Multisensory Research

Multisensory Information Facilitates the Categorization of Untrained Stimuli

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Supplementary Material

The Results of Reaction Times in Experiment 2

Is There a Multisensory Facilitation Effect when Learning Low-Distortion Stimuli in the Training Phase?

To explore whether multisensory information can facilitate the categorization of low-distortion stimuli, a 3 (modality conditions: auditory vs visual vs audiovisual) × 8 (blocks: 1 to 8) within-subjects ANOVA was conducted on reaction times (see Fig. S1A). It revealed that the main effect of blocks was significant, $F_{7,175} = 18.53$， $p < 0.01$， $\eta_p^2 = 0.43$, indicating that reaction times changed with training. The main effect of modality conditions reached significance, $F_{2,50} = 7.35$， $p < 0.01$， $\eta_p^2 = 0.23$. Post-hoc pairwise comparison (LSD) analysis revealed that reaction times were significantly faster for audiovisual trials than for visual trials ($t_{25} = -3.51$, $p < 0.01$, $d = 0.70$), and for auditory trials ($t_{25} = -3.79$, $p < 0.01$, $d = 0.76$). The interaction was also significant, $F_{14,350} = 2.44$， $p < 0.01$， $\eta_p^2 = 0.09$. The simple-effect analysis revealed that reaction times were significantly faster for audiovisual trials than that for auditory trials for blocks 3, 5, 6 7 8 (ps < 0.05, ds > 0.44), and that for visual trials for blocks 5, 7, 8 (ps < 0.05, ds > 0.48). The results indicated a multisensory facilitation effect on reaction times when learning low-distortion stimuli.

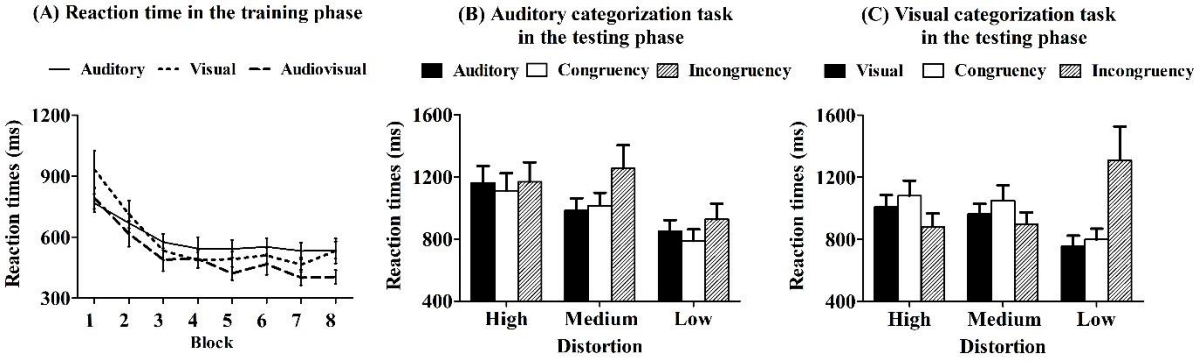

Figure S1. Reaction times in Experiment 2. (A) Reaction times for auditory, visual, and audiovisual trials in the training phase. (B) Reaction times for auditory, congruent, and incongruent trials when responding to auditory stimuli in the testing phase. (C) Reaction times for visual, congruent, and incongruent trials when responding to visual stimuli in the testing phase. The error bars represent standard errors

Is There a Congruency Effect for Trained and Untrained Stimuli when Categorizing Auditory Stimuli in the Testing Phase?

To investigate whether the congruency effect on categorization accuracy with auditory stimuli was due to a trade-off between reaction time and accuracy, a 3 (modality conditions: auditory vs congruent vs incongruent) × 3 (distortion levels: high vs medium vs low) within-subjects ANOVA on reaction time was conducted (see Fig. S1B). The main effect of modality conditions reached significance, $F_{2,50} = 6.08$， $p < 0.01$， $\eta_p^2 = 0.20$. Post-hoc pairwise comparison (LSD) analysis revealed that reaction times were significantly slower for incongruent trials than for auditory trials ($t_{25} = -2.20$, $p < 0.05$, $d = 0.44$) and congruent trials ($t_{25} = 3.2$, $p < 0.01$, $d = 0.64$). The main effect of distortion levels also reached significance, $F_{2,50} = 11.72$， $p < 0.01$， $\eta_p^2 =$

0.32. The interaction was not significant, $F_{4,100} = 1.51$， $p = 0.20$， $\eta_p^2 = 0.06$. The results suggested that the congruency effect on categorization accuracy was not due to a trade-off between reaction time and accuracy.

Is There a Congruency Effect for Trained and Untrained Stimuli when Categorizing Visual Stimuli in the Testing Phase?

To investigate whether the congruency effect on categorization accuracy with visual stimuli was due to a trade-off between reaction time and accuracy, a 3 (modality conditions: visual vs congruent vs incongruent) × 3 (distortion levels: high vs medium vs low) within-subjects ANOVA on reaction time was conducted (see Fig. S1C). The main effect of neither the modality conditions, $F_{2,50} = 1.60$， $p = 0.21$， $\eta_p^2 = 0.07$, nor the distortion levels, $F_{2,50} = 0.22$， $p = 0.80$， $\eta_p^2 = 0.01$, was significant. The interaction was significant, $F_{4,100} = 8.6$， $p < .01$， $\eta_p^2 = 0.30$. The simple-effect analysis revealed that reaction times were significantly slower for incongruent trials than for visual trials ($p < 0.05$, $d = 0.58$) and congruent trials ($p < 0.01$, $d = 0.61$) for low-distortion stimuli. The results indicated that the congruency effect on categorization accuracy was not due to a trade-off between reaction time and accuracy.

