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The Role of Executive Functions and Working Memory in the Early Development of Drawing and Language

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Abstract--- Many studies have looked at how language and drawing evolved, but the connection between these two symbolic representation systems is less studied and more contentious. Although working memory and executive functions appear to be engaged in drawing and language learning, their role in the relationship between drawing and language remains a mystery. Future study could employ these models to specify the developmental links between language and drawing, working memory and executive processes, as this article analyses the relevant material. Different theoretical perspectives on executive function development and the connections between drawing development and language, executive function, and working memory are systematically embodied in a set models. An explicit model of the causal links between these components of cognitive development will be beneficial in the future research.

Keywords--- Young children, Drawing, Language, Symbolic representation, Working memory, Executive functions, and Development.

I. Introduction

What is the relationship between early sketching and language development? How does the general development of the cognitive system influence the development of language and art?Many studies have looked at how different ways of representing things, like drawing and language, came to be, but less has been said about how they relate to each other. Several studies have also suggested that Working Memory (WM) and Executive Functions (EF) are important for the early development of both drawing and language. But it is still not clear if there is a shared cognitive structure between language development and drawing development.

This article looks at some of the research that has been done on how the development of drawing, language, and their cognitive bases are related. In the last section, we talk about a few different frame models that researchers can use to figure out how these different parts of early cognitive development are related.

II. Drawing and Language

The first few years of a child's life are filled with symbolic representations. Language and drawing are two of the first ways that children learn to represent things. The early development of language [1–6] and drawing [7–10] has been studied for a long time, but their relationship has gotten less attention.

When we compare the development of graphic symbolism to the development of language, we can say that representational drawing comes later, around the age of three [11–13], while the first words appear around the age of one [14]. In particular, Callaghan [11] suggested that children understand what pictures mean before they can make them. Adamson [14] said that children can understand language by the time they are 9 to 10 months old, but they don't start making language until the first half of their second year.

Piaget [5] said that children can use language symbolically when they use words to talk about things that aren't there, replacing information in one modality (i.e. sounds) with information in another modality (e.g., a visually seen or tactually felt object). But babies can make sounds that sound like words very early on in their first year. Graphic production, on the other hand, needs coordination between the eyes and hands and a finely tuned pincer grip to use the tools of drawing. Both of these skills aren't fully developed until the second year of life [15], so children can't draw pictures that look like real things until then.

It would be good to think about the parts of the brain that are important for language and drawing development. But this part should only be thought about very carefully. First, the brain of a young child is very malleable as it grows. The process of modularization, which includes the modular structure of language, is far from being finished [16–18], and the way the brain is divided into left and right sides changes as the child grows and as processes become more automatic [19]. Second, it is hard to use brain imaging techniques to study drawing tasks right now because drawing causes large movement artefacts. Because of this, not much is known about the parts of the brain that are involved in drawing development. On the other hand, there is more evidence about language. Friederici, for example, said that in ERP studies, 14-month-olds already show a stronger N400 response to words that don't go with a picture, and at 19 months, this effect also shows up for phonotextually legal nonwords. However, this semantic N400 effect seems to be more frontal in young children than in adults [20]. Walton et al. found that phonological

awareness was linked to diffusion parameters in bilateral ventral white matter pathways and the corpus callosum in children ages 3 to 5. From this, they came to the conclusion that the relationships found in the left hemisphere show that structural markers of language processing that are found in older children and adults are already present in 3-year-olds. On the other hand, the relationships found in the right hemisphere do not match up with common adult relationships. They suggest that a child's network for processing language is bigger than an adult's and gets more specialised as the child grows [21]. Rosselli et al. [22] looked at the research on how the brain affects language development and came to the conclusion that when doing language tasks, the brain is activated in a different way in young children than in adults. "Evidence suggests that language is distributed differently from birth, but lateralization of language in the left hemisphere changes with experience, and greater lateralization of language in the left hemisphere seems to be an indicator of maturity." (p.16).

