

Does Motor Development Influence Language Development?

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The emergence of language in infants is one of the biggest achievements in their first two years of life. At the present, there is a great deal of information available regarding the precursors that influence the onset of language in both typically and atypically developing children. It is commonly acknowledged that achievements in cognitive development during these stages of life widely influence the emerging language system. However, one of the other precursors that require additional attention is motor development. The implications that this system has on future language development is something that needs further consideration in the study of both typically and atypically developing populations with deficits in these areas.

At the present time, the field of psychology has paid little attention to the study of motor development. As Rosenbaum (2005) states, some of the possible reasons that were previously thought to contribute to this neglect were: (1) no famous psychologists had studied motor control, (2) cognitive psychologists were mainly interested in exclusively human functions, and (3) motor control was simply too hard to study. However, Rosenbaum (2005) goes on to discredit these previous assumptions and explains some more viable options for this neglect: (1) cognitive psychologists are more interested in epistemology than in action, (2) psychologists have disfavored motor control because overt responses seem to be the only admissible ways of measurement in behaviorism, and (3) psychologists believe that neuroscience is highly influencing the field when it comes to motor-control research.

Due to this unfortunate neglect, there is currently inadequate coverage of motor development in both psychological journals and textbooks. This insufficient coverage leaves both professionals and students in the field with much to wonder about the actual processes of motor control and its relationship to other developmental systems. Therefore, the current aim

should be to point out that motor-control joins two of the most prominent branches of psychology: behavioral and cognitive. Acting and knowing are inseparable aspects of human life and only recently have psychologists begun to realize that there is more purpose to movement. This system of development is currently being given more recognition as an initiator of perception-action cycles rather than just a response to input.

Movement Helps Infants Experience Their World

The central claim that links motor development to language development is the idea that advanced motor skills provide infants with more opportunities for experiencing their world (Iverson, 2010). Changes in posture, locomotion, and object-manipulation allow the child to sit-up, move about their surroundings, and experience items previously seen in their environment in a new manner. With these new advances, children begin to develop and refine basic skills that are related (both directly and indirectly) to the development of communication and language. These findings demonstrate the necessity of increased exploration in the field of motor development and its link with language development.

Posture

Iverson (2010) states that before infants are able to sit up without assistance, their rib cage is restricted. But once they are able to sit on their own, their rib cage is then freed. This gives the infants the ability to breathe more efficiently and maintain subglottal pressure (a skill necessary in speech production). With practice, infants are eventually able to generate longer utterances in one breath. In addition, sitting changes the position of spine which then influences the vocal track curvature. As a result, the tongue falls into a more forward position in the mouth. Due to these changes the infant is better able to produce consonant-vowel segments.

Locomotion

Another claim regarding the onset of language asserts that parents can provide additional assistance toward language growth. In an article by Iverson (2010) the author states that when infants begin walking this ability allows them to bring objects of interest to an adult. They can then display this object to the adult in order to share interest and attention to that object. It has been found that infants are more likely to learn words for something if they are able to focus their attention on the object at hand. Once the child's attention is given to the object, the caregiver then provides input. This input can include verbal responses that emphasize the nature of the object (e.g. "Yes Johnny, that's a cup!"). This, in turn, increases the likelihood of the child associating the object with the spoken word. Thus, these transitions to walking provide additional experiences to enhance language learning.

Object-Manipulation

Needham, Barrett, & Peterman (2002) found that infants' early contact with objects in their environment allows for increased enrichment. In this study, children were given "sticky mittens" and allowed to engage in play sessions. These mittens had palms that would stick to the edges of toys, allowing children to more easily pick up objects in the room. After the play sessions, children were given assessments in which researchers compared their object explorations skills with those of children who had not used the sticky mittens. The results showed that infants who had used the sticky mittens were able to pick up and explore more objects, which facilitated their toy engagement. This suggests that early experiences, which provide children with increased opportunities for exploration, encourage their ability to reach for objects. These increased acts of object-engagement can promote increased stimulation and jump-start the processes behind their cognitive development. Early experiences such as this form of

object-manipulation are highly influential in early childhood and have a substantial effect on language development later in life.

