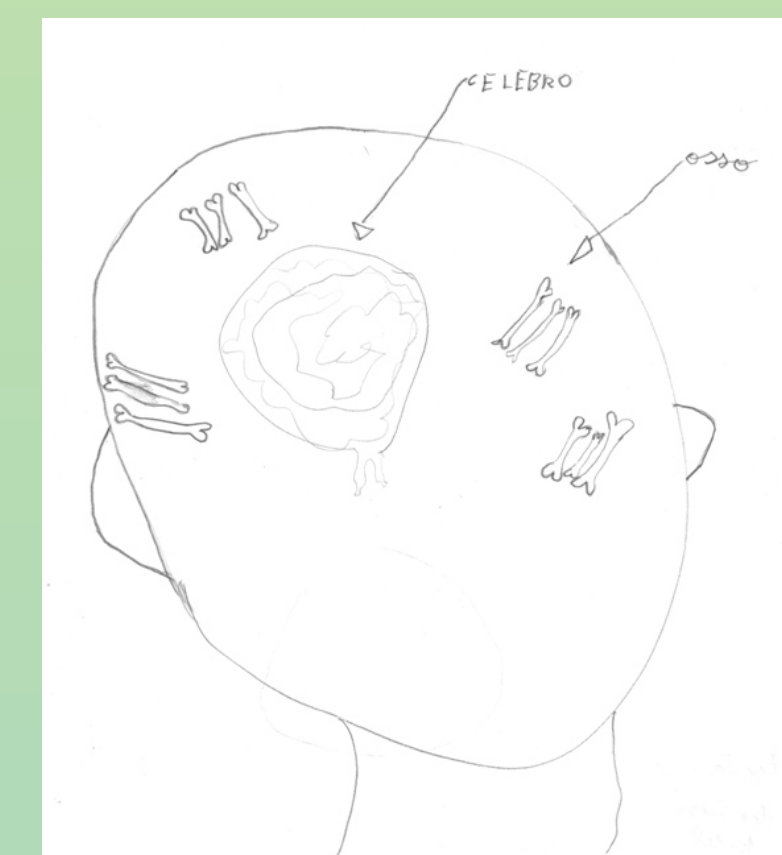


Figure 3. A drawing by a 6 years-old girl, kindergarten III, representing a dog bone model of the skull & brain.

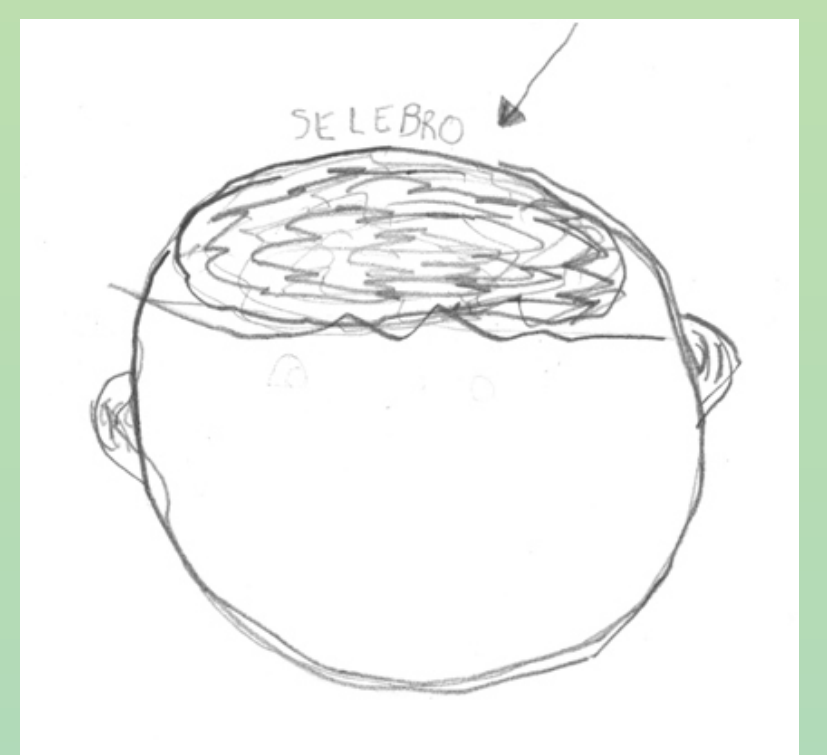


Figure 4. A drawing by a 6 years-old boy, kindergarten III, representing the brain in the shape of a calotte model.

