



## Effects of a music-based short story on short- and long-term reading comprehension of individuals with Autism Spectrum Disorder: A cluster randomized study



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### ABSTRACT

The purpose of this study was to investigate the effects of singing versus reading a short story on the short- and long-term reading comprehension of children with Autism Spectrum Disorder (ASD). The principal investigator collected data at three separate one-week summer camps during daily scheduled music therapy groups. Participants ( $N = 29$ ) were cluster randomized to experimental (sung short story) or active control (read aloud short story) groups. Participants completed five comprehension check (CC) questions within five minutes of the story being delivered as well as approximately seven hours later. Main effects for day were statistically significant and there was a significant interaction concerning day by treatment group. Mean CC scores increased from day one to day three for both the control and experimental groups. Initial comprehension on day one might have been enhanced by music but musically induced gains dissipated for days two and three, possibly due to learning effects and repetition of material over the course of three days. The use of a live music-based short story may have resulted in increased cognitive arousal and attention span aiding in immediate and long-term increased comprehension of the experimental group. This hypothesis could both inform future researchers in designing studies concerning music-based interventions to promote reading comprehension and enhance best-practice approaches in classroom and music therapy settings. Implications for clinical practice, limitations, and suggestions for future research are provided.

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### Literature review

As individuals communicate, information is either received directly from person to person or indirectly from inanimate objects in the environment. Once this information is received, it is processed and then comprehended in a variety of brain locales. However, some individuals – including those diagnosed with Autism Spectrum Disorder (ASD) – experience neurodiverse processing of information, which can lead to non-traditional ways to engage in social, communication, and adaptive behaviors. One essential skill integrated within each of these identified areas is the need to comprehend information that is being received. Comprehension is a vital component for learning (Anderson et al., 2001; Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956), socializing, and daily living tasks. Moreover, researchers and practitioners need to investigate and implement best-practice approaches to assist

individuals with ASD in improving their ability to comprehend verbal and non-verbal information in order to improve their ability to engage in a myriad of daily interactions.

Comprehension can be defined as the act or action of grasping with intellect (Merriam-Webster.com, 2013). Mastropieri and Scruggs (1997) described reading comprehension as “the most important academic skill learned in school” (p. 197). In Bloom’s Taxonomy of Learning Domains (Bloom et al., 1956), “comprehension” is considered the second tier after “knowledge” and can be seen as a critical step towards “application” (the third tier). In a revised version of the taxonomy, Krathwohl (2002) referred to “remembering” followed by “understanding” as the equivalents to Bloom’s first and second tiers. While being able to remember and comprehend both what one reads as well as hears are two separate cognitive skills, both are vital skills required for not only academic progress but also for acquisition of social skills. Social and communication exchanges require individuals to both remember and analyze information that is being delivered, often from multiple sources. The concept of comprehension is rooted in the ability of the individual to process and synthesize auditory and visual information. Authors have noted the

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importance of being able to generalize learned information so that successful social and academic experiences may occur (Anderson et al., 2001).

Researchers have studied the neural systems of individuals with ASD and a prevailing conclusion is that individuals with ASD seem to present with atypical brain connectivity (Lai, Pantazatos, Schneider, & Hirsch, 2012). Specifically, researchers have reported decreased activation of Broca's area in high-functioning subjects with ASD (Fletcher et al., 2010; Harris et al., 2006; Just, Cherkassky, Keller, & Minshew, 2004; Kana, Keller, Cherkassky, & Minshew, 2006; Sahyoun, Belliveau, Soulieres, Schwartz, & Mody, 2009). Although individuals with ASD do not present with visible lesions in the left hemisphere, researchers have demonstrated deficits in language acquisition and reading comprehension of individuals with ASD (Asberg, Kopp, Berg-Kelly, & Gillberg, 2010; Frith & Snowling, 1983; Minshew, Goldstein, Taylor, & Siegel, 1994; O'Connor & Klein, 2004; Snowling & Frith, 1986; Tesink et al., 2009). Lai et al. (2012) demonstrated decreased functional responses to speech stimulation in children with ASD in both the left inferior frontal gyrus and in the secondary auditory cortices in the left temporal lobe. However, researchers have demonstrated that auditory stimulation in the form of a song resulted in increased left inferior frontal gyrus (Broca's area) activation and increased frontal-posterior functional connectivity relative to speech stimulation (Caria, Venutui, & De Falco, 2011; Lai et al., 2012). Thus, music might be an engaging technique to help promote bi-hemispheric activation resulting in increased communicative abilities in children with ASD.

