Neuropsychologia 49 (2011) 3093–3102

Contents lists available at ScienceDirect

Neuropsychologia

journal homepage: www.elsevier.com/locate/neuropsychologia

Effect of musical experience on verbal memory in Williams syndrome: Evidence from a novel word learning task

Marilee A. Martens[a,b,*], Melissa K. Jungers[a], Anita L. Steele[c]

[a] The Ohio State University at Newark, 1179 University Dr., Newark, OH 43055, USA
[b] Nisonger Center, The Ohio State University, 258 McCampbell Hall, 1581 Dodd Dr., Columbus, OH 43210, USA
[c] Ohio University, Robert Glidden Hall, Athens, OH 45701, USA

ARTICLE INFO

Article history:
Received 11 May 2011
Received in revised form 25 June 2011
Accepted 17 July 2011
Available online 22 July 2011

Keywords:
Williams syndrome
Music
Verbal memory
Developmental disabilities

ABSTRACT

Williams syndrome (WS) is a neurogenetic developmental disorder characterized by an increased affinity for music, deficits in verbal memory, and atypical brain development. Music has been shown to improve verbal memory in typical individuals as well as those with learning difficulties, but no studies have examined this relationship in WS. The aim of our two studies was to examine whether music can enhance verbal memory in individuals with WS. In Study 1, we presented a memory task of eight spoken or sung sentences that described an animal and identified its group name to 38 individuals with WS. Study 2, involving another group of individuals with WS ($n = 38$), included six spoken or sung sentences that identified an animal group name. In both studies, those who had participated in formal music lessons scored significantly better on the verbal memory task when the sentences were sung than when they were spoken. Those who had not taken formal lessons showed no such benefit. We also found that increased enjoyment of music and heightened emotional reactions to music did not impact performance on the memory task. These compelling findings provide the first evidence that musical experience may enhance verbal memory in individuals with WS and shed more light on the complex relationship between aspects of cognition and altered neurodevelopment in this unique disorder.

© 2011 Elsevier Ltd. All rights reserved.

1. Introduction

Williams syndrome (WS) is a unique neurodevelopmental genetic disorder caused by a hemizygous deletion of approximately 28 genes on the 7th chromosome (7q11.23) (Ewart et al., 1993). WS has intrigued cognitive neuroscientists due to its atypical cognitive profile. Individuals with WS display mild to moderate intellectual delay (Klein & Mervis, 1999; Martens, Wilson, & Reutens, 2008), relative strengths in expressive language, receptive vocabulary, and phonological memory (Brock, 2007; Klein & Mervis, 1999), and significant deficits in visuospatial processing and mathematical ability (O'Hearn & Luna, 2009; Vicari, Bellucci, & Carlesimo, 2005). They are highly sociable and many display a natural affinity for music and a heightened emotional response to music (Levitin et al., 2003). In fact, music camps and a music-based postgraduate program have been created in order to respond to the musicality that has been noted in WS.

Early reports suggested children with WS learn songs easily and have strong singing skills (Udwin, Yule, & Martin, 1987; von Arnim & Engel, 1964). Parents report that individuals with WS are more involved in musical activities than individuals with Prader–Willi or Down syndrome who have similar cognitive abilities (Dykens, Rosner, Ly, & Sagun, 2005). Individuals with WS demonstrate increased emotional responsiveness to music and increased interest in music compared to typical mental age-matched and chronological age-matched controls, as well as those with other neurodevelopmental disorders (Don, Schellenberg, & Rourke, 1999; Hopyan, Dennis, Weksberg, & Cytrynbaum, 2001; Levitin et al., 2004). Based on parental report, individuals with WS perform as well as chronological age-matched controls at reproducing music and spontaneously playing rhythmic patterns (Levitin et al., 2004). Don and colleagues reported that children with WS demonstrate relatively strong skills on tonal and rhythmic musical tasks compared to their nonverbal abilities (Don et al., 1999).

It has also been suggested that individuals with WS may possess absolute pitch – the ability to name notes without use of a reference tone – at a higher prevalence than is found in the general population. In a music camp setting, five individuals with WS averaged 97.5% correct on tests of absolute pitch, which led the researchers to suggest that the prevalence of absolute pitch in WS may be atypically high compared to the general population (Lenhoff, Peral, &

* Corresponding author at: The Ohio State University at Newark, Department of Psychology, 2012 Founders, 1179 University Dr., Newark, OH 43055, USA.
Tel.: +1 740 366 9415; fax: +1 740 366 5047.
E-mail addresses: martens.22@osu.edu (M.A. Martens), jungers.2@osu.edu (M.K. Jungers), steelea@ohio.edu (A.L. Steele).

0028-3932/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.neuropsychologia.2011.07.016

Hickok, 2001). As evidence of their absolute pitch ability, Lenhoff and colleagues noted that these individuals were able to identify specific notes played in dyads and triads and could sing familiar songs using the musical note names rather than the lyrics.

Additional studies, however, determined that not all aspects of music are strengths for individuals with WS. Tonal and rhythmic abilities of individuals with WS are commensurate with their mental age (Levitin & Bellugi, 1998). Hopyan and colleagues determined that although individuals with WS perform similarly to typical chronological age-matched controls on melodic imagery and phrasing, they score significantly weaker on measures of pitch, rhythm, and musical interpretation (Hopyan et al., 2001). Children and adolescents with WS have also been found to be impaired in recognizing changes in pitch directionality compared to typical age-matched controls (Deruelle, Schon, Rondan, & Mancini, 2005).

