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## The influence of age and gender

The research problem investigated is whether factors such as age and/or gender have an influence on children's conceptualisation of the structure of the Earth. This was investigated through the analysis and modified replication of the study of Vosniadou & Brewer (1992).

A mental model is an explanation of how someone understands their surrounding world. They are made and influenced by intuitive understanding and culturally accepted concepts. In children, it is their intuitive understanding through their everyday experiences which originally form their mental model of the Earth (Vosniadou & Brewer, 1992). From observing their surroundings on the Earth, such as the straight horizon, it appears as flat. Only when new information of scientifically accepted knowledge, ie that the Earth is spherical, is introduced and understood, do these mental models change. However, this change in their conceptualisation of the Earth's structure is often resistant in young children (Solomon, 2002), as it is contradictory to what they physically witness every day. Therefore, in order to modify their initial mental models, children must negotiate this inconsistent information. As more scientific information is accepted, children eventually form a mental model consistent with the scientific accepted knowledge that the Earth is a sphere.

This area of study is important to investigate to determine whether factors such as age and gender influence how children construct and modify their mental models. This has the potential to gain greater understanding of children's learning and therefore improve teaching methods. With more insight, teaching could become more efficient and specific for children to understand.

Vosniadou & Brewer (1992) study involved a detailed investigation of the conceptual change of children's mental models of the Earth's shape. They performed this through asking sixty children aged from 6-7, 9-10 and 10-11, forty-eight questions. These questions were categorised as either factual and generative. Factual questions are questions in which information which may have been given by adults, such as the Earth is round, can be repeated. In contrast, generative questions, such as "is there an edge to the Earth", did not allow children to recite given information but required them to use their mental representation of how they view the Earth to answer the question. From their answers, the children were scaled into categories of the level of their understanding of the Earth's structure. There were six different models of the Earth's shape (fig 1) identified, these ranged from the basic flat Earth to the culturally accepted sphere. From their results, they observed that older children were able to assimilate knowledge provided by adults with their intuitive understanding to produce mental models most similar to a spherical Earth.

The independent variable of age in Vosniadou & Brewer's (1992) study shows a positive correlation between cognitive development and age. The observation that children's increasing ability to receive and understand more complex information as they age is consistent in many other studies. In Siegler & Alibali's research (2005), it was shown that children's abstract thinking abilities improve with age. This acknowledgment of new information that may contradict their own ideas, encourages further cognitive development. This is outlined by Piaget (1953), who explained that children's increasing ability to restructure their knowledge occurs because of children's capacity as active learners. This investigation of age is an essential variable when

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observing development.

Another variable which is important to consider in the development of children's mental models is gender. The Vosniadou & Brewer (1992) study does not consider this potentially interfering variable. Therefore, an investigation of the association this factor may have on cognitive development is imperative. Some researchers have found that children show no difference in their intellectual abilities (Lajoie, 2004) and show similarity in solving rational problems at young ages (Stokes, 1990). In contrast, other studies indicate there is differences between sexes. In Bronfenbrenner's (1998) bioecological model, he proposes that both intrafamilial and extrafamilial systems act as key environmental factors in child development. That is, a child's environment shapes and influences how they develop and conceptualise their knowledge. Thus, as boys and girls are generally treated differently in these environments (Butler, 2011) (Blechner, 1995), which may result in their cognitive development differing between genders. However, while this may..... (this may explain the higher percentage of males in the workforce in areas involved in science in math due to the fact that their environment (society) expects/encourages them to succeed in these areas rather than "girly" writing/art/humanities) don't know how to say it

In this study there are three central aims designed to further develop the findings of the original Vosniadou & Brewer (1992) study. Firstly, to investigate the impact of age on the knowledge acquisition of the Earth's structure and whether maturity relates to an increased understanding that correlates with what is culturally acceptable. The second aim is to determine if gender is associated with the scientific understanding of the shape of the Earth. Finally, to examine if the mental models of younger children is different from those whom are older.

It is hypothesised that a) children who are older will have a more sophisticated understanding of the Earth's shape thus, their mental model will more closely resemble a sphere, b) there will be no differences between the genders of children of the complexity of their understanding the Earth's structure as....dont know how to explain why , c) older children will have different, more complex mental models to the younger children, as their increased maturity will allow them to accept more abstract ideas.