The extent to which infants create categories about the world from limited experi...

This essay will discuss ‘ the extent to which infants create categories about the world from limited experience’. Explicitly contrasting human development with the data-heavy processes of machine learning, it will draw on two themes: Representation in the early years and Communication in the early years and will explore how these relate to the issues raised in the 2015 Laura Schulz TED talk ‘ The surprisingly logical minds of babies’.

Schulz’s TED talk focuses on how babies learn so quickly from so little data. Schulz researches the topics of generalisation and causal reasoning through experiments with infants aged 15 months and, from laboratory studies, deduces that babies have a remarkable capacity for making sense of the world. These experiments show that babies are able to observe a phenomenon in context and, relying on very limited data, make choices and adapt their behavior. Babies form categories in order to make sense of the information with which they are presented. Schulz (2015) argues that infants are able to process data more quickly and effectively than computers and, stating that this is the work of the mind not the brain, maintains that this learning is species-specific. This research argues persuasively for the powerful capabilities of human infants to create categories and make sense of the world.

As humans, we gain an understanding of the world by making categories to group information. Madler (1997, cited in Gjersoe, 2018) proposes that children as young as 3-4 months form categories based on their perception, organising information to enable them to understand the world. They form perceptual categories (Gjersoe, 2018), based on an object’s external features. As they get older they start to form more complex conceptual

categories based on what the object is used for (Gjersoe, 2018). Top-down processing uses our cognitive ability to form these categories while in contrast bottom-up processing, as used in machine learning, requires access to extensive data (Gjersoe, 2018). As argued by Schulz (2015), it is the human mind's remarkable ability to use top-down processing to create categories and make predictions that enables children to make sense of the world from very little data.

The origins of the belief that infants have an innate set of capacities that motivate them to actively interact with the world creating representations or categories can be traced to the constructivist theory of developmental psychologist Jean Piaget (1896 – 1980) (Gjersoe, 2018). Although Piaget felt that infants had representational capabilities, he proposed that learning developed in chronological stages and therefore involved age-related limitations (Gjersoe, 2018). Taking an empirical stance, Piaget observed that, while young children can create categories, they are prone to error related to the level of their experience. Piaget concluded that a child's ability to form representations was a slow process of development through experience of repeated actions and was unachievable until aged 18 months (Gjersoe, 2018). Piaget's staged model of learning contrasts with Schulz's (2015) view that infants can make generalisations and form expectations about the world from " just a few examples".

Karmiloff-Smith (1992, cited in Gjersoe, 2018) proposes a model similar to Piaget's whereby children's learning and their development of categories is formed by their progression from implicit representations, which are learned from their physical interaction with the world, to explicit forms of

representations that can be modified with every new experience. However, unlike Piaget, Karmiloff-Smith does not believe children's development is a linear process and instead argues that infants go through a U-Shaped pattern of development, becoming worse at a task before getting better (Karmiloff-Smith, 1992, cited in Gjersoe, 2018). Karmiloff-Smith conducted an experiment where she asked children between 4 and 9 years of age to balance a series of different blocks on a narrow metal support. The 4 year olds and 8 year olds were able to pass the task, although it was concluded that they did so using different representational abilities. The 6 year olds however could not pass the task. Karmiloff-Smith surmised that this was because they had made a generalisation about balancing in relation to all objects and therefore continued to apply this theory; when they were unable to pass the task, they concluded that the theory was right but that they were doing something wrong. Karmiloff-Smith's' findings are mirrored by Schulz's later research establishing generalisations and causal reasoning processes in very young children.

It is however important to note a potential limitation of Schultz's experimental methods. Researchers such as Topál et al. (2008, cited in Gjersoe, 2018) suggest that, rather than making decisions based on the evidence provided, infants could instead be responding to social cues given by the experimenter. Topal et al (2008, cited in Gjersoe, 2018) developed three different versions of Paiget's A-not-B task, examining how infants failed to represent objects when they had gone out of sight. The same experiment was conducted three times: the first saw the experimenter interact with the infant (ostensive-communication), the second saw them sat in front of the

infant but turned at a 90 degree angle away from the infant (non-communicative) and the third showed the experiment being conducted where the experimenter was behind a cardboard sheet (non-social). The results showed that children made fewer errors within the non-communicative and non-social experiments, indicating that potentially children are responding to cues of the experimenter and therefore mis-interpreting the aim of the task or purposely making an error to please or oblige the experimenter.

