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CRITIQUE OF MANDLER'S THEORY OF PERCEPTUAL ANALYSIS

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Recently, cognitive development has become a topic of mass popularity within the world of academia. Among the various developmental benchmarks, one topic that has eluded many is concept formation. Possibly the oldest and most famous theory regarding concept formation originates from psychology – Piaget's theory of sensorimotor development. In recent years, Jean Mandler has proposed an alternative explanation to this phenomenon. Unlike Piaget, Mandler has clearly outlined the steps that transform perceptual information into concepts. After extensive reading, I was convinced that she postulated a more probable and convincing theory. After closer inspection, however, I have located a major shortcoming in Mandler's explanation – her theory does not seem to account for blind infants (Keil, 2008; Zlatev, 2007). Due to the plethora of people worldwide who suffer from visual impairment, there must be an explanation for concept formation that includes this sample of individuals as well. Since Mandler's theory does not account for the blind population, the basis of her perspective is substantially weakened. In this paper, I intend to critique Mandler's theory of perceptual analysis by exploring its main tenet: the importance of visual perception for cognitive development (Mandler, 1992; Zlatev, 2007). By providing examples of other ways in which these two are intertwined, it can be concluded that Mandler has the right idea. If vision truly affects cognition, however, does this mean that a lack of vision interrupts proper cognitive development? If so, how do blind individuals form concepts? In this paper, I plan to address these questions. Before I begin, I will first review the key components of Mandler's theory of perceptual analysis.

In her various articles, Mandler has suggested that perceptual analysis is the mechanism through which concepts are first formed (Mandler, 1992; Evans, 2010). According to Mandler, infants attend closely to a perceptual array presented to them by their senses. In doing so, a new kind of information is abstracted. Now the once perceptual information has been recoded into a non-perceptual form that represents meaning. This conceptual primitive is called an image schema, in which "spatial structure is mapped into conceptual structure." (Mandler, 1992, p. 591). These conceptual primitives later form the foundation of the human conceptual system. The basis of this entire process begins at the process of perceptual analysis. According to Mandler, infants are able to engage in perceptual analysis from the time of birth; thus, it is an innate ability. However, in order to carry out this process, the infant must receive spatial information from his senses. She argues that the spatial information most crucial to concept formation comes from the visual system (Zlatev, 2007). Mandler was certainly not the first to assume that cognitive development is dependent on visual input (Hupp, 2003). In order to consider Mandler's theory credible, it must be shown that the two are, in fact, intertwined.

Support for the idea that vision affects cognitive development comes from many sources. For instance, Sternberg argued that cognitive mechanisms are sight-dependent (Hupp, 2003). Going back to the time of Descartes, he believed that, "although vision is influenced by one's cognitions, a coding of the physical properties of an image must mechanically move through the optic nerve and thusly represent a picture to the nervous system" (Hupp, 2003, p. 7). For example, thoughts may be able to influence the perception of an apple, but one must first see the apple for a mental picture to exist before any kind of cognitive work can take place. The idea that vision precedes thought was further supported by Pylyshyn in later years (Hupp, 2003). He reported that visual perception may lead to changes in the way in which we mentally represent the observed world.

Further evidentiary findings have demonstrated the interrelatedness of vision and cognition. For example, by modulating cortical cells located in the posterior parietal cortex of the brain, Pylyshyn was able to illustrate the function of an "extra-visual effect" (Hupp, 2003). Signals in both the visual and motor cortexes jointly activate these cortical cells. Activation in the motor cortex does not necessarily suggest movement; as in this case, simply thinking about a plan of action can also stimulate this area. Thus, the cortical cells studied were activated by both vision and thought. This study provides convincing evidence that the systems work together. Other researchers, namely Milner and Goodale, termed this phenomenon: "vision for action" (Hupp, 2003). This concept of "vision for action" was further illustrated by Kosslyn (Hupp, 2003). By using both positron emission tomography (PET) and functional magnetic resonance imaging (fMRI), he showed that cognitive activity was coupled with general activation in the visual system.

