



## Effects of pitch, rhythm, and accompaniment on short- and long-term visual recall in children with autism spectrum disorders

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### ABSTRACT

The purpose of the study was to examine paired associate effects of speech, rhythm, pitch, and accompaniment on short- and long-term recall of visual information in children with ASD and in neuro-typical children. The principle investigator (PI) collected phase one data ( $n = 42$  children with ASD) during three separate one-week summer camps and phase two data ( $n = 14$  neuro-typical children) during an academic year at a local religious institution. Participants received the seven-item visual stimuli paired with one of four music conditions (speech, rhythm, pitch, and accompaniment). The PI tested participants in both short- and long-term conditions. Results for phase one were statistically significant for term, with more accurate recall during the short-term phase. Although there were no significant between-condition differences, short- and long-term recall were most accurate during the accompaniment condition and least accurate in the speech condition. Regardless of condition, participants had better recall during sequential positions of primacy and recency. Neuro-typical participants had higher mean recall across all four conditions and two terms than participants with ASD. When delivering visual information to children with ASD, clinicians might consider pairing it with music to facilitate recall. Implications for clinical practice, limitations, and suggestions for future research are provided.

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### Literature review

Contemporary society tends to be visually oriented. As such, children and adults with autism spectrum disorders (ASD) receive vast amounts of visual information but typically are unable to process it as quickly as people who are neuro-typical. Thus, their ability to encode and decode visual information can be negatively impacted and can lead to a frequently occurring information processing deficit. In order to facilitate memory and cognitive processing, researchers have investigated the benefits of visual information and paired associate relationships with memory for people with and without ASD. For example, people who are neuro-typical are able to recall their experiences and memories visually (Fredrickson & Kahneman, 1993) and remember words that lend themselves to picture images more efficiently than abstract, low-imagery words (Marschark, Richman, Yuille, & Hunt, 1987). Due to a plethora of learning applications, the ability to retain and recall information has been – and continues to be – an area of much consideration in academic, social, and vocational environments.

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People with ASD appear to exhibit the ability to recall some visual information. However, the complexity of the stimuli appears to be a confounding variable that decreases the accuracy of visual memory recall of people with ASD (Williams, Goldstein, & Minshew, 2006). Researchers have found that children with ASD performed similar to neuro-typical peers on delayed match-to-sample visual memory tasks (Barth, Fein, & Waterhouse, 1995) and seemed to present with adequate visual memory recall for pictures of common objects arranged randomly or sequentially (Prior & Chen, 1976). Ameli, Courchesne, Lincoln, Kaufman, and Grillon (1988) concluded that children with ASD along with their neuro-typical peers demonstrated significantly better visual recall of meaningful visual material than meaningless visual material.

One method for enhancing memory is through the use of both visual and auditory cues. In his Dual Coding Theory (DCT), Paivio (1991) asserted that humans have more than one information processing system and noted that non-verbal and verbal processing systems work in tandem to help people encode and decode information. Thus, in order to augment learning, teachers should attempt to utilize more than one communication channel. Other scholars have supported Paivio's DCT in their research: In a literature review, Denis (1984) discussed how participants receiving imagery instructions (i.e., enhancement via visual cues) remembered more than participants who did not receive imagery instructions. Additionally, Levin and Berry (1980) demonstrated

enhanced memory recall when participants listened to tape-recorded and graphically depicted newspaper stories compared to when participants only listened to the stories.

In an attempt to provide a multi-sensory experience to enhance learning, educators have infused visual supports into academic and social environments of children with ASD (Hodgdon, 1995). Goldstein (1999) suggested that children with poor verbal imitation skills may be the best candidates for an Augmentative and Alternative Communication (AAC) system. Specifically, Picture Communication Symbols are the most commonly used line drawings for augmenting spoken language (Educating Children with Autism, 2001). Bondy and Frost (1994) examined the impact of the Picture Exchange Communication System (PECS) on the development of communication in 66 children with ASD. The authors reported that two of the 19 children who used PECS for less than one year acquired speech. Additionally, 39 of 66 children who used PECS for two years developed independent speech, 20 developed speech as they used PECS, and seven only used the PECS to communicate.