Researchers have demonstrated that individuals with ASD can present with difficulties in both reading (Asberg et al., 2010) and pragmatic language comprehension (Tesink et al., 2009). In his original description of ASD, Kanner (1943) wrote, "the children read monotonously, and a story... is experienced in unrelated portions rather than its coherent totality" (p. 42). Similarly, Winner (2007) asserted that children with ASD presented with limited ability to form *gestalts*, a necessary skill required for reading and social comprehension. Children with ASD appear to present with lower reading comprehension scores when compared to IQ-matched peer controls (Minshew et al., 1994). Moreover, researchers have concluded that while children with ASD can read accurately, their success at reading comprehension appears to be reduced (Frith & Snowling, 1983; Minshew et al., 1994; O'Connor & Klein, 2004; Snowling & Frith, 1986).

Due to the conclusions by researchers demonstrating deficits in reading comprehension in children with developmental and intellectual disabilities, including but not limited to ASD, several researchers have studied the effects of music on reading comprehension. Researchers have investigated the use of background and live music making on the reading comprehension of children. Zoller (1991) concluded that because music can provide a multisensory experience for children it could be used to enhance speech and language skills. Moreover, she asserted that music could specifically be used to improve auditory attention, perception and memory, spatial awareness, vocabulary development, motor programming, and pragmatic skills. Faham (2011) studied neuro-typical individuals who used English as a foreign language. In this study, participants listened to a reading passage and were then tested on their reading comprehension. Faham concluded that the reading comprehension of participants who listened to background classical music while listening to the reading passage was significantly higher than control group participants' reading comprehension. Register, Darrow, Standley, and Swedberg (2007) studied the impact of a music curriculum on the reading skills of second graders. Although between-group differences did not reach significance, children who received the

music/reading curriculum presented with higher total test scores than those in the control condition. The researchers also noted that the children and teachers commented on how the music appeared to create an engaging and motivating learning environment.

Colwell (1994) studied the participation and attention span of kindergartners when storybooks were first rehearsed through song. She concluded that the eye contact and verbal participation of the children in the experimental group were higher than the same measures for the children in the control group. Barclay and Walwer (1992) used unfamiliar songs to help children link words to pictures in picture books. Kouri and Telander (2008) studied the effects of sung storybooks compared to read storybooks on the comprehension and narrative re-telling of kindergarten and first grade children with speech and language delay. These researchers concluded that while story re-telling and comprehension scores did not differ between conditions, certain advantages were associated with language expression and focused attention in both conditions. They recommended that future researchers consider including live singing accompaniment as a comparison to spoken and taped music stories in future investigations.

While researchers have investigated the effects of original compositions and songs utilizing lyric replacement for social, behavioral and communication skills of children with ASD (Brownell, 2002; Pasiali, 2004; Schwartzberg & Silverman, 2013), to date, researchers have not studied the specific impact of music-based interventions on the reading comprehension of children with ASD. Specifically, there is a lack of published research investigating how a sung short story might influence the reading comprehension of children with ASD. Therefore, the purpose of this study was to investigate the effects of singing versus reading a short story on the immediate and long-term reading comprehension of individuals with ASD. Specifically, the researchers sought to answer the following research questions: Are there short- and long-term comprehension differences when a story is read versus when it is sung to individuals with ASD?

## Method

### Research participants

Participants ( $n = 108$ ) were campers attending three separate weeklong summer camps for individuals with a primary diagnosis of Autism Spectrum Disorder (ASD). The researchers did not obtain personal health information (i.e., an Autism Diagnostic Observation Schedule [ADOS] score) because the researchers did not want to exclude anyone potential subjects from the study. The principal investigator (PI), a board-certified music therapist, initially recruited all 108 individuals to participate in the study. Two months prior to the beginning of the summer camp sessions, the camp director assigned all 108 campers to one of six groups. Therefore, each week 36 campers attended one week of camp and were evenly assigned to one of six groups. The PI utilized these six groups as the six clusters and randomly assigned each cluster to either the experimental (three groups;  $n = 54$ ) or active control (3 groups;  $n = 54$ ) group. Of the 108 recruited participants, all 108 consented and assented to participate in the study. Ninety-three participants participated on the first day of the study and a total of 29 participants were included in data analyses for the experimental ( $n = 13$ ) or active control ( $n = 16$ ) group because those participants completed all measures required in the study design. Of the 29 participants, 26 were male and 3 were female. Participants ranged in age from nine to 21 years with a mean age of 15.57 ( $SD = 3.42$ ) years. The flow of participants through the study is depicted in Fig. 1.

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