Even further evidence can be seen from individuals who suffer from some degree of neural trauma, rendering them unable to perform normal cognitive functioning. For example, in the case of visual agnosia, the individual is able to perceive an object (as there is nothing wrong with his retinal cells) but cannot identify it (Hupp, 2003). Wiring has been severed between neural areas of perception and those of recognition.

This type of visual agnosia, anomia, is clearly demonstrable by PET, MRI, and neuropsychological testing that implicates a disconnection of sensory impulses and cognitive evaluations between Wernicke's area in the temporal lobe and the visual cortex, located in the occipital lobe (Hupp, 2003, p. 8).

Given these findings, scholars of cognitive science have come to accept the relationship between vision and cognition (Hupp, 2003). As an active member in the field, Mandler was correct to believe that visual perception and cognitive development are linked. Considering the studies just explored, her theory of perceptual analysis – visual perception leads to conceptual primitives – seems plausible. However, concept formation for blind individuals in the context of perceptual analysis has yet to be addressed. If visual input is necessary for conceptual output, then individuals without vision would not be able to form complete concepts. If Mandler's theory is accurate, the blind should display delayed cognitive development.

Cognitive theorists have proposed that blind individuals "may have developed different cognitive pathways to acquire, process, and accommodate sensory information" (Hupp, 2003, p. i). In other words, the blind may "think differently" in comparison to sighted individuals. According to Siegler's rule-assessment approach to cognitive development, any kind of obstacle presented to the encoding of novel stimuli may hinder the developmental process (Hupp, 2003). The loss of vision can be included as an example of a sensory impairment that ultimately interferes with the encoding process. Thus, in line with this approach, blind individuals should have mental capabilities far different from those with normal vision. However, current studies regarding the mental capacities of the blind and sighted do not, in fact, support this conclusion (Hupp, 2003).

Before the studies below are explored, it is important to first consider the problem with using a "blind-versus-sighted comparison" (Orlansky, 1988). According to Warren, we must not assume that any set of common measures applied to a group of blind individuals and a group of sighted individuals will result in truly equal measurements (Orlansky, 1988). Since there is no test that is completely equal for both groups, the available data must be considered with the understanding that there may be a slight margin of error.

In 1968, Tillman and Bashaw conducted a study in which both blind and sighted children completed the Wechsler Intelligence Scale for Children (WISC), which generates an IQ score representative of the child's general intellectual ability (Begum, 2003). Tillman and Bashaw were interested in the verbal IQ in regard to subtest scores. Their findings showed equal mean verbal IQ between the two groups of children, but different patterns of high and low scores on the subtests (Begum, 2003). Thus, intellectual ability between the two groups is somewhat comparable, with differences in specific areas of strength and weakness.

In 1989, Ittyerah and Samarapungavan compared the performance ability of three groups of children – (1) congenitally blind, (2) sighted children who were blindfolded, and (3) sighted children with no blindfold (Begum, 2003). They all completed the same set of tasks that have been commonly used to indicate level of development. "Results indicated that cognitive development in the blind is not identical to that in sighted groups. Moreover, the differences in performance between groups are content or task-specific and do not take the form of a global deficit across all developmental tasks" (Begum, 2003, p. 60). In a way, these findings mirror those found in Tillman and Bashaw's study. In the previous study, differences in overall IQ mean were negligible. In this study, Ittyerah and Samarapungavan found no overwhelming disparity in global intellectual ability. In both, however, there were variations in performance on particular subtests and specific tasks. This can be explained by the fact that blind children and those with normal vision "think differently"; thus, certain areas of performance will prove to be stronger, while others remain weaker.

Just four years earlier, in 1985, Singh conducted a study that found the same results as the previous two. Unlike the other studies, however, the participants were adults. They completed a revised version of the Wechsler Adult Intelligence Scale (WAIS), called the WAIS-R (Begum, 2003). Their overall scores, as well as their performance on specific verbal subtests, were compared. Results show that scores "did not differ significantly" between those who were visually impaired and those with normal vision (Begum, 2003).

Tobin and Gottesman considered the literature available on this subject (Begum, 2003). As indicated by the three studies discussed earlier, differences in cognitive fimctioning between blind individuals and sighted individuals are minimal and trivial. "There can be little doubt that developmentally, and in every other way, such [blind] children have more things in common with their sighted peers than things that separate them" (Begum, 2003, p. 56).

