Chapter 13
The Visual World Paradigm in Children with Spoken Language Disorders

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ABSTRACT

Eye movements have become a commonly used response measure in studies of spoken language processing. These studies are included in the so-called 'visual world paradigm' in which participants' eye movements are monitored during scene viewing in language comprehension and production activities. In this chapter the most important aspects for running eye-tracking studies in children are revised. Developmental studies using eye movements have increased in the last ten years from babies to adolescents. However, there are only a handful of papers based on the 'visual world paradigm' that analyze the spoken language in children with language disorders. These studies using eye movements have explored spoken word recognition; verb argument and thematic relations; and narrative comprehension and production. Results has proven eye tracker to be an effective tool for understanding language representation and processing in children with language disorders.

INTRODUCTION

Eye movements have been one of the most widely used response measures in psycholinguistic studies of reading for more than a century (see Henderson & Ferreira, 2004; Rayner, 1998). In contrast, it is only within the last two decades that eye movements have become a commonly used response measure in studies of spoken language processing (Tanenhaus, 2007). These studies are included in the so-called 'visual world paradigm' (Cooper, 1974; Tanenhaus, Spivey-Knowlton, Eberhard & Sedivy, 1995). In these studies, participants' eye movements are monitored during scene viewing in language comprehension and production activities. When people are simultaneously presented with spoken language and

a visual field containing elements semantically related to the informative items of speech, they tend to spontaneously direct their line of sight to those elements that are most closely related to the meaning of the language currently heard (e.g. fixating on a lion upon hearing part or all of the word 'lion'). On the other hand, in language production, when speakers describe actions or events based on a visual image, they focus their visual attention on each element before producing specific language about it (e.g. fixating on a zebra upon say the sentence 'The zebra runs away' while watching a scene of the African savannah).

BACKGROUND

Eye Tracking in Spoken Language Processing

In 'visual world paradigm' studies, participants' eye movements are monitored to understand the detailed incremental nature of language processing. With the advent of head-mounted and remote eye-tracking systems, it is relatively easy to obtain a moment-by-moment record of where participants are looking as they understand or produce spoken language (Trueswell, 2008). Research using eye movements in this manner is now quite extensive (see the edited volumes by Henderson & Ferreira, 2004; Trueswell & Tanenhaus, 2005; plus reviews by Tanenhaus & Trueswell, 2006; Trueswell & Gleitman, 2007; and references therein). This paradigm has been applied to the study of several issues of language comprehension processing as word recognition and prosody (e.g. Allopena, Magnuson, Tanenhaus, 1998; Dahan, Maguson & Tanenhaus, 2001; among others); lexical and syntactic ambiguity resolution (e.g. Dahan & Tanenhaus, 2004, Spivey, Tanenhaus, Eberhard, & Sedivy, 2002; Trueswell, Sekerina, Hill & Logrip, 1999); circumscribing referential domains (e.g. Altman & Kamide, 1999; Arnold, Eisenband, Brown-Schmidt, & Trueswell, 2000; Kamide, Altmann & Haywood, 2003; Kukona, Altmann & Kamide, 2014; Trenkic Mirkovic & Altmann, 2013; among others); word order variation, discourse, and information structure (e.g. Kaiser & Trueswell, 2004); pronouns and other referring expressions (e.g. Arnold et al., 2000; Järvikivi et al. 2005; Brown-Schmidt et al., 2005; Runner, Sussman, & Tanenhaus, 2003; Runner et al., 2006) and common ground, alignment and dialogue (e.g. Branigan et al., 2000; Brown-Schmidt et al., 2005; Pickering & Garrod, 2004). Studies of language production using this paradigm have often looked at the production of short phrases or lists of objects (Belke & Meyer, 2002; Meyer, Sleiderink, & Levelt, 1998; Van der Meulen, 2001, 2003) or the production of entire utterances (Bunger, Papafragou, & Trueswell, 2013; Griffin & Bock, 2000; Gleitman, January, Nappa, & Trueswell, 2007). For a review of the applications of visual world paradigm see Tanenhaus (2007).

In the studies of spoken word recognition subjects are presented with auditory instructions to manipulate one or more objects or images on a computer screen. The set of objects represents possible momentary interpretations of the stimulus at referential (Chambers, Tanenhaus, Eberhard, Filip & Carlson, 2002), syntactic (Tanenhaus et al., 1995), lexical (Allopenna et al., 1998) or sublexical (McMurray et al, 2003) levels of analysis. Eye-movements are monitored while subjects follow the instructions and reveal partial interpretations of the stimulus before they make their ultimate response (the action). For example, Allopenna et al. (1998) presented subjects with a visual display containing a target (e.g. a picture of a beaker), an auditory onset cohort (e.g. a beetle), a rhyme (e.g. a speaker), and unrelated object (e.g. a carriage). Subjects heard an auditory target (beaker), and selected the target with a mouse while fixations to each object were recorded. Initial fixations were equally likely to be directed to the target and cohort (since disambiguating information had yet to be processed), whereas later fixations were

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