Predictors of Language

Oral-Motor Predictors

In a study by Gernsbacher, Sauer, Geye, Schweigert, & Goldsmith (2008), researchers were interested in finding what specific oral-motor movements were able to predict later speech fluency in autistic¹ children. The researchers first found that producing animal sounds at 18 months was significantly correlated with blowing raspberries at 6 months, sticking out ones tongue at 24 months, puffing out ones cheeks at 24 months, and blowing bubbles with a straw at 24 months. These oral-motor skills allow children to practice similar movements of the mouth that are required for speech production. The researchers found that children who were able to produce these movements had better speech fluency in later years. In addition, these particular oral-motor markers helped to distinguish autistic children from typically developing children better than other traditional milestone markers (e.g. crawling, responding to name).

In a study by Alcock (2006), the research more specifically assessed the idea that oral-motor skills are a predictor of later speech and language development. Three separate groups were assessed for their level oral-motor control: adults with acquired aphasia, individuals with developmental dysphasia, and typically developing children. In individuals with speech difficulties (e.g. aphasia, dysphasia), oral-motor control was impaired and complex oral-motor movements were difficult for these individuals to produce. However, differences were also noticeable in individuals without specific speech impairments (e.g. typically developing children). In these individuals, it was found that oral-motor skills predicted their level of language abilities; individuals with more complex oral-motor skills had a superior command of

¹ The authors respectfully use the term “autistic” rather than “person with autism”

language compared to the individuals with less complex oral-motor skills. The author concluded that oral-motor skills may be a necessary component of gaining adequate language skills and can even facilitate the individual's ability to communicate at a more advanced level.

Manual-Motor Predictors

In the study by Gernsbacher et al. (2008), the researchers also looked at manual-motor movements as predictors for later speech fluency in autistic children compared to typically developing children. They found that pointing distally to an object at 18 months was significantly correlated with grabbing dangling toys at 6 months, clapping at 12 months, stacking blocks at 12 months, indicating wants by pointing at 18 months, playing with connecting blocks at 24 months, assembling puzzles at 24 months, and turning doorknobs at 24 months. These manual-motor skills allow children to have new experiences in their environments, which aids in the child's language learning. These manual-motor skills, similar to the oral-motor predictors, also helped to distinguish autistic children from typically developing children better than other traditional milestone markers.

A study by Iverson & Fagan (2004) more specifically assessed this idea that manual-motor skills were a predictor of later speech and language. In this study the investigators videotaped 6- to 9-month-old infants as they were engaging in a rattle and toy play session with their caregivers. From these recorded sessions, the researchers found that rhythmic manual movements (e.g. rattle shaking) coordinated with vocalization for children who were babblers and was twice as high as that of pre-babblers. These results suggest that the repetitive movements of rattle shaking correspond similarly to the repetitive vocalization of babbling. However, the researchers also found that the majority of the consonant-vowel repetitions that the babbling children produced were performed in conjunction with the rhythmic movements.

Therefore, the greater rates of rattle shaking seem to facilitate the infants' ability to produce repetitive consonant-vowel sounds due to the equally repetitive nature of both skills.

Cross-Cultural Language Development

Iverson, Caprici, Volterra, & Goldin-Meadow (2008) conducted a research study of the gestural cues in found in Italian children compared to those found in American children. The researchers found that there were differences in the amounts of gestures that were produced by American children and Italian children and that these differences were inversely related to the size of the children's spoken language. American children produced fewer gestures, but had larger vocabularies, while Italian children produced more gestures, but had smaller vocabularies. It was found that the ability to produce gestures while speaking predicted the onset of two-word combinations (e.g. "want cup") especially for American children.

However, it was found that the children used two different types of gestural cues: representational and deictic gestural expressions. Deictic gestures were produced by pointing, showing, and ritualized reaches. The representational gestures differ from deictic in that they depend less on context for their interpretation. One type of representational gesture is iconic, these gestures include, actions that correspond to their meaning (e.g. holding hand to ear for TELEPHONE, moving body rhythmically without music for DANCING). The other form of representational gesture is called conventional, which includes actions that are arbitrarily related to their meanings (e.g. shaking head for NO, turning and raising the palms up for ALL-GONE). It was found that Italian children typically used more representational gestures where as American children used more deictic gestures. The use of these gestures proved extremely important in helping facilitate the children's communication (especially for the Italian children). Since Italian children typically had smaller vocabularies, when they spoke they were able to fill

in the missing words with representational gestures in order to complete their thoughts and provide an understandable message to their audience.

