

## Title:

# The mechanism of spoken word processing: Insights from congenital amusia

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## Abstract

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### Background

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Congenital amusia is a lifelong disorder of musical abilities, characterized by severe deficits in pitch perception. Pitch is not only a fundamental attribute of music but also is critical in determining the meaning of speech sounds, especially for tone languages such as Mandarin Chinese. Previous research indicate that approximately one third of Chinese amusics also suffer from poor tone perception (tone agnosia). However, whether and how the pitch deficits of Chinese amusics relate to cognitive functions and speech perception remain unknown.

### Aims

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We examine domain-specific and general working memory in Chinese amusics and how their perceptual (pitch) and cognitive (working memory) performance contribute to speech perception.

### Method

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Chinese amusics, divided into a pure-amusia group (N=14) and a tone-agnosia group (N=7), were tested together with normal controls (N=22) on pitch perception (tone frequency discrimination), working memory (tone and picture 3-back), and speech perception (monosyllable word same/different classification). In word classification, the same/different relationship of tone and the remaining syllable were independently manipulated.

### Results

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Pitch perception of amusics was worse than controls, as expected. Interestingly, the tone-agnosia group was even worse than pure amusics. For working memory, the three groups also showed a hierarchical pattern: when tested in the visual domain, the pure-amusia group did not differ from controls, while the tone-agnosia group was significantly worse; when tested in the auditory domain, both amusics groups performed worse than controls, but did not differ from each other.

For speech perception, performance did not differ among the three groups when all information were congruent or when tone was incongruent with word judgment. However, when syllable conflicted with word judgment, the tone-agnosia group was significantly slower than pure amusics and controls. Performance on this condition correlated significantly with auditory working memory even when controlling for pitch perception.

## Conclusions

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Our results revealed that Chinese amusics suffered also from working memory impairment, which was specific to the auditory domain in the pure-amusia group, but was domain general in the tone-agnosia group. Word perception was impaired only in the tone-agnosia group and only when atonal syllable conflicted with word judgment. Correlation analyses relate this impairment to working memory beyond pitch perception. This result is consistent with our Reverse Accessing Model, suggesting that poor tone perception in some amusics may reflect difficulty to resolve conflicting information in working memory.

## Key words

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Congenital amusia, tone agnosia, tone language, pitch, cognition