The findings of verbal memory studies in WS are mixed, depending upon the choice of control groups and whether the tasks measured short- or long-term verbal memory. Children with WS demonstrated better recall on the Rivermead Behavioral Memory Test (Wilson, Cockburn, & Baddeley, 1985) than children with intellectual disabilities of mixed etiology matched on chronological age and Verbal IQ (Udwin & Yule, 1991). Children, adolescents, and young adults with WS performed significantly better on verbal rote memory tasks, such as repeating short series of numbers or words, than individuals with Down syndrome with similar cognitive abilities (Jarrold, Baddeley, & Hewes, 1998; Klein & Mervis, 1999; Wang & Bellugi, 1994). However, verbal short-term memory appears to be particularly impaired in individuals with Down syndrome, making this comparison less meaningful (Jarrold, Cowan, Hewes, & Riby, 2004).

Initial research suggested that verbal short-term memory may be relatively strong in WS (Mervis, Morris, Bertrand, & Robinson, 1999; Nichols et al., 2004), while verbal long-term memory is more significantly impaired, as evidenced by the lack of a primacy effect in a free recall task (Vicari, Brizzolara, Carlesimo, Pezzini, & Volterra, 1996). Later studies, however, questioned the validity of a dissociation between memory storage systems in WS. The primacy effect was evident in WS when the participants were prompted to use a rehearsal strategy (Brock, Brown, & Boucher, 2006). Furthermore, Sampaio and colleagues found that both short- and long-term verbal memory systems were delayed in WS (Sampaio, Sousa, Fernandez, Henriques, & Goncalves, 2008).

The relationship between music and memory is complex. There is a common belief that words set to music are remembered better than spoken words. Advertisers use music to help listeners recall their slogans (Yalch, 1991) and children's educational television programs include songs to improve verbatim recall (Calvert, 2001). Music may serve as a mnemonic device: a memory aid that helps in the encoding and retrieval of information. In order to be effective, a mnemonic device must provide structure so that new information can be incorporated into the existing framework, it must be easily used, and it must provide cues for retrieval (Ashcraft, 2006). Familiar songs appear to meet these requirements by providing a structure for learning, encoding, and retrieval of information through rhythm and melody (McElhinney & Annett, 1996; Rainey & Larsen, 2002; Wallace, 1994). Deutsch suggests that music may be an important mnemonic device due to its rhythmic structure and its repetitive nature, which allow verbal information to be 'chunked' (Deutsch, 1999).

In a study of memory for text, participants who had experience singing or playing a musical instrument listened to spoken or sung versions of a three-verse ballad and recalled the words on paper after the first, second, and fifth presentations and again after a distraction task (Wallace, 1994). Participants recalled sung lyrics best, even when compared to rhythmically spoken lyrics. Similarly, participants who learned song lyrics recalled more words and phrases when the lyrics were presented in the original recording than in a spoken version matched for timing and phrasing (McElhinney & Annett, 1996).

Music may also be advantageous when remembering unconnected text. Rainey and Larsen (2002) examined college students' memory for learning lists of names with familiar melodies compared to a spoken condition. Although there was no difference in the time it took to learn the names, the participants who initially learned the lists in the sung condition took fewer trials to relearn the list 1 week later than those in the spoken condition. Scientific facts presented in song were better recalled by 8-year-olds and adults compared to the same facts presented in a lecture format (Chazin & Neuschatz, 1990). Wolfe and Hom found that young children learned telephone numbers with fewer trials when the numbers were set to familiar music compared to unfamiliar music or a spoken condition (Wolfe & Hom, 1993). In addition, background music led to improved performance on a mathematical and memory task in children compared to a no-music condition (Hallam, Price, & Katsarou, 2002).

There is also evidence that music is an effective mnemonic for individuals with special learning needs. Familiar music rehearsal enhanced memory for multiplication tables compared to a verbal rehearsal condition in elementary students with learning disabilities (Claussen & Thaut, 1997). Musical mnemonics, in conjunction with modeling and cuing, significantly aided short-term retention for children with learning disabilities (Gfeller, 1983). Children with language delays also showed significant gains in the recall of learned material when music was employed (Krauss & Galloway, 1982). Intensive music curricula have been shown to be effective in teaching prereading skills to preschoolers enrolled in an early intervention program (Register, 2001) and in improving reading skills for second-grade children with learning disabilities (Register, Darrow, Standley, & Swendberg, 2007). Children with intellectual disabilities demonstrated increased paired-associate verbal learning following their participation in a 6-week Kodály music education class (Ross, 1971). There has been one previous study involving individuals with WS examining the educational benefits of music. Young adults with WS, most of whom had a background of musical training, increased their understanding of fractions when this mathematical concept was taught using music as a pedagogical tool, with 63% achieving a posttest mastery level of .80 and above (Reis, Schader, Milne, & Stephens, 2003).

There may, however, be limits to the strength of music as a mnemonic device. Melody aids in the recall of text, but only when the melody is learned easily (Wallace, 1994). In addition, the advantage for sung over spoken lyrics may be due to the decreased presentation rate of music (Kilgour, Jakobson, & Cuddy, 2000). Another explanation for improved recall for verbal materials with music may be increased cognitive attention, with evidence that music can influence autonomic arousal (Rickard, Toukhsati, & Field, 2005). It is possible that using music to learn leads to increased rehearsal of verbal material because in general, people enjoy listening to and producing music (Schulkind, 2009).

Despite the mounting evidence that individuals with WS are overly responsive to music and have delays in verbal memory, to our knowledge there have been no experimental studies that have directly examined the memory-enhancing effects of music in individuals with WS. Two studies were conducted to investigate verbal memory accuracy, measured by word learning, as a function of spoken and sung input in individuals with WS. Study 1 measured long-term memory of eight animal group names that were taught in either a sung or a spoken condition. Study 2 measured both short- and long-term memory of six animal group names that were taught in either a sung or a spoken condition. We also acquired data on the participants' degree of musical enjoyment, early exposure to music, and experience with music lessons.

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات