Spatial-Temporal Processing and Social Cognition:
Contributions to Language Development in Children with Autism

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Language is a fundamental human ability that is impaired in approximately 75% of children diagnosed with an Autism Spectrum Disorder (ASD; Tager-Flusberg & Cooper, 1999). Most interventions for ASD children focus on teaching nouns, despite mounting evidence suggesting that acquiring a cadre of verbs is necessary for developing grammatical speech (Fernald, Perfors, & Marchman, 2006). Learning most verbs and prepositions is harder than learning most nouns even for typically developing children because the referents of such words are temporally dynamic, perceptually variable, and name the spatial relations *between* objects rather than the objects themselves (Gentner & Boroditsky, 2001). Although learning relational words like verbs inherently requires children to process space/time relationships, the role of spatial and temporal processing in the language development of ASD children has hitherto not been explored.

A growing body of research suggests that to learn a verb or relational term, children must accomplish two tasks. First, they must discriminate and categorize semantic components (Talmy, 1985) within the flow of everyday events, which requires them to process space/time relationships. Second, children must combine these semantic components in language-specific ways and map a word onto their newly formed relational concepts (Gentner, 1982). Researchers have explored two key supports for helping children map verbs and relational terms onto referents in the world: social cues (Tomasello & Merriman, 1995) and linguistic cues (Fisher & Song, 2006). In typical children, social and linguistic cue understanding appear in synchrony but are recruited and weighted differently across developmental time (Hollich, Hirsh-Pasek, & Golinkoff, 2000), which confounds any attempt to identify the separate contributions of each to word learning. However, the wide variability seen in ASD children in the areas of spatial/temporal processing (Dakin & Frith, 2005), social skills (Baron-Cohen, 1995), and linguistic skills (Tager-Flusberg, 2006) may enable us to clarify the individual contributions of these cues to learning verbs and relational words.

Why do ASD children have particular difficulty learning verbs and other relational terms? In collaboration with Robert Schultz, PhD and Sarah Paterson, PhD at the Center for Autism Research at the Children's Hospital of Philadelphia and the University of Pennsylvania, we will administer a series of four tasks and standardized language tests to typically developing children and ASD children with the goal of answering **three questions**: *First,* do ASD children have difficulty learning verbs and relational terms because they lack the necessary conceptual underpinnings? Task 1 addresses this question by examining the discrimination and categorization of two well-researched event components: path and manner. *Second,* do ASD children have trouble with verbs due to difficulty understanding the social intentions and goal-directedness of others? Tasks 2 and 3 represent a multi-method approach investigating children's social intent and its relation to vocabulary outcomes. Task 2 examines infants' intentional understanding through imitation and the completion of failed intentions. Task 3 explores how children use temporal cues to detect social intent. Although Tasks 2 and 3 both draw upon children's ability to detect social cues, Task 3 also incorporates a strong temporal component. *Third,* how do children's face processing skills interact with these other skills to impact verb and

relational word learning? Task 4 examines face processing, which loads on both spatial-temporal and social cues. Our research calls for an analytic strategy that will deconstruct the various tasks to establish how spatial/temporal and social features contribute independently and jointly to language outcomes.

This series of four studies will investigate how spatial ability and temporal processing interact with social cognition to predict verb and relational word learning in TD and ASD children. We hypothesize that aspects of spatial-temporal processing and social cognition contribute individually and jointly to the process of learning relational words like verbs, and expect that these studies will produce valuable data regarding the necessary and sufficient conditions for acquiring these types of words. Importantly, our multi-pronged investigation into the underpinnings of verb development will allow us to create individual profiles of spatial-temporal and social skills in ASD children, which can then be used to aid in diagnosis and to inform strategic language intervention.

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