Williams (1992) and Grandin (1995) provided additional evidence to support the use of visual prompts to assist in encoding and retrieving information. Each author discussed usage of visual supports and visual cues in order to engage successfully within their environment. Other researchers have investigated the research findings of Williams and Grandin. Similarly, the National Autism Center conducted the “National Standards Project” (National Autism Center, 2009), wherein a review committee sought to provide the strength of evidence supporting educational and behavioral treatments that target the core characteristics of ASD. This committee examined 775 research studies and identified 11 treatments as being “Established/Effective” for individuals with ASD. The committee suggested schedules, including the use of visual supports, as one of the 11 established-effective strategies for individuals with ASD.

Many researchers have studied the effects of music mnemonics, or paired associate music, as a compensatory strategy to facilitate learning, memory, and recall (Gfeller, 1983; Hebert & Peretz, 1997; Kilgour, Jakobson, & Cuddy, 2000; Rainey & Larsen, 2002; Wallace, 1994; Wolfe & Hom, 1993). Specific to ASD and mnemonics, Brownell (2002) used mnemonics training in the form of social stories for children with ASD. In this study, the researcher created musically adapted social stories to modify the behaviors of children with ASD. Participants were more successful when engaged during the singing condition than when reading a social story. However, there remains limited published research regarding music mnemonics as a teaching tool for children with ASD. In her meta-analysis concerning music therapy and ASD, Whipple (2004) noted that additions to the literature base should utilize (1) larger sample sizes and (2) further clarification of the efficacy of specific music therapy applications. In today’s era of heightened accountability for the efficacy of psychosocial treatments, it would seem appropriate to take Whipple’s recommendations into account during future music therapy studies for children with ASD.

Researchers have published several related studies examining the use of music mnemonics as a tool to improve memory recall for people with special needs. Claussen and Thaut (1997) demonstrated that a group of children with learning disabilities who learned multiplication through a song yielded significantly higher recall accuracy than those who learned it through verbal rehearsal. In a related study, Gfeller (1983) researched the effectiveness of melodic-rhythmic mnemonics as an aid to short-term memory and reported that after one rehearsal individuals, with learning disabilities demonstrated a significantly greater recall. Moore, Peterson, O’Shea, McIntosh, and Thaut (2008) researched music as a mnemonic device on memory recognition for people with multiple sclerosis. The researchers examined a memory recognition task when paired with speech and paired with music. Although

participants demonstrated no significant difference between baseline and treatment, the researchers suggested that music mnemonics may facilitate learning for people who are less impaired.

While researchers have conducted studies examining how to improve teaching and learning for children with ASD and researchers have studied various aspects of mnemonics for people with special needs, there has been no study utilizing various aspects of musical mnemonics to improve the visual recall abilities of children with ASD. Therefore, the purpose of this study was to examine the effects of paired associate music on visual recall in children with ASD. More specifically, the researchers sought to determine the impact of speech, rhythm, pitch, and accompaniment on short- and long-term memory recall of visual information in children with ASD. Specific research questions were as follows:

1. What paired-associate musical elements (speech, rhythm, pitch, and accompaniment) best facilitate short- and long-term visual recall in children with ASD?
2. Are there differences in paired-associate visual recall in children with ASD and neuro-typical children? What paired associate musical elements might reduce potential between-group visual recall differences?

## Method

### Research participants

#### Phase one

Phase one research participants included 42 children with a diagnosis of ASD attending one of three week-long summer camps. Of these 42 participants, 37 were male and five were female and their ages ranged from nine to 21 with a mean age of 14.14 years ( $SD = 3.37$ ). The principal investigator (PI) recruited participants by first sending a notification via to parents and guardians that a memory and music study would be an optional component of camp. On the first day of camp, the PI met with potential participants and their family members. The PI explained the study and participants’ family members read a brief summary of the study, asked questions, and then signed the consent form. Before participating in the voluntary study, campers also signed an assent form to complete verification of study participation. Participants could withdraw from the study at anytime without penalty. Participants received no payment and testing occurred individually in the campers’ cabins.

#### Phase two

Fourteen neuro-typical children, not diagnosed with ASD or any other disorder and attending a local religious institution for weekly education, participated in the second phase of this study. All neuro-typical participants (eight female and six male) were 14 years old. After initial contact via was made with potential participants’ parents or guardians, the PI followed a similar recruiting method utilized in the first phase of this study. The PI met with potential participants’ family members prior to the beginning of their school year to explain the study and consent. After a brief presentation about the research study, family members asked questions and voluntarily signed consent forms. Before participating in the study, the neuro-typical participants also signed an assent form to complete the verification of study participation. As in phase one, participants could withdraw from the study at any time without penalty. Participants received no payment and testing occurred individually in a private classroom within the religious institution.

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