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Music to my mouth: Evidence of domain general rate priming in adults and children

Melissa K. Jungers*, Julie M. Hupp

Department of Psychology, The Ohio State University at Newark, United States

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ABSTRACT

Will listening to music on the radio change the way you or your children speak? Comparisons are often drawn between the domains of music and language. Temporal processing is one general mechanism that influences both domains; however, a cross-domain influence of rate priming has not yet been established between music and speech. The current research examines if the timing in one modality (music) affects the production timing in a different modality (language) for both adults (Experiment 1) and preschool children (Experiment 2). Participants listened to short unfamiliar musical melodies presented at either a fast or slow rate, and then described pictures aloud. Results demonstrate that both adults' and children's language production was influenced by the timing of the music domain; faster musical primes led to faster speech production. These findings support domain general temporal processing since musical timing affects linguistic timing even when the music has no linguistic component.

1. Introduction

Adults' speech is often primed by timing aspects of what they have just heard. Speakers are likely to persist in the pause length (Giles, Coupland, & Coupland, 1991) or the rate (Jungers & Hupp, 2009; Jungers, Hupp, & Dickerson, 2016; Jungers, Palmer, & Speer, 2002) of recently heard utterances. This priming is beneficial in conversation because sharing linguistic features increases comprehensibility and improves communication between partners (Giles & Powesland, 1975; Savelkoul, Zebrowski, Feldstein, & Cole-Harding, 2007). Children also respond to the timing of language. Children's rate of production is influenced by the rate of language they have just heard (Guitar & Marchinkoski, 2001; Hupp & Jungers, 2009), and preschool aged children can coordinate response time latencies within a conversation based on the response time of their conversation partner (Newman & Smit, 1989).

Adults and children have the ability to incorporate aspects of language from perception into production. Specifically, speech rate can be primed by the rate of linguistic information they have just heard, and this effect is typically larger in adults than it is in preschool children (e.g., Hupp & Jungers, 2009; Jungers & Hupp, 2009). It is not clear if this developmental difference is due to improved linguistic abilities or if it is due to development of timing mechanisms.

Given the structural similarity between music and language, it is also likely that language may be influenced by music, and evidence suggests that there is a close relationship between the two domains. An unexpected chord or unexpected word will show the same P600 activity (Patel, Gibson, Ratner, Besson, & Holcomb, 1998). There is also evidence that the language and music domains share temporal processing mechanisms. When participants are trained to direct their attention to the end of a musical sequence, this

* Corresponding author at: Department of Psychology, The Ohio State University at Newark, 1179 University Drive, Newark, OH, 43055, United States.
E-mail address: jungers.2@osu.edu (M.K. Jungers).

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learned preference for the end of a temporal sequence transfers to the domain of language (Hupp, Sloutsky, & Culicover, 2009). Additionally, in preschool children, the ability to synchronize with a beat predicts language skills (Woodruff Carr, White-Schwoch, Tierney, Strait, & Kraus, 2014). Music and speech both rely on patterns of strong and weak beats, but in music, these rhythmic patterns are more regular than in speech. Music-like rhythms prime speech processing (Cason, Hidalgo, Isoard, Roman, & Schön, 2015; Cason & Schön, 2012). Specifically, a simple music-like rhythm enhanced the processing of nonsense words when they matched in metric pattern (Cason & Schön, 2012). Listening to music-like rhythm patterns led to better detection of phonemes when the metrical pattern matched than mismatched, and this result was stronger in adults who were trained to vocally imitate the strong and weak beat patterns (Cason, Astésano, & Schön, 2014).

Adults' speech production rate can be primed by familiar musical melodies (Jungers et al., 2016). In this study, adults heard familiar melodies at two rates (fast or slow) and then gave descriptions of pictures. Their rate of speech production was influenced by the primed musical rate. This cross-domain persistence of rate from music to language further suggests a shared temporal processing mechanism. However, given that the melodies were familiar and the song titles were given, it is possible that participants were imagining the lyrics and singing along in their heads during the fast or slow musical prime thereby incorporating linguistic factors. So, it would not have been surprising that this musical rate prime would then transfer to a linguistic task. The current study uses novel melodies to eliminate the possibility that cross-domain temporal priming is due to linguistic factors.

Adults' and children's speech production is influenced by temporal information. For example, adults' speech rate is affected by the timing of familiar melodies. However, the musical primes in previous research also had a linguistic component, so it is not clear if the rate of music itself was the relevant priming component. And, rate persistence from the music domain to the language domain has not yet been investigated in children. The goal of the current research is to examine whether adults' (Experiment 1) and children's (Experiment 2) speech rate is influenced across domains by the rate of unfamiliar music that they hear.

2. Experiment 1: adults

In this study, rate transfer was measured in adults who were primed with fast or slow unfamiliar musical melodies and then subsequently asked to produce picture descriptions.

2.1. Method

2.1.1. Participants

Twenty-six undergraduate students (14 females, 12 males; mean age = 20.46 years, *SD* = 6.84) participated to fulfill a research requirement for an Introductory Psychology course. Data was excluded from three additional participants who were wise to the study hypothesis. All participants were native English speakers, with 76.92% of participants self-reporting as White, 15.38% of participants indicating Black/African American, 7.69% of participants not indicating race/ethnicity or reporting "other." Participants had little to no formal music training (mean years of lessons on an instrument = 1.11 years, *SD* = 1.97), with 17 of the 26 participants reporting no formal training.

2.1.2. Materials

There were 20 short, unfamiliar melodies selected from American folk songs. Fast melodies were played at 120 beats per minute (average duration 4 s), and slow melodies were at 60 beats per minute (average duration 8 s). The unfamiliar melodies were controlled so that the fast and slow melodies contained the same number of notes. The same melodies were used for both conditions; thus, the same unfamiliar song was heard at a fast rate for half the participants and at a slow rate for half the participants. All melodies were produced with a piano timbre and did not include any lyrics.

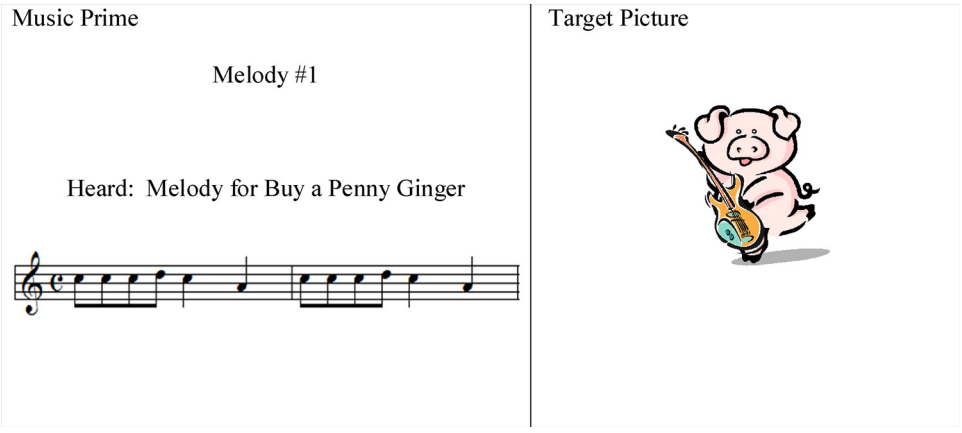

Fig. 1. Example stimuli. For each trial, the prime melody is in either a fast or slow rate, and then the participants produce a description of the Target picture.