THE EFFECT OF MUSICAL EXPERTISE ON THE REPRESENTATION OF SPACE

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INTRODUCTION

Individuals typically show a leftward bias – known as pseudoneglect – in bisecting physical lines as well as numerical intervals, possibly reflecting a right hemisphere dominance in spatial representation.

Previous studies demonstrated that musicians, in visually based tasks, have a more accurate performance in bisection tasks, and even show a rightward bias [1], thus suggesting that musical experience may influence the representation of peripersonal space. The pitch of isolated tones are mentally represented along spatial axes (SMARC effect) [2], tones appear to be mapped onto a mental spatial representation in a way that affects motor performance [3].

In the past, a series of RT experiments explored response device orientation (horizontal vs. vertical) task: the pitch of isolated tones triggered the automatic activation of a vertical axis independently of musical expertise; in contrast automatic association with the horizontal axis seemed linked to music training for pitch [2].

Up to now, the interaction between pitch height and external space has not been investigated in performance with a line bisection task. Moreover, spatial biases using a line bisection paradigm in musicians has been studied exclusively in visual modality [1]

AIM OF THE STUDY

This study aims to clarify the effects of music on the representation of external space in musicians and non musicians by using a crossmodal paradigm.

METHOD

Participants

• 12 skilled piano players (4 males, mean age=24 years)
• 12 non musicians (4 males, mean age=23.25)

Procedure

Blindfolded musicians and non musicians participants had to bisect a series of wooden rods of different lengths with the right index finger. The rods were positioned horizontally or vertically (radially). 10 seconds were given for each rod's exploration.

During the tactile exploration, audio files were presented in the auditory modality. After completing the bisection task, two different feedbacks were requested to the participants in the different conditions: i) in the “height judgment task”, participants had to indicate whether the auditory stimulus was a low tone (DO-C3 and SOL-G3), a height tone (MI-E5 and SI-B5) or consisted of white noise; ii) in the “timbre judgment task”, participants had to indicate whether the auditory stimulus was a normal tone (DO and SI), a distorted tone (DO and SI distorted) or consisted of white noise.

RESULTS

Deviations from the veridical center were converted to signed percentage scores by subtracting the true half-length of the rod from the measured distance of each setting from the left extremity of the rod, and then dividing this value by the true half-length and multiplying the quotient by 100. Percentage signed deviations for the three different lengths were collapsed together [5].

Bisection biases: musicians show a tendency to bisect to the right of the veridical midpoint, while non musicians show a leftward bias.

Horizontal effect of auditory stimulus: in musicians the low tones shifted its perceived midpoint significantly toward the left, as compared to listening to high tones or to white noise.

Bisection biases: in the radial plane musicians tend to err in the opposite direction compared to non musicians, i.e., in the direction away from the body.

Radial effect of auditory stimulus: in both musicians and non musicians, listening to low tones in the height judgment task shifted the perceived midline to the body direction. When the tone was irrelevant to the task no modulation on the bisection bias was reported in either musicians or non musicians.

DISCUSSION

• "Minineglect" in musicians

Recently, a rightward bias in a visual line bisection task has been reported in musicians. The present data suggest that, in musicians, rightward biases are present also in the tactile modality, suggesting that the rightward bias is supramodal. Our findings also show that in the radial plane, musicians tend to err in the opposite direction compared to non musicians.

• Pitch presentation can influence spatial judgment in a crossmodal auditory-tactile paradigm

Horizontal bisection

Our findings indicate that in musicians tones are likely to automatically activate a “music spatial line”, left to right oriented. The effect of this representation is larger when attention is specifically devoted to the “spatial” aspect of the musical tones.

Non musicians did not show an effect of tones on bisection: the association of musical tones with the horizontal axis is likely linked to music training.

Radial bisection

Both musicians and non musicians show an effect of low tones on their bisection performance in the height judgment task: these results suggest that the vertical association of pitch and space is more automatic than the horizontal one.

No modulation was reported in the timbre judgment task: this suggests that modulations of the bisection bias in the radial plane occurs when participants pay attention to the height of the tones only, i.e. to the specific feature of the sound that is spatially represented.

REFERENCES