Common Mechanism Underlying Multimodal Integration
(多感覚情報処理の共通メカニズム)

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multisensory integration, psychophysics, postdiction, visual illusion, auditory illusion

1. Background

For researches in fields of psychology and neuroscience, multimodal illusions were powerful in the exploration of how the human brain integrates multisensory information. The Audio-Visual (AV) Rabbit illusion[1], described an auditory dominant multisensory illusion where the number of flashes perceived was affected by the number of beeps. However, AV Rabbit illusion, as well as many other illusions, had one modality completely dominant over the other. Our goal was to find a common stimulus which can create bidirectional illusions in order to help us understand the mechanisms underlying multimodel integration.

2. Material & Method

A hearing threshold test was conducted to obtain individuals' noise hearing level (NHL) and beep hearing level (BHL). In the AV Rabbit illusion test, series of beeps and flashes were presented as stimuli and participants were asked how many flashes/beeps they have perceived after every trial. 4 conditions (2b2f, 3b3f, 2b3f, 3b2f) were prepared, where half of all trials were with noise(Fig. 1.).

3. Result

When beeps were strong enough, the perception of the flashes was strongly affected (Fig.2.(i),(ii)), confirming the AV Rabbit illusion. Meanwhile, when the beeps were weak, the perception of the flashes became correct and the beeps were away from the correct answer. Fig showed psychophysical curves (Fig.2.(iii),(iv)), certified that the beep detectability can change the dominant modality in the audiovisual perception.

4. Discussion

4.1 The robustness of visual modality

Results of flashes was more stable, in condition 2b3f1n & 3b2f1n, where STD of beeps was 0.2009, STD of flash was 0.0191 (Wilcoxon test, $p = 0.0003$). and for 3b2f1n was 0.2061, larger than 0.0485, the STD of flash ($p < 0.0001$). This corresponds with the theory that vision is the most importance sense of human.

4.2 Factors determining the dominant modality

Existing of "strong beep illusion" group and "strong flash illusion" group suggested that information processing varied across individuals. The results suggested both the information reliability hypothesis & modality appropriateness hypothesis.

5. Conclusion

We (i) testified the AV Rabbit illusion and proved that (ii) by lowering the detectability of AV Rabbit illusion stimulus, the direction of the multisensory effect was changed. We also (iii) detected the robustness of visual sense and (iv) found intriguing individual differences of multisensory illusion. (v)We also discussed the different hypotheses on factors influencing multimodal integration.

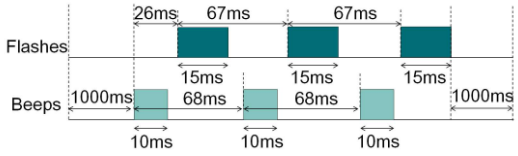

Fig. 1. Time course of 3b3f

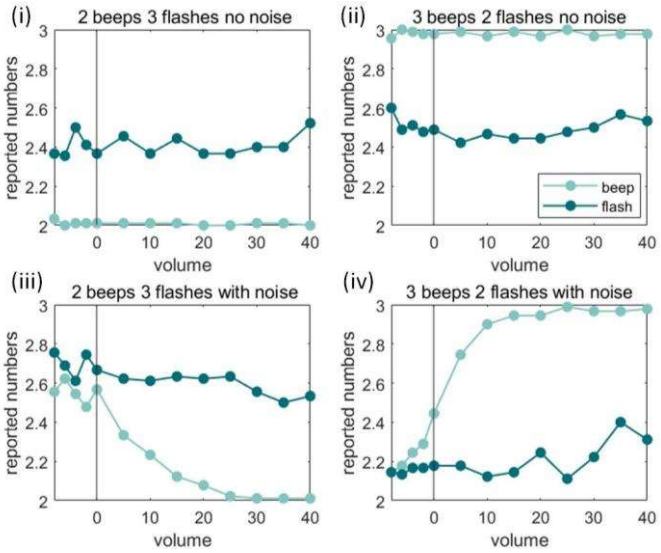

Fig. 2. Results of 2b3f & 3b2f (with/without noise)

Reference

[1] Stiles, Noelle RB, et al. "What you saw is what you will hear: Two new illusions with audiovisual postdictive effects." *PloS one* 13.10 (2018): e0204217.