There is one neuropsychological study about how children draw that could be related to these studies about how language develops. Stiles et al. found that children with congenital focal injuries to the right hemisphere can make simple drawings of a house by the age of 5 or 6, but they rely heavily on stereotyped graphic formulae and find it hard to change the structure of their drawings when asked [23]. This suggests that the left hemisphere could handle schematic formulas to graphically represent object categories, like houses. However, a good right hemisphere would be needed to be able to change these simple graphic schemes and add details that make sense in the context. Given that at least some language in the brains of preschoolers is already lateralized to the left side, we could say that language representations could help with the formation of early, simple graphic schemes but not with changing those schemes to make representations that go beyond categorical information.

Aside from the fact that drawing comes after language in terms of time, we must also look at the cognitive aspects of the relationship between the two ways of representing things. There are four main lines of thought in the literature: (1) Drawing and language are both ways of communicating meaning that come from the same domain-general symbolic resource. (2) Drawing and language are two separate systems that develop separately. (3) Drawing is a form of language. (4) Language has an effect on drawing.

The first position is mostly based on Piaget's point of view [5, 24], which saw drawing and language, along with mental imagery and symbolic play, as two forms of a more general symbolic function. He said that in the first stage of development (the sensory-motor period, which lasts until a child is about 1 1/2 years old), babies can't think of an object that isn't there, and there isn't much of a difference between a sign and what it means. Symbolic function is something that kids learn between the ages of 2 and 7. From this point of view, drawing and language are two ways of communicating meaning that come from the same source: the general symbolic resource that starts at age two.

The second position, on the other hand, is based on Paivio's [25] dual-coding theory, which says that visual and verbal information are processed separately and through different channels. This means that the human mind has different ways of representing information processed through each channel. From a different point of view, Chomsky's [3] argument that language development is based on a particular Language Acquisition Device is consistent with the idea of separate development, because the specific and innate mechanisms of language development would be very different from the mechanisms used to develop visual imagery and motor skills.

The third way of thinking is that drawing is a form of communication [26–28]. Willats [26] said that children first use their picture primitives (dots, lines, and areas) to represent objects globally. They then use these primitives to build meaningful basic schemes, and finally, they arrange these schemes in space using syntactic rules of adjacency, projection, and occlusion. It seems that, just as children learn to speak by playing with phonemes and only later make words and sentences, they also learn to draw by scribbling, which lays the groundwork for drawing [8, 13], and only later do they combine drawing elements to make more complex drawings. Cohn [26, 27] talks about the "visual lexical items" of drawing from this point of view. In particular, he said that drawings are built on a "lexicon" of schematic patterns that are stored in the long-term memory of each person. There are different levels of complexity to these patterns, from simple "graphemes" like dots and lines to parts of meaningful drawings (like the patterns used to draw an eye or a hand) to schematic full drawings (like a typical way to draw a car or a house) to patterns that show how an entire scene is put together. He also said that simple graphemes have nothing to do with meaning, but that more complicated schemata often have meaning because they are related to ideas or spatial structures.

Lastly, and this is the fourth point above, some studies have shown that language can affect how people draw. In particular, Callaghan [29] found that young children (ages 212 to 3 years old) use language to help them understand how to use pictorial symbols. This means that having verbal labels can help children do better on graphic symbol tasks. Toomela [30] said that the development of language can be seen as a bridge between the development of drawing and the development of language. One reason could be that toddlers already have a symbolic part of their language, but they don't have a symbolic part of their drawing until around age three. This symbolic part of their language could affect their transition from scribbling to drawing things that look like them. Adi-Japha et al. [31]

found that being bilingual makes it easier for preschoolers to draw in different ways. This also suggests that language has an effect on drawing.

Overall, at least three out of four ways of thinking point to a link between drawing and language development in young children.

III. Conclusion

The first few years of a child's life are very important for the development of representational systems, like drawing and language, as well as EF [58] and WM [66]. However, there are no studies that look at how all of these things might be related in young children. In this paper, we summed up the different ideas about these relationships that have been put forward in the literature and put them into nine different, testable models. These models look at the connections between basic cognitive processes (WM, inhibition, shifting, and updating), drawing, and language. We think that the relationships between these parts may change during the first few years of life. This is because language can play a big role in the change from non-representational to representational drawing, and WM and EF could be a cognitive foundation for both drawing and language, which could explain at least some of their common variation.

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