Another important finding of this study was that Italian children seemed to produce greater amounts of representational gestures than American children, yet these gestures were much less likely to overlap with their spoken vocabularies (and vice-versa). When researchers included representational gestures with spoken words, Italian children produced as much language as American children. Therefore, representational gestures contribute greatly to Italian children's language system; it provides them a way to express meaning that they are not able convey in words. As a result, this study emphasizes the importance of cross-cultural research regarding early gesture-speech combinations and gives insight as to what defines language as a whole. It is not necessarily just verbal communication, but it also includes gestural language as a means for expression. Taking this finding into consideration shows how much importance motor-control has on one's ability to develop language in order to communicate with others.

Directions for Future Research

As demonstrated in this review, there are many different factors of motor development that seem to contribute to the development of language. However, none of the present factors have shown extremely conclusive results. Therefore, the extent of the effect that these motor skills have on the development of language is still relatively unknown and requires further investigation. Considering this need for further research, the authors have outlined some specific areas of interest for additional examination. These areas were chosen due to much interest involving these topics and the authors' beliefs (in accordance with the views of other professionals in the field) that these are prominent areas that need to be addressed.

Progression of Motor Development

Research has found that motor skills are essential in allowing infants to experience the world around them. Past research has emphasized that these experiences result from a progression of an infant's development which goes from posture, to locomotion, to object-manipulation. However, this process of development is not extremely precise in its sequence of events. For example, object-manipulation is technically something that is able to happen once an infant is able to hold an object. It is not necessarily an event that exclusively occurs once the child is able to move independently. Therefore, it is possible (and highly probable) that object-manipulation can precede locomotion.

Future research should seek to incorporate a more accurate portrayal of motor development and its progression in infants. Current theorists and experts in movement analysis have defined this sequence of motor development in more detailed ways. They have described this progress of motor development through six distinct patterns of bodily connectivities: breath, core-distal, head-tail, upper-lower, body-half, and cross-lateral motor movements (Hackney, 2002). Using these patterns of body movements, movement analysts are able to describe more accurately the processes that occur in infants as they explore their movement capabilities.

By future research focusing on more distinct phases of motor development more conclusive results and specific mechanisms may be discovered as to how motor development directly influences language development. Research will also be able to draw more distinct conclusions as to where deficiencies in motor skill first begin to occur in infants and how those affect language learning. Once deficiencies are discovered at particular stages of development, research can then begin to describe ways in which those individuals can be helped at those specific stages in order to optimize both the individual's motor skills and language skills.

Posture and Language Production

One specific area of interest to examine within the developmental progression of motor skills would be posture (specifically the head-tail spinal connectivity). Previous research has found that posture greatly affects the infant's ability to sit up without assistance. These upright positions help influence proper curvature of the spine, which allows the tongue to fall into a more forward position in the mouth and facilitates the child's ability to produce the sounds that are required for speech. In assessing the importance of posture on speech patterns, the current authors believe it would be beneficial to examine children who exhibit physical impairments of the spine (e.g. cerebral palsy). Looking at these types of individuals, research could better understand how these physical limitations (specifically in the spinal region) influence their speech patterns. Once researchers are able to identify and describe the mechanisms that are responsible for faulty postures additional research could be conducted to find ways to promote more adequate spinal alignment. By helping individuals to enhance their posture, this will in turn allow these individuals to have more control over their speech production.

Posture and Language Comprehension

However, language is not solely dependent on speech production; comprehension is also an important factor to assess. In looking at the progression of language development, it seems as though comprehension is dependent on production and so production must occur first. For example, many children begin to produce sounds, and sometimes whole words, without fully recognizing the meaning behind what they're saying. Therefore, production can be seen as an important precursor to language comprehension. In terms of specifically studying the effects that motor development has on this aspect of language development, further research should first investigate how a lack of proper posture affects language production and if this correlates with poor language comprehension later in life.

Concluding Thoughts

There are many ways in which one could go in terms of the research information presented. However, the authors of this current review feel that the points presented will allow for more comprehensive investigation of these other areas. Once the development of motor skills is fully understood along with the effects it has on language development, researchers can begin to implement ways in which practitioners can also help these individuals. Preventative medicine is an increasingly common field within the health care system, and early assessment of individuals with motor and speech delays can help to identify concerns early in life. If these issues are determined in the beginning stages of one's life, it will allow these individuals more options to receive treatment, thereby making it easier for them to move about their world and communicate with others.

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