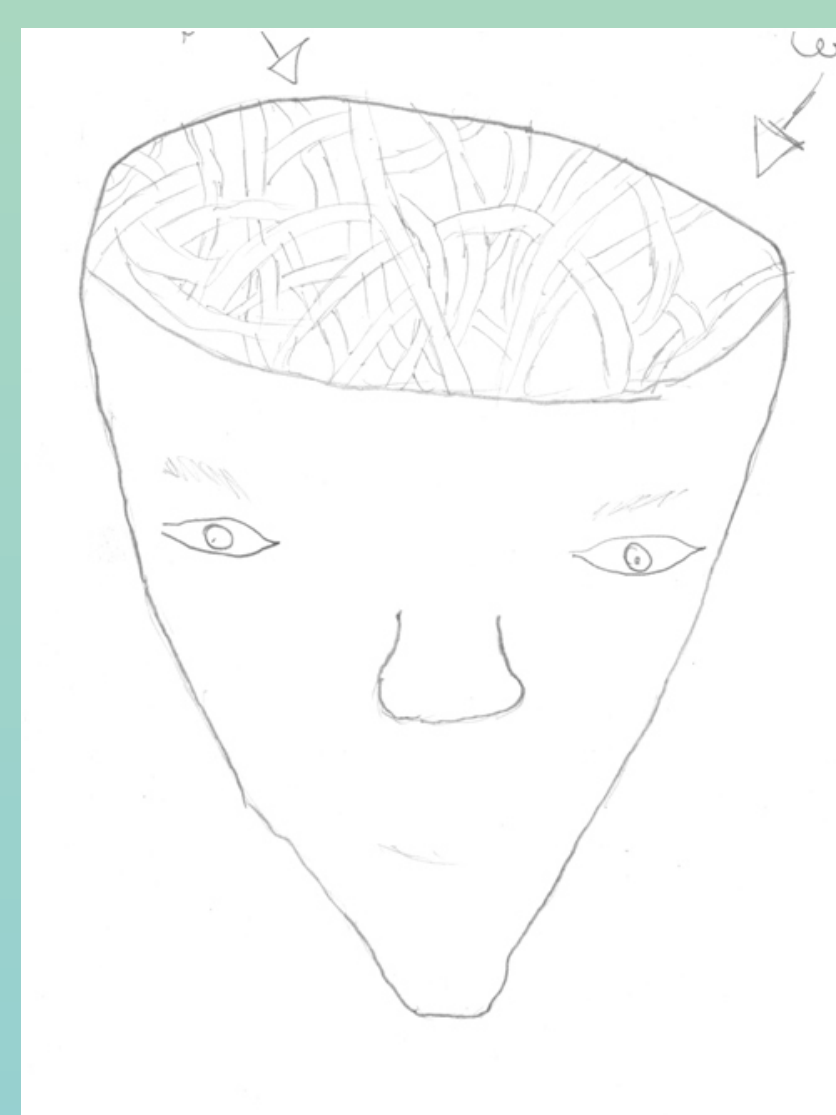


Figure 5. A drawing by a 10 years-old boy, 4th grade representing an enteric model of the brain.

