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It's More than a Touch: Early Tactual Development in Infants and Toddlers

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It is well known that the sense of touch is intimately connected to an individual's sense of self (Metzoff, Saby, & Marshall, 2018) and early attachment to caretakers. Infants who do not receive human touch early in their development are impacted with both immediate and long term consequences (Als, Tronick, & Brazelton, 1980; Ardiel & Rankin, 2010). As children mature, the link between cognitive understanding and tactile perception becomes more relevant during the early childhood of young children with visual impairment, as this population is busy discovering the cognitive interpretation of objects and drawings through tactual discrimination, tactile-spatial perception, part-whole relationships, and an understanding of the second and third dimension.

The sense of touch is unique in that it depends on physical contact and is spread throughout the body (Hatwell, 2003; McLinden & McCall, 2002). Touch can be receptive or "cutaneous," as when individuals feel a blanket underneath on the bed or react to the squeeze of a handshake or a hug. It can also be active and exploratory or “haptic” in nature; as when children reach to explore a texture, a toy, or manipulate an item to discover how it works. Traditionally, developmental assessments have posited that a lack of vision can have a detrimental effect on haptic development (Ochiatia & Huertes, 1993; Reynell, 1978), but more recent studies have questioned this assumption. McLinden (2012) found in a current literature review that:

> While the precise role of vision in early haptic development has not yet been fully ascertained, there is evidence that its function is not as a substitute for haptic perception, but rather serves as a guide or “mediator” of haptic perceptual activities (p. 132).

Other past research indicates that young children with visual impairment display similar characteristics in the development of tactual discrimination as infants with sight (D’Anguilli, Kennedy, & Heller, 1998; Schellingerhout, Smitsman, & van Galen, 1997). Studies in tactual discrimination that used cerebral functional imagery indicate that the haptic learning system develops along similar pathways as the visual system (Gentaz & Badan, 2003; Sera & Millett, 2011), and a recent magnetic resonance imaging (MRI) study confirms that early onset blindness leads to changes in brain functioning that supports compensatory development in tactile processing (Bauer et al., 2017).

The cutaneous system develops first in utero, and early in infancy the more active “haptic” skills are acquired. Through the use of habituation research adapted for haptic procedures, studies show that very young babies can determine contour (Streri, 2003) and can discriminate texture before shape (Schellingerhout et al., 1997). Streri (2003) found that "infants adjust or adapt their activities to object properties in order to extract the most pertinent information” (p. 59). Recent neural imaging research by Metzoff et al. (2018) has demonstrated that even 60-day-old infants respond consistently to tactual stimulation with the lip, hand and foot. This study is relevant to the field of visual impairment as infants at this age are not independently reaching, ambulating or speaking, and are not visually aware of their lips.

Research in the area of movement based haptic exploration of the young child with visual impairment is limited, but Schellingerhout, Smitsman, and Cox (2005) show that (a) both hands move together in synchrony; (b) the hands show a preference for textures that are increasingly dense; and (c) once a complex texture is found, movement patterns are slowed for further exploration.

As infants move from using their mouths to their hands in effective exploration, the work of Lederman and Klatsky (2009) “has demonstrated a link between hand movement profiles and the perception of specific object properties, grouping these into distinctive exploratory procedures (EPs)" (McLinden, 2012, p. 130). These patterns of hand movements to obtain specific information are related to the motor development and age of the child. As the exploratory needs of the infant and toddler change, EPs are rejected and accomplished (Bushnell & Boudreau, 1991). Exploratory procedure research is well established with young children with sight, but there are also multiple studies applying the use of EPs in young children with visual impairment (McLinden & McCall, 2002; McLinden, 2012; Schellingerhout et al., 1997).

Older babies prefer shape characteristics over textures because they are beginning to experiment with manual EPs. The variability of exploratory behavior is not confined to object properties, but also applies to the opportunities presented by the environment. Sera and Millett (2011) proposed that in studies of very young children, the participants attended more closely to the stimuli, and that as they age, the children used previous assimilated information to make choices and were more likely to make mistakes.

Through haptic research it is known that using mental synthesis with touch as an exploratory procedure (Lederman & Klatsky, 2009) can increase working memory load (Sebastian, Mayas, Manso, & Ballesteros, 2008). In addition, Pring (1994) explained “in the encoding strategy for braille, tactual input tends to be successive while with print visual encoding may take place almost simultaneously” (p. 68). This is true for all haptic learning; acquiring information requires touching each item or letter individually, building up a successive process of understanding and memorizing new items in short-term memory, then in long-term memory (Hughes, 2011). Discovering and retaining knowledge about body awareness, real objects, object relationships, and representational symbols takes significantly longer for a haptic learner (Hatwell, 2003).

The previous studies, although diverse, build a research base that the field of visual impairment can use to determine if improving haptic development skills are linked to academic and literacy skills. Improved MRI allows for studies that confirm neuroplastic changes in the brain functioning of individuals with early onset blindness that supports compensatory development in tactile processing (Bauer et al., 2017). Haptic skills develop as children learn about their world and are exposed to increasingly complex textures. For example, very young infants may only be able to explore textures with their mouths or through passive interactions with their hands. As they grow older and their motor skills improve, educators should expect the child to use his or her hands in a variety of ways (holding, poking, squeezing) and to be able to categorize objects in new ways.

In contrast, by focusing on the belief that concept and tactual understanding is innate, some cognitive development researchers (Carey, 2009; Streri, 2003) support the theory of evolutional acquisition, or nativism. Gibson and Walker (1984) challenged the maturational process by arguing that tactual discrimination of objects does not happen because of the environment or the individual but occurs due to the interaction of both. Information is not out there in the environment waiting to be found. Instead, it is a learning process that emerges as a child actively engages with her surroundings. A nativist learning theory assumes that sensory and conceptual representations are present at birth, and that as the child experiences mental representations though object manipulations and language exposure they develop an understanding (Carey, 2009). Very young infants of three to five months have been shown to differentiate between textures and contours through active mouthing and limited hand explorations (Gibson & Walker, 1984; Schellingerhout et al., 2005). As neuro-imaging improves, the nativist theory of learning is supported by more recent studies that argue the brain does not acquire sensory information in a cross-modal manner or using one sense to make up for another, but that an integrated sensory organization is present before birth (Lickliter, 2011). A tactually diverse environment for learning results in increased adaptations and interactions by the young child guided first by perceptual experiences and improving to executive exploratory procedures (Lederman & Klatsky, 2009).

Just as young children with sight visually (a) discriminate shape, sizes, and length for early mathematic literacy, (b) recognize salient features of letters, and (c) demonstrate knowledge of early literacy book skills and direction following, young children with visual impairment learn about their world in a tactual experiential manner though independent movement. These early academic skills contribute to the attainment of crucial childhood outcomes and preschool standards that guide the early childhood core curriculum (Karoly, 2012; Scott-Little, Kagan, & Frelow, 2003).

Current research supports an integrated method of teaching and active exploration of the early childhood environment. All children, regardless of their visual diagnosis, benefit from focused tactual development activities to provide them with a sense of self and others, mature hand movements, and age appropriate cognitive understanding. Challenging what we have always done to address the needs of children who require instruction to address a more integrated sensory system in the early years will help us to understand the need for increased tactual development activities.

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