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Commentary

Commentary: Encouraging Children's Optimum Development in an Environment of Technological Change

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Physicians, educators, and parents all have a common interest in promoting the healthy development of children and adolescents. Recently individuals in each of these groups have expressed concerns that, in the present environment of rapid technological change, the increasing presence of technologically-enhanced devices in infant, toddler, and preschool children's lives, may be affecting not only children's play, social, cognitive, and physical development but their brain development as well. Both physicians and educators have long expressed concerns about how the rapid changes in children's technological environment may affect a wide range of areas related to their developmental progress [1-3]. Discussion of the close ties of children's play development to other areas of their development also has been extensive [4,5].

Recently, physicians and educators have expressed concerns about how reductions in children's time for traditional types of play experiences (i. e., the "play deficit") may be affecting their development in many areas, including their brain development [6,7]. It seems reasonable to hold a hypothesis that, if the experiences of very young children are being changed by these technological changes, then their brain development may also differ in the future. That is, some of the early life experiences that have "made us human" may be lost. Of course, some types of brain development changes may make humans better at meeting the challenges of a diverse technologically-intense world, but they also may result in the loss of some common human experiences (e.g., child directed play) that have had a role in expanding the creative, social, intellectual, and even moral development of the human species!

There are many parallels between brain development and play development [8,9] and this concurrent development may be a vital part of the early years of life. For example, infant brain synaptogenesis occurs initially primarily in visual and sensorimotor areas and early infant play involves practice of sensorimotor systems—observing patterns, exploring objects, repeating sounds and motions. As the frontal lobe develops in the infant years, early pretend play begins to be evident. During the 3-5 age period, when frontal lobe development has rapid expansion of synaptic connections, this early pretense becomes elaborated into complex sociodramatic play and playing games with rules increases. From age 5-8, when the frontal lobe is at its most dense and pruning become more extensive, games with rules become elaborated and complex types of pretense (although often private settings) are common, including "small worlds" play [10].

Many theorists have stressed how important the earliest human experiences are for young children's optimum development and noted how children's play is a vital part of their experiences. Two early influential theorists were Jean Piaget [11] and Lev Vygotsky [12]. Piaget identified the developmental stages of play (sensorimotor, pretense, games) and minutely described how the early sensorimotor experiences of infants were related to their cognitive understanding of the world. He also explored later stages of thought that are enhanced by children's playful interactions with the objects and people in their environment. Vygotsky discussed how early play involves making and manipulation symbols and explained how play and thought is co-constructed with others and becomes the basis upon which symbolic systems such as literacy rest. Other authors [13] have discussed the importance of the infant, toddler, and early childhood years for neuronal growth, including the generation of synapses and formation of important neuronal connections. Thus, the experiences that children have during those early age periods greatly influence their brain development as well as other areas of development throughout life.

Unfortunately, the increasing presence of technological devices in the lives of very young children may be preventing or at least diminishing children's opportunities to engage in the traditional types of early play experiences that have enabled humans to develop important basic human qualities. Many examples of the increasing infant and child use of these new technologically-enhanced "playthings" are evident, such as parents giving the baby a phone to look at while diaper changing and quieting crying children by giving them images on phones or other electronic pads. Adults also

give such devices to very young children to gaze at during restaurant visits or long waits at doctors' offices, exchange adult-child social interactions on long airplane trips for iPad-provided movies, and place infants and young children in front of a TV or computer screen to quiet restlessness.

For busy parents, the idea of substituting such devices for more time-consuming interpersonal interactions is very tempting, especially since they work so well at distracting young children and they involve much less parenting effort. However, the loss of adult playful human interactions with young children is especially troubling given the research on how humans are made, especially since we now know how important such interactions are for early brain development. Also, time spent on these devices by preschoolers is time not spent in outdoor play and child-child social play.

Theorist and researcher, Jerome Bruner [14], asserted that technological revolutions of the past have been instrumental in enhancing brain development because they enabled humans to learn to thrive in more complex environments and make elaborative models of their world experiences. He described three types of technology advances: ones that amplified motor capabilities (e.g., wheels), ones that amplified sensory capabilities (e.g., radios), and ones that amplified ratiocinative capabilities (e.g., language). Each of these types of technology supported human development of greater cognitive ability to "represent the world." These modes of representation begin early in human life, first with "enactive representation," which involves young children's use of motor responses, which encode knowledge in the body as the child engages in actions on the environment. For example, infant play with toys and engaging in "peek a boo" with parents encode knowledge of both the physical and social world. Bruner asserted that enactive representation is the basic type of cognition, upon which the other two types of cognition - "iconic" knowledge (pictures, models, images) and "symbolic" knowledge (language, mathematical symbols) are built. These types of representation also develop during the early childhood years but, at least in Bruner's view, they are based on the child's earlier enactive knowledge gained from "real world" physical and social experiences. A major question at the present time is whether these newer technological advances are supporting the development of all three of these types of knowledge or whether they are focused primarily on iconic and symbolic representation, diminishing the development of essential enactive representations. The loss of enactive representation may be an unintended consequence of the pervasive use of these later technologies by young children and thus may have long term unintended socio-cognitive consequences.

A contemporary researcher in the field of early human development, Michael Tomasello [15], also has stressed the importance of the first years of life as the time when many essential human qualities are constructed from young children's experiences interacting with other humans. Through child interactions with parents, siblings, and other people, "shared intentionality" is developed. Tomasello states that this ability to understand shared intentions is a uniquely human characteristic that follows three developmental steps. Children of about nine months learn "joint intentionality" in interaction with caregiving adults and, during the second and third years of life, they gain "cognitive intentionality" as well as sociocultural knowledge through child interactions with adults and peers. By age six or seven, because of these many joint human intentionality experiences they have experienced, children can demonstrate self-regulation and conform to beliefs and actions related to social and cultural norms that have been transmitted through these human interactions. At the present time it is not known whether these essential socio-cognitive abilities must be based on "in-person" shared human intentionality experiences but, based on their research studies conducted during this transformational period of life, Tomasello and colleagues have concluded that these early social interactions are crucial for "making us human." Thus, the loss or even diminishment of such interactions may have dire long-term socio-cultural consequences.

At the present time it is unknown what the full effects of recent technological change will have on human development, but those physicians, educators, and parents who are expressing alarm about the loss of active play time, diminishment of adult-child playful interactions, and the substitution of child-technological device interactions for child-human interactions may be predicting an important long-term problem. Until longitudinal research effects on the substitution of technology-enhanced interactive devices for human social interaction in the early years are fully known, young children's lives should continue to be filled with playful social and cognitive interactions involving real world objects and real people and their time spent in interaction with technology-enhanced devices should be limited.

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