Schulz's (2015) findings that infants learn much from so little very quickly imply that there is an inborn capacity in the minds of human babies, as if babies do not need to perform an action repeatedly in order to learn from it as Piaget suggests, we can then conclude that there is something inherent in their mental capacity to make categories about the world. Core knowledge theory argues that a baby's capacity to form mental representations is innate rather than empirical and has been tested via the work of Baillargeon through the habituation test (Baillargeon at al., 1985, cited in Gjersoe, 2018). Baillargeon believed that infants continue to look at something if they interested in it and their looking time is reduced if they become bored or habituated to it (Gjersoe, 2018). This idea was used in experiments to conclude what representations infants already have about the world. If an infant is surprised by an outcome (assessed through looking time) then this gives an indication that they already had an expectation about the result. In the drawbridge experiment, Baillargeon showed children both a possible event and an impossible event concerning a block stopping a drawbridge as it swung back and forth. In the possible event, the block stops the

drawbridge and in the impossible event the drawbridge falls against the table, appearing to travel through the solid block (Baillargeon et al., 1985, cited in Gjersoe, 2018). Infants looked longer at the impossible event, suggesting that they had an expectation of what should happen and were surprised when this expectation was violated. Researchers inferred that by 5 months infants could not only assume the action of the block when it was out of sight but also form a representation of what effect and impact the block should have on the drawbridge. These findings challenge Piaget's belief that babies are unable to make these sorts of representations or categories until 18 months old and instead support Schulz's research findings in babies of 15 months.

Spelke (Spelke et al., (1992) cited in Gjersoe, 2018) also maintain that infants have core knowledge present from birth and that this knowledge shapes their expectations of how objects and events should behave and unfold. Believing infants have three innate expectations about how an object will behave when out of sight, one of which is solidity – knowing that objects cannot pass through other solid objects. Spelke tested infants as young as 10 weeks old, demonstrating that they looked longer at an impossible event of a ball passing through an obstacle than they did at the possible event. These findings add further weight to the argument that the infants had an expectation that this event would not happen and were surprised when it did. Core knowledge theory therefore supports the proposal that infants begin to create categories about the world from as early as 10 weeks old and even proposes that these skills are innate, adding a new dimension to Schulz's theory that young infants deduce so much from very limited

experience. A point to consider however is that, while there is evidence to suggest that very young infants are able to form categories and representations about the world from limited experience and appear to be able to start to generalise and form casual relationships and to understand what happens to objects when they go out of sight, as assessed through looking time experiments, it is questionable how accurate they can be at such a young age.

Research into communication in the early years offers a wealth of additional evidence to support Schulz's argument for the remarkable capacities of human babies and the belief in innate capacities of core learning theorists. Infants begin to develop communication by organising sensory information and Tomasello (2018) outlines the ways infants communicate before they can use language through crying, pointing and gesturing. Infants use these forms of communication in order to make sense of the world around them. They begin to form categories and create patterns by building schemas through interactions with parents and caregivers (Ibbotson, 2018) and Harris, (2004, cited in Ibbotson, 2018) writes that comprehension of words begins around 7 to 8 months old, before infants are able to speak. A study by Mehler et al. (Mehler et al., 1988, cited in Ibbotson, 2018) concludes that babies have a preference for their native language. In an experiment with 4-day old babies, Mehler presented French infants with two recordings of one story, one in French and one in Russian. From an assessment of the babies' sucking rate as an indicator of their arousal level, the researchers concluded that they had a preference for the French language. When the recordings were played to babies whose mothers spoke another language other than

French or Russian, the babies showed no preference between the two languages, contrasting with the appeal of the familiar language. Babies appear to recognise their native language from the pitch, rhythm and stress of the sounds, known as prosody (Ibbotson, 2018). Research shows that babies show sensitivity to sounds even when they in the womb at around 15 weeks old. It appears then that babies even before birth are forming categories of sounds in order start their communication development (Ibbotson, 2018).

Ibbotson (2012) discusses infants' abilities to categorise from a young age, implying that part of language development depends on a set of cognitive skills including categorisation, with children sorting through lots of data (seven-and-a-half million utterances) and starting forming abstract structures through questioning. Unlike Schulz, Ibbotson appears to imply that children use bbottom up processing to develop their language by shifting through even " find-grained lexical differences" to form categories and construct grammar (Ibbotson, 2012, p. 125). However, Ibbotson appears to share Schulz's view that this capacity is unique to the human mind and is species-specific as well as relying on social skills such a shared intention (Ibbotson, 2012).

When communicating, to understand each other correctly we need to have some knowledge of what the other intends to draw our attention to; we do this by using common ground (Ibbotson, 2018). Infants demonstrate their use of common ground, by inviting the parent into communication with them through pointing. Pointing is meaningless when stripped of context but when a baby points at an object that they and the parent have just played with

there is already a common ground or shared experience and the infant will have developed an expectation that you know what they are implying. As with Schulz's laboratory infants, with limited experience of an episode of play, the child will nevertheless have categorised that this object is for play and will have formed an expectation or generalisation that the parent will want to play with it again (Ibbotson, 2018).

In conclusion, Schulz's claim that children learn so much from limited experience is supported. The extent in which they do this is uncertain however, as infants inevitably make errors in their learning and results in testing can be influenced by relational and social factors. However, there is little doubt that the mind of a human baby has a remarkable capacity for learning and that this is exclusive to humans, superior to animals and machine learning. This capability appears to develop not just from a young age but even before birth they are using early communication and representational skills to form categories in order to make the world.

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