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## Joint engagement in infants and its relationship to their visual impairment measurements

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### ARTICLE INFO

Sadly, our beloved colleague and co-author Valerie Morash passed away in January 2017. She contributed greatly in the statistical analyses in this project and reviewed the manuscript for submission. However, she passed away during the submission of this paper. She was therefore not involved in the correction process.

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### ABSTRACT

Coordination of attention between a social partner and an external focus of shared interest, called joint engagement, is associated with positive developmental outcomes such as better language, socio-emotional, and theory of mind skills in sighted infants. Current measures of joint engagement rely on an infant's visual behaviors, making it difficult to study joint engagement in infants with low or no vision. In a naturalistic observational study, 20 infants with various levels of visual impairments – mean ages: 1.08 years ( $N = 9$ ) and 1.62 years ( $N = 18$ ), were videotaped during 30-min free play sessions with their caregivers. Seven infants were tested at both ages. Videos were coded to determine the percentage of time the dyads participated in joint engagement. Results showed that all visually impaired infants participated in joint engagement, with a significant increase between earlier and later ages. Infants' visual impairment levels were described in terms of visual acuity and contrast sensitivity as measured using both visual evoked potential and preferential looking techniques. Of the visual measurements, infants' reduction in contrast sensitivity measured with preferential looking, alone, predicted the infants' percentage of time in joint engagement across ages. Contrary to prior research that exclusively focused on visual acuity, this finding supports the need to include contrast sensitivity measurements in studies with visually impaired infants.

### 1. Introduction

Around the end of the first year of life, sighted infants start to participate in joint engagement (JE), that is, in interactions where they coordinate their attention between a social partner and an external focus (object/event in the environment) that is of interest to both the child and his/her social partner (Bakeman & Adamson, 1984). It is well documented that JE relates to positive developmental outcomes in sighted children such as better language, socio-emotional, and theory of mind skills (Carpenter et al., 1998; Carpenter, Nagell, & Tomasello, 1998). It is important to characterize JE development in all infants so that disturbances are recognized promptly. While JE development has been addressed by numerous studies with sighted infants, only a few studies have addressed this question with visually impaired (VI). The few studies that exist include either very few subjects or second-hand reports, which limits their validity. Research with this population is particularly necessary since VI infants can have difficulties in early interactions such as engaging in contingent and mutually responsive exchanges with caregivers, and engaging with objects, that in sighted infants are deemed germane to JE development (Bigelow, 2003). The current study addresses this research need by reporting 20 VI infants' time expended in JE (using both visual and non-visual senses), and the predictive role of an infant's contrast

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sensitivity for participation in JE.

### 1.1. JE in sighted infants

Developmentally, infants first participate in “supported” joint engagement (SJE). SJE depends on the social partner attracting the attention of infants to his/her actions with objects. Although the child is aware of the caregiver’s action with respect to the object, the child’s attention remains primarily on the object. Later in development, infants participate in “coordinated” joint engagement (CJE). In CJE, infants themselves can initiate the sharing of attention and overtly acknowledge the social partner’s participation in their common engagement (Adamson, Bakeman, Deckner & Nelson, 2012; Bakeman & Adamson, 1984, 1986). In research with sighted infants, indexing of such acknowledgement has heavily relied on the child’s gazing back and forth between social partner and object (Carpenter et al., 1998). This same behavior is utilized to index the concept of “joint attention”. Despite this common index, authors vary in their claims as to what this milestone implies for children’s social cognition. For some joint attention authors (Carpenter et al., 1998), it implies that the child has an initial understanding of others as intentional agents in the sense of having goals and mental representations that inform their actions. For coordinated joint engagement authors, it implies that the child voluntarily and repetitively notices the social partner’s role in their attention to a common focus without claiming the child understands others as intentional agents (Bakeman & Adamson, 1984). By the last half of the second year, symbols are being incorporated within JE (“symbol-infused”), allowing for communication regarding absent or imaginary references (Adamson et al., 2004; Adamson, Bakeman, & Deckner, 2004). Evidence shows a relationship between JE and healthy development. Sighted infants’ participation in CJE and symbol-infused SJE correlates positively to their receptive and expressive language at later ages (Adamson et al., 2004; Mundy et al., 2007). They show more “functional play” (using objects in conventional ways) during CJE and more stereotypical play outside of it (Bigelow, 2004). Participation in CJE and symbol-infused JE correlates positively with sighted infants’ performance at preschool age in theory of mind tests (Charman et al., 2000; Nelson, Adamson, & Bakeman, 2008). Participation in CJE in infancy positively correlates to emotional regulation skills at both concurrent and later ages (Morales, Mundy, Crowson, Neal, & Delgado, 2005; Vaughan Van Hecke et al., 2012).

