



# Emotional prosody perception and its association with pragmatic language in school-aged children with high-function autism



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## ABSTRACT

Emotional prosody perception is essential for social communication, but it is still an open issue whether children with high-function autism (HFA) exhibit any prosodic perception deficits or experience selective impairments in recognizing the prosody of positive emotions. Moreover, the associations between prosody perception, pragmatic language, and social adaptation in children with HFA have not been fully explored. This study investigated whether emotional prosody perception for words and sentences in children with HFA ( $n = 25$ , 6–11 years of age) differed from age-matched, typically developing children (TD,  $n = 25$ ) when presented with an emotional prosody identification task. The Children's Communication Checklist and Vineland Adaptive Behavior Scale were used to assess pragmatic and social adaptation abilities. Results show that children with HFA performed poorer than TD children in identifying happy prosody in both emotionally neutral and relevant utterances. In contrast, children with HFA did not exhibit any deficits in identifying sad and angry prosody. Results of correlation analyses revealed a positive association between happy prosody identification and pragmatic function. The findings indicate that school-aged children with HFA experience difficulties in recognizing happy prosody, and that this limitation in prosody perception is associated with their pragmatic and social adaptation performances.

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## 1. Introduction

Social communication deficit is one of the core symptoms in children with autistic spectrum disorder (DSM-V, 2013). The ability to correctly and effectively recognize a speaker's emotions from their utterances is essential to social communication (Lindner & Rosén, 2006; Shriberg et al., 2001). In addition to semantic meaning, emotional prosody of utterances also manifests a speaker's emotions during social communication. Deficits in producing appropriate emotional prosody in storytelling and conversations are well documented for children with autism (e.g., DSM-V, 2013), but it is still an open issue whether perceptual deficits in emotional prosody play any role in precipitating these deficits in producing intact emotional prosody.

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### 1.1. Emotional prosody perception in high function autism

Prosody is a linguistic term that includes intonation, stress, and rhythm (McCann, Peppé, Gibbon, O'Hare, & Rutherford, 2007). It plays an important role in linguistic functions as well as in emotional expression and comprehension (Lindner & Rosén, 2006; Paul, Augustyn, Klin, & Volkmar, 2005). Deficits in prosody perception might result in atypical prosody production in autism, and also associate with difficulties in decoding emotional signals during social communication (Paul, Augustyn, et al., 2005). During social interactions, the ability to integrate emotional prosody and emotional semantics of a speaker's utterances is crucial to understanding the emotional state and communicative intentions of the speaker as it allows the listener to reciprocate with appropriate responses. Thus, the ability to comprehend emotional prosody in speech is a critical function of human social life (Wittfoth et al., 2010). Many studies have examined autistic children's abilities to recognize emotions through facial expressions; however, relatively few studies have been conducted to examine autistic children's abilities to understand emotions through prosody (Lindner & Rosén, 2006; McCann & Peppé, 2003). Further, while there is extensive evidence in the literature of impairment in the expressive prosodic abilities of autistic individuals, the state of receptive prosodic abilities has been neglected (Le Sourn-Bissaoui, Aguert, Girard, Chevreuil, & Laval, 2013; McCann & Peppé, 2003). Among studies on prosody perception in adults, adolescents, or children with high-function autism (HFA) or Asperger syndrome (AS), findings of deficits in prosody perception have been equivocal.

In the past decade, many studies have reported that adults or children with autism experienced difficulties in using emotional prosody to identify the emotions of others (Golan, Baron-Cohen, Hill, & Rutherford, 2007; Hubbard & Trauner, 2007; Järvinen-Pasley, Peppé, King-Smith, & Heaton, 2008; Lindner & Rosén, 2006; McCann et al., 2007; Peppé, McCann, Gibbon, O'Hare, & Rutherford, 2007; Rutherford, Baron-Cohen, & Wheelwright, 2002). In contrast, several studies have reported that the emotional prosody perception in autistic individuals is similar to that in normal controls (Brennan, Schepman, & Rodway, 2011; Brooks & Ploog, 2013; Chevallier, Noveck, Happe, & Wilson, 2011; Grossman, Bemis, Skwerer, & Tager-Flusberg, 2010; Paul, Augustyn, et al., 2005). Therefore, it remains an open issue whether autistic children exhibit any difficulties in recognizing emotions through speech prosody.

### 1.2. Methodological and age differences in previous studies

Inconsistent findings may occur as a consequence of small participant sample sizes (Hubbard & Trauner, 2007; Lindner & Rosén, 2006). In addition, the use of relatively large age ranges, e.g., from early childhood to adolescence, make it difficult to compare results between different studies to determine whether people with autism show any developmental differences in prosodic processing at certain ages (Brooks & Ploog, 2013; Golan et al., 2007; Grossman & Tager-Flusberg, 2012; Grossman et al., 2010; Hubbard & Trauner, 2007; Järvinen-Pasley et al., 2008). The ability to perceive emotional prosody starts from infancy and continues to develop during middle childhood. Sakkalou and Gattis (2012) showed that 14- to 18-month-old infants infer the intentions of other people using prosodic cues. Sensitivity to emotional prosody continues to improve in typically developing (TD) school-aged children. In a study by Friend and Bryant (2000), TD children aged 4, 7, and 10 were presented with utterances containing semantic content of positive or negative emotion in combination with happy or angry prosody, and asked to judge whether the speaker was happy or angry. Their results showed that 4- and 7-year-old children weighted semantic meaning more than emotional prosody, whereas 10-year-old children valued prosodic information more than semantic meaning. Another study, which compared the relative contribution of emotional prosody versus semantic content in judging a speaker's emotion, found that adults relied exclusively on prosody, whereas 4-year-old children responded primarily to semantic content (Morton & Trehub, 2001). These studies showed a developmental trend where children between 5 and 10 years of age gradually reduced their reliance on the semantic content of utterances to identify emotions. In other words, emotional prosody sensitivity improves in elementary school-aged children; this period is critical for the development of relative weighting between prosody and semantic content in emotion identification. Thus, assessing emotional prosody perception in elementary school-aged children with HFA would be essential to determine whether children with HFA exhibit any emotional prosody perception deficits when typically developing children are still developing their emotional prosody perception during the middle childhood.

The variety of emotional prosody tasks employed in previous studies is another reason for inconsistent findings (Golan et al., 2007). Previous studies have presented emotional prosody to people with autism in different linguistic units, such as words and sentences. In addition to stimulus duration, these stimuli also varied in many aspects, such as sufficiency of contextual information, that would influence emotion identification (Paulmann & Pell, 2010; Peppé et al., 2007). For example, the profiling elements of prosody in speech-communication (PEPS-C) test requires children to distinguish a food item that a person likes or dislikes, based on the emotional prosody of a *single word* (Peppé et al., 2007). Studies adopting the PEPS-C to assess emotional prosody perception in children with HFA have demonstrated impairments in this population (McCann et al., 2007; Peppé et al., 2007). In contrast, studies presenting *sentences* as stimuli to assess emotional prosody perception in children with HFA have reported that it is similar to that in TD children (Bertrand & Priego-Valverde, 2011; Chevallier et al., 2011; Grossman et al., 2010; Paul, Augustyn, et al., 2005).

Further, studies have also utilized variations in emotional semantics of speech stimuli, i.e., using stimuli with either emotionally neutral content (e.g., *fruit name* or *I have a pencil*) or emotionally relevant content (e.g., *hate* or *I am very glad to see you*). When a listener identifies emotions from speech stimuli, emotionally neutral and emotionally relevant utterances provide different emotional semantic cues that require different levels of cognitive processing (e.g., execution function). For

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