This conclusion poses a challenge to the consistency of Mandler's theory. Blind individuals are certainly able to form concepts, as suggested by their comparable levels of cognitive functioning; moreover, they are able to do so without visual perception. Thus, it appears that Mandler's focus on visual perception, in the context of perceptual analysis, falls short. So how do blind individuals form concepts? Results from a number of studies suggest that other sensory systems may become highly sensitive for blind individuals. With additional information from the other senses, their bodies may somewhat counterbalance the lack of vision (Hupp, 2003; Orlansky, 1988).

The child's remaining senses – primarily hearing and touch – may develop into useful avenues of sensory input but can never fully compensate for the loss of vision, nor can they usually provide information that is as exact, complete, spontaneous, and continuous as that normally gained by children who are constantly able to see their environment (Orlansky, 1988, p. 98).

According to Marzi, blind individuals often behave differently to sensory input than sighted individuals (Hupp, 2003). A beautiful example of this was illustrated by Morgan:

Morgan then described how a sample of blind individuals was able to form a three-dimensional cognitive map based on auditory information. These individuals used this cognitive map to assist them in moving about, or orienting, to the physical world. Morgan concluded that blind individuals would often compensate for their lack of vision with over-developed abilities in other sensory functions (Hupp, 2003, p. 9).

As this example shows, blind individuals were easily able to attain spatial information from auditory stimuli alone. This clearly goes against Mandler's preference for visual perception as the preceding element in concept formation.

In addition to auditory information, blind individuals seem to also rely on tactile stimuli. In fact, many researchers have used touch to measure intelligence in the blind (Hupp, 2003). Worchel conducted a study that attempted to assess the perception of tactile form in blind individuals (Begum, 2003). There were three measures: reproduction, verbal description, and recognition. The findings indicate that sighted individuals were better at reproduction and verbal report, but the blind do just as well in the recognition of tactile form (Begum, 2003). These conclusions mirror the findings discussed earlier. Blind individuals and sighted individuals tend to differ in performance on subtests; this, in turn, indicated that the blind have certain strengths and weaknesses. Perhaps these data apply to the tactile stimuli as well. Thus, blind individuals perform better on tactile recognition, and worse on reproduction and verbal description. Regardless, the idea that blind individuals are able to gain spatial knowledge through their other senses directly opposes Mandler's theory.

Let us, for a minute, accept the idea that spatial knowledge can be acquired by the other senses. Using the premise of Mandler's theory, this information must then be recoded into a non-perceptual form that represents meaning. If blind individuals are receiving spatial information from other sensory inputs and are able to form concepts, it must hold that their concepts are formed from image schemas based on non-visual perceptual information. This reasoning would only work given that we follow the process in Mandler's explanation of concept formation. At this point, however, a rather large shortcoming in her theory has been exposed. Thus, it does not make sense to apply her notion of image schemas. If we were to modify her theory of perceptual analysis to include all sensory systems, however, then we can keep the roots of her perspective.

As I mentioned at the beginning of this paper, Mandler's theory is highly appealing since it offers an explanation for the relationship between spatial information and conceptual formation. Since Mandler first proposed her theory of perceptual analysis, she has dramatically impacted the way in which other members in the field of cognitive science view infant cognition (Keil, 2008). I applaud Mandler's efforts, but the fact that her reasoning does not seem to account for blind individuals cannot be overlooked. A credible theory would include all kinds of people, especially a subpopulation that is constantly growing. Currently, there are over ten million people in the United States alone who suffer from "significant impairment of vision which cannot be further improved by corrective lenses" (Hupp, 2003, p. 1). If Mandler's theory is deemed accurate, how would cognitive development, including concept formation, be explained for these people?

I believe the information from this paper questions the validity of Mandler's current theory. By showing that cognitive development in blind individuals is comparable to that of sighted individuals, we can disregard the main tenet in Mandler's theory of perceptual analysis: visual perception leads to concept formation. Without this basis, the entire theory crumbles.

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