### 1.2. Risk factors in VI infants

Prior to JE, sighted infants participate in contingent and mutually responsive exchanges with caregivers (Adamson and Mc Arthur, 1995). VI infants are at risk of engaging less in such interactions because several behaviors reported in these infants, when interpreted by caregivers as lack of interest, decrease positive social exchanges (Warren, 1984). These behaviors include: responding to social interaction with decreased/absent eye contact, gaze or smiling (Lueck et al., 2008; Lueck, Chen, Kekelis, & Hartman, 2008); averting gaze and turning head/body away from caregivers; and initiating play interactions with their mothers less often than sighted peers (Cass, 1998; Kekelis & Anderson, 1984; Rogers, 1988; Rogers and Puchalski, 1984). However, it is unclear whether this perceived lack of interest in social interactions is a result of an observer’s biases regarding what indexes an infant’s interest. VI infants demonstrate interest in objects or people by active tactile exploration (Fraiberg, 1977); react to mother’s approach by increasing motor activity (Preisler, 1990); and initiate communication with caregivers as frequently as sighted peers (Pérez-Pereira & Conti-Ramsden, 2005). Prior to JE, sighted infants also experience how their behaviors impact their social partners by seeing how others react to their own facial expressions. Since VI infants have reduced or no access to such visual cues, if their social partners do not use other cues, these infants will have fewer opportunities to perceive their actions as having an effect on others (Bigelow, 2003). However, there is evidence that caregivers can learn to interpret and sensibly respond to VI infants’ signals through non-visual means (Als, Tronick, & Brazelton, 1981; Loots, Devisé, & Sermijn, 2003).

JE requires participants to recognize when others attend to an external focus. VI infants risk engaging less with objects; reaching for objects in sighted peers is observed by 4–6 months of age, whereas reaching upon hearing objects’ sound cues emerges later—10–12 months—in both sighted and visually impaired children (Warren, 1984). A connection between VI infants’ advancements in object permanence and JE was reported in two congenitally blind infants. These infants’ CJE and object permanence were assessed longitudinally. CJE was observed only after infants had started reaching for objects on sound cues (Bigelow, 2003). VI infants can also have less experiences encountering objects in the environment because they may achieve independent locomotion at later ages than sighted peers (Brambring, 2006). When VI infants attend to external foci, caregivers can have difficulties identifying infants’ attentional cues and/or responding in ways within infants’ perceptual capabilities (Bigelow, 2003; Preisler, 1990).

There is evidence that VI infants develop JE more slowly than sighted peers. Social games between VI infants and their caregivers over-rely on repetitive vocal games, to the detriment of games involving objects (Dale & Salt, 2007). In a study of 10 VI children, 1-year-old blind infants had difficulties sharing attention on objects, and even very low vision positively impacted this ability (Preisler, 1990). A study of two congenitally blind infants reported emergence of CJE at later ages than in sighted peers (18 and 23 months versus 12 months, Bigelow, 2003). One-to-three-year-old children who have only light perception or worse visual condition had significantly lower CJE skills scores than sighted peers (Dale, Tadić, & Sonksen, 2013). Compared to sighted peers, VI preschool children scored significantly lower in their ability to establish and maintain CJE (Tadić, Pring, & Dale, 2009).

Two other lines of research indicate the risk of JE development in VI infants. First, atypical JE is part of the developmental regression/stasis reported in a sub-group of blind/severely visually impaired infants (Cass, Sonksen, & McConachie, 1994; Dale, 2005; Dale and Sonksen, 2002). Second, atypical JE in VI infants, compared to their sighted peers’ developmental patterns, is considered by some authors “autistic-like”, and used by clinicians to diagnose autism (Hobson, 2005; Naber et al., 2007; for a contrasting perspective see Pérez-Pereira and Conti-Ramsden, 2005). Normative development of JE in VI infants has not been fully characterized,

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