

Music to my ears (and fingers): Investigating causal effects of verbal vs. musical labels on tactile discrimination.

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Can language affect the nature of our perception? How much of our perception is shaped by our own language? These questions were investigated using a controlled, within-subject experimental design, where participants learned the discrimination of fine-grained, difficult-to-distinguish tactile patterns on their fingertips with pseudowords or tone sequences. Their discrimination ability was tested both before and after the associative learning, to test if there was any difference in their discrimination abilities related to the co-presented linguistic or musical stimuli (Miller & Pulvermüller, in prep).

Previous research (Miller et al. 2018; Schmidt et al. 2019) showed that associating specific irrelevant meaningless verbal label with almost indistinguishable tactile stimuli made these easier to discriminate. This raises the question whether this facilitatory effect is specific to verbal language, or might arise with other stimuli too. To address this question, we used tactile patterns, and paired them either with verbal, language-like labels or with matched musical sequences, testing participants' ability to discriminate the tactile patterns both before and after. Tactile patterns were divided into two equally matched sets, and each set was presented systematically and consistently with unique, but task-irrelevant, auditory stimuli. All participants had equal exposure to all verbal and nonverbal stimuli as well as all tactile patterns throughout the study.

After five days of learning and exposure, participants showed an overall discrimination improvement in both categories, indicating that this facilitative effect is not limited to creating implicit associations between tactile patterns and verbal labels. There was, however, a significantly greater improvement for patterns, which were paired with verbal labels when compared to the patterns paired with non-verbal, tonal sequences, indicating that spoken language may still have an advantage over non-spoken auditory input.

While it is assumed that both language-like and tone sequences would activate primary auditory cortex, it is possible that verbal labels lead to larger and more widespread activation patterns than tonal labels. Whereas the traverse temporal gyri have been shown to be active during tone processing, the fact that pseudo-words consist of pronounceable phonemes could mean that they activate not only primary auditory cortex but more widespread areas of the perisylvian language cortex, including prefrontal areas. Coactivation and thus the eventual subsequent strengthening of reciprocal connections between auditory and articulatory circuits means that upon hearing pronounceable pseudo-words, not only primary auditory cortex will be activated but also inferior frontal areas. Though we did see overall learning effects for both language-like and tone pairings, this advantage for the 'pronounceable' stimuli may explain why we saw a larger improvement in discrimination among tactile stimuli, which were paired with the language-like stimuli, as compared to the tactile stimuli paired with the non-verbal tone stimuli.

These results also demonstrate that cross-modal associations can be facilitative for difficult, fine-grained discrimination. However, associations formed with verbal, language-like stimuli lead to a greater improvement than associations with non-verbal tone stimuli. This could indicate that, while facilitation effects may generalise to other types of cross-modality associations, language associations under the same conditions as non-language associations still lead to superior improvement.

References

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