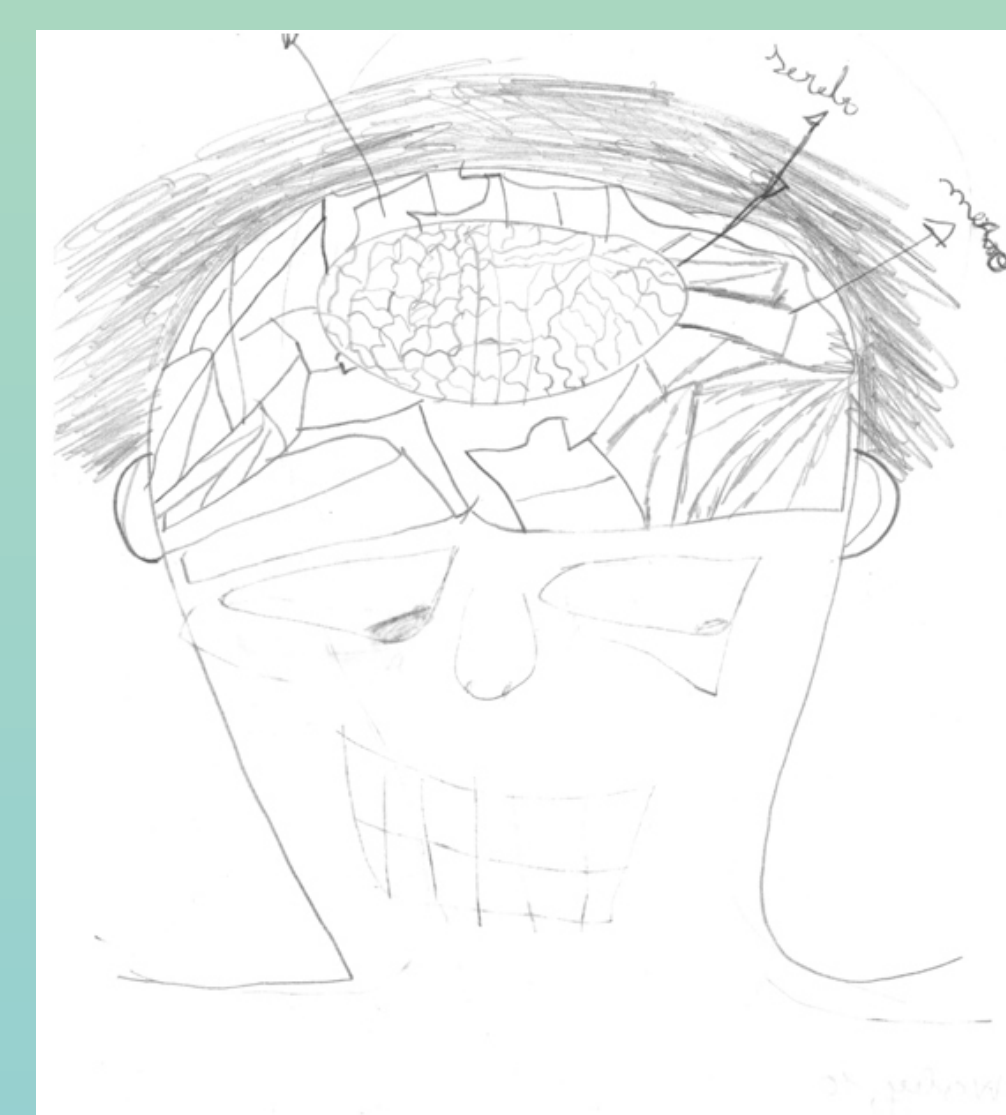


Figure 6. A drawing by a 10 years-old boy, 4th grade representing an epithelial model of the brain.



Figure 7. A drawing by a 10 years-old girl, 4th grade representing the brain hemispheres model and sensory organs (eyes).

Table 1. Distribution of the number of students by grade level.

Grade	n	Sex (M: masculine; F: feminine)
Nursery - (4 to 5 years old)	29	M=15 - F=14
Kindergarten III - (5 to 6 years old)	170	M=91 - F=79
Primary school:		
1 st grade - (7 years old)	154	M=68 - F=86
2 nd grade - (8 years old)	225	M=123 - F=102
3 rd grade - (9 years old)	268	M=146 - F=122
4 th grade - (10 years old)	305	M=155 - F=150
Total	1151	

Table 2. Classification of drawings according to models in percentage

Grade/ model	Mental image	Hydraulic model	Dogbone model	Enteric model	Epithelial model	Brain calotte model	Un - classified	Brain hemispheres	n
Nursery	10.0	-	50.0	-	-	-	40.0	0.0	29
Kindergarten III	1.7	17.6	11.0	4.1	0.58	10.5	54.1	0.0	170
1 st grade	2.6	15.6	2.6	4.5	3.2	20.1	51.2	0.0	154
2 nd grade	6.2	12.8	3.5	6.2	3.1	28.8	37.7	0.8	225
3 rd grade	2.2	6.7	0.0	6.7	6.3	50.3	24.6	2.9	268
4 th grade	2.2	6.7	0.0	6.7	6.3	50.3	24.6	2.9	268
4 th grade	4.2	4.5	0.6	9.1	2.2	52.7	18.3	7.8	305
Total									1151

References

- Clément, P., Mein M, T. (1987). Modèles cérébraux et comportementaux: approche historique et relations avec les modes d'apprentissage. Actes J.I.E.S., 9:151-168.
- Frändberg, B., Aldman, G., Hjorth, A. (2004). Children's understanding of the human body: a review. 5th ERIDOB.
- Giordan, A., de Vecchi, G. (1996). As origens do saber: das concepções dos aprendentes aos conceitos científicos. Porto Alegre, RS: Artes Médicas.
- Gottfried, G. M., Gelman, S., A., Schultz, J. (1999). Children's understanding of the brain: from early essentialism to biological theory. Cognitive Development, 14:147-174.
- Johnson, C., Wellman, H. (1982). Children's developing conceptions of the mind and brain. Child Development, 51(1):222-234.
- Palmberg, I. E., Kuru, J. (2001). Children and nature: conceptions, importance and personal meanings. Atee 26th Annual Conference, p.1-p.12.
- Pines, A. L., West, L. H. (1986). Conceptual understanding and science learning: An interpretation of research within a sources-of-knowledge framework. Science Education, 70(5):583-604.
- Reiss, M. J., Tunnicliffe, S. D. (2001). Student's understandings about organs and organ systems. Research in Science Education, 31:383-399.
- Reiss, M. J., Tunnicliffe, S. D., Bartoszeck, A. B. et al., (2002). An international study of young peoples' drawings of what is inside themselves. Journal of Biological Education, 36(2):58-64.
- Savy, C., Clément, P. (2002). Dessine ce qu'il a dans ta Tête: conceptions sur Le cerveau d'élèves de maternelle ET Du primaire. Actes J.I.E.S., 24:509-514.