The Results of Reaction Times in Experiment 3

Is There a Multisensory Facilitation Effect when Learning High-Distortion Stimuli in the Training Phase?

To explore whether multisensory information can facilitate category learning of high-distortion stimuli, a 3 (modality conditions: auditory vs visual vs audiovisual) × 8 (blocks: 1 to 8) within-subjects ANOVA was conducted on reaction times (see Fig. S2A). The main effect of blocks was significant, $F_{7,189} = 7.44$， $p < 0.01$， $\eta_p^2 = 0.22$. Neither the main effect of modality conditions, $F_{2,54} = 0.97$， $p = 0.39$， $\eta_p^2 = 0.04$, nor the interaction, $F_{14,378} = 0.37$， $p = 0.98$， $\eta_p^2 = 0.01$, was significant. The results suggested that the multisensory facilitation effect on categorization accuracy was not due to a trade-off between reaction time and accuracy.

Is There a Congruency Effect for Trained and Untrained Stimuli when Categorizing Auditory Stimuli in the Testing Phase?

To investigate whether the congruency effect on categorization accuracy with auditory stimuli was due to a trade-off between reaction time and accuracy, a 3 (modality conditions: auditory vs congruent vs incongruent) × 3 (distortion levels: high vs medium vs low) within-subjects ANOVA on reaction times was conducted (see Fig. S2B). The main effect of distortion levels was significant, $F_{2,54} = 7.07$， $p < 0.01$， $\eta_p^2 = 0.24$. Post-hoc pairwise comparison (LSD)

analysis revealed that reaction times were significantly slower for the high-distortion stimuli than for the low-distortion stimuli (t_{27} = 3.42, p < 0.01, d = 0.66) and medium-distortion stimuli (t_{27} = 3.24, p < 0.01, d = 0.62). Neither the main effect of modality conditions, $F_{2,54}$ = 2.69， p = 0.08， η_p^2 = 0.11, nor the interaction was significant, $F_{2,54}$ = 2.14， p = 0.08， η_p^2 = 0.09. The results indicated that the congruency effect on categorization accuracy was not due to a trade-off between reaction time and accuracy.

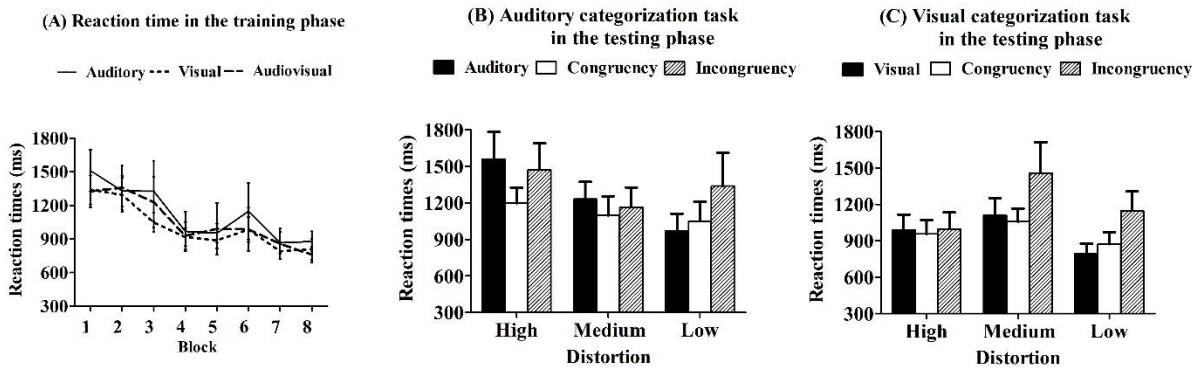

Figure S2. Reaction times in Experiment 3. (A) Reaction times for auditory, visual, and audiovisual trials in the training phase. (B) Reaction times for auditory, congruent, and incongruent trials when responding to auditory stimuli in the testing phase. (C) Reaction times for visual, congruent, and incongruent trials when responding to visual stimuli in the testing phase. The error bars represented standard errors.

Is There a Congruency Effect for Trained and Untrained Stimuli when Categorizing Visual Stimuli in the Testing Phase?

To investigate whether the congruency effect on categorization accuracy with visual stimuli was due to a trade-off between reaction time and accuracy, a 3 (modality conditions: visual vs congruent vs incongruent) × 3 (distortion levels: high vs medium vs low) within-subjects ANOVA on reaction times was conducted (see Fig. S2C). The main effect of modality conditions reached significance, $F_{2,54} = 3.50$， $p < 0.05$， $\eta_p^2 = 0.14$. Post-hoc pairwise comparison (LSD) analysis revealed that reaction times were significantly slower for incongruent trials than for congruent trials ($t_{27} = 3.29$, $p < 0.01$, $d = 0.63$). The main effect of distortion levels was significant, $F_{2,54} = 5.77$， $p < 0.05$， $\eta_p^2 = 0.22$. The interaction was not significant, $F_{4,108} = 1.44$， $p = 0.23$， $\eta_p^2 = 0.06$. The results illustrated that the congruency effect on categorization accuracy was not due to a trade-off between reaction time and accuracy.