Age and musicianship-related use of timbral auditory streaming cues

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Introduction

Understanding speech in noisy environments becomes increasingly difficult with age, and is the most commonly reported hearing issue in older adults (Pichora-Fuller et al., 2016). Auditory stream segregation is crucial to understanding speech in noise, with a growing literature investigating how it is affected by aging. Current evidence suggests that concurrent stream segregation – the segregation of simultaneous sounds – suffers (Alain et al., 2001) while sequential stream segregation – the segregation of sounds over time – remains intact when frequency is the primary auditory cue for segregation of two auditory streams (Snyder & Alain, 2006). Musical training has also been linked to better auditory stream segregation, where less difference between streams is needed for successful segregation (François et al., 2014; Marozeau et al., 2013). We present two studies that investigate how musical training interacts with aging to impact the relative salience of intensity, spectral envelope and temporal envelope as auditory streaming cues.

Method

In Study 1, a repeating four-note *target* melody was interleaved with semi-random *distractor* tones that were manipulated in terms of three *features*, intensity, spectral envelope and temporal envelope, over 20 equally spaced *levels* of increasing dissimilarity to the target (see Marozeau et al., 2013 for details). Two of the target melody notes were inverted 25% of the time to create a *deviant* melody, which participants identified by pressing the space bar on a keyboard. This task is only possible when the target is segregated from the distractor, which is easiest when the distractors are less similar to the target. This type of task generates *hits* and *false alarms*, allowing the calculation of *d' score*, a common measure of sensitivity. 54 participants took part in Study 1, 28 younger (< 38 years; 16 female) and 26 older (> 60 years; 9 female) and 12 in Study 2, (6 younger, 6 older; 10 from Study 1, 2 from lab). Study 2 was a dissimilarity rating paradigm with 15 four-note target melodies with combinations of intensity, spectral envelope and temporal envelope levels. This will allow direct comparison of *d'* scores between the three features by generating a common perceptual dissimilarity scale (see Marozeau et al., 2013 for details).

Results

Mixed effects linear modelling was used to measure effects of *age*, *musicianship* as measured by the Gold-MSI musical training sub-section (Müllensiefen et al., 2014), *dissimilarity*, based on the MDS solution generated by Study 2, *feature*, and their interactions on *d'* scores. There was a significant main effect of musicianship but not of age. The interaction between age and musicianship was not significant; all other interactions were. Figure 1 illustrates *d'* scores for each participant group and each feature along the common perceptual dissimilarity scale.

Discussion

Our results provide evidence that sequential auditory streaming, when cued by intensity, spectral envelope and temporal envelope is similar in older and younger adults. With respect to timbre, poor performance by all participant groups when the temporal envelope was manipulated suggests that greater

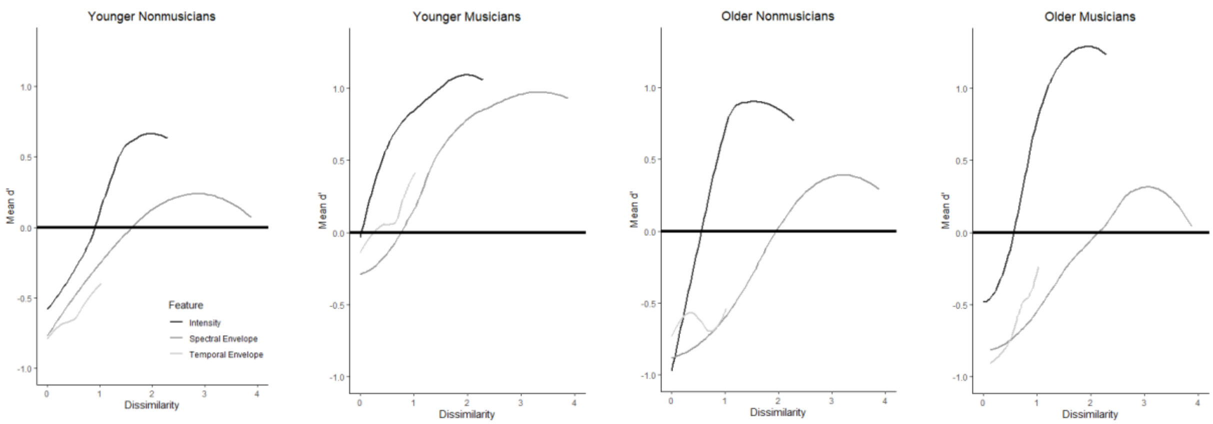

Figure 1: Mean d' scores for each participant group and feature plotted on the perceptual dissimilarity scale established by Study 2. For visualization purposes, musicians are defined as having scored > 50% on the Gold-MSI musical training sub-scale.

differentiation was needed for the temporal envelope to be a useful auditory streaming cue. Furthermore, the interaction between age and feature suggests that older adults used spectral envelope less than younger adults, relying more strongly on intensity as a streaming cue. This may be due to high frequency hearing loss, where older adults may be less able to detect changes in spectral envelope. However, older adults performed similarly to younger adults with low Gold-MSI scores for both timbre features, suggesting that timbre perception is unchanged by aging, though it may become a less reliable auditory streaming cue.

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