Spatial disparity does not affect Temporal Ventriloquism

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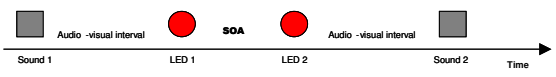
INTRODUCTION

The most commonly held view in multisensory perception is that sharing the same location is a crucial condition for cross-modal interactions to occur (Radeau, 1994; Stein & Meredith, 1993). Here we explored the importance of co-localization for Temporal Ventriloquism. Temporal ventriloquism is a shift in the perceived occurrence of a visual stimulus towards a sound that is presented in close temporal proximity.

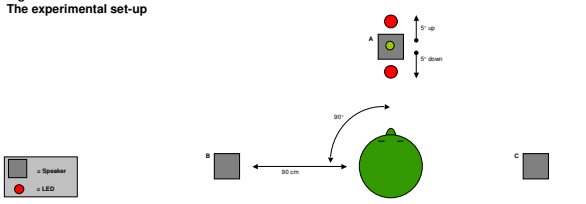
Participants judged in a visual Temporal Order Judgement task (TOJ task) which of two lights appeared first. Temporal ventriloquism was examined by presenting an irrelevant sound before the first and after the second light (Morein-Zamir et al., 2003). A pilot study had shown that the optimal sound-light interval was 100 ms. By introducing a spatial disparity between the sound and light we tested whether similarity in space is important.

Figure 1. Trial example



SOA: Stimulus Onset Asynchrony

Figure 2.
The experimental set-up



Exp 1:
Central sounds: Speaker A
Lateral sounds: Speaker B or speaker C (varied between blocks)

Exp 2:
Central sounds: Stereo sound from speaker B and speaker C
Lateral sounds: Speaker B and speaker C (First sound B and second C or vise versa, varied randomly within blocks)

METHOD

Experiment 1 (N=20)

Stimuli. Lights were presented by two red LEDs, one below and one above central fixation. Sounds were presented either at central location in between the LEDs (speaker A), or at a lateral location at the left or right (speaker B or C, varied between blocks).

Procedure. Trials consisted of the onset of the two LEDs with a variable Stimulus Onset Asynchrony (SOA, see Figure 1). The participant's task was to judge which light was presented first (lower or upper).

Design. Three within-subject factors:

- Sound Location (Central or Lateral sounds).
- Audio-visual Interval (Lag 0 or 100 ms).
- SOA (-75, -60, -45, -30, -15, 15, 30, 45, 60, or 75 ms; negative values indicating that the onset of the lower LED was first).

A silent condition (Visual) was added to test whether the presence of the sounds helped or interfered with performance.

Experiment 2 (N=16)

The lateral sounds now moved from left-to-right or from right-to-left within a trial. Central sounds were stereo sounds.

RESULTS

Experiment 1 & 2

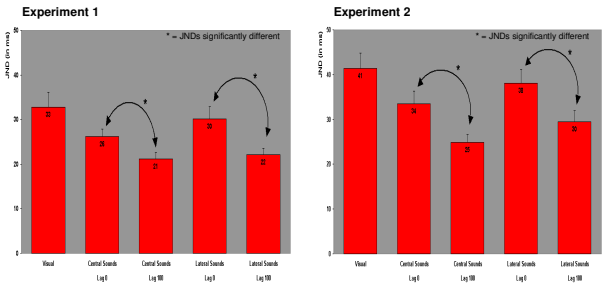
Just Noticeable Differences (JNDs) were computed for each condition, for each participant.

A 2 (Sound Location) x 2 (Audio-visual Interval) ANOVA on JNDs showed:

- JND smaller (better performance) with audio-visual interval 100 ms versus 0 ms = Temporal Ventriloquism,
  $F(1,19) = 16.08$, $p = .001$ (Exp 1), and $F(1,15) = 18.31$, $p = .001$ (Exp 2).
- JND smaller (better performance) with central sounds versus lateral sounds,
  $F(1,19) = 7.36$, $p = .014$ (Exp 1), and $F(1,15) = 8.51$, $p = .011$ (Exp 2).
- NO interaction between Sound Location and Audio-visual Interval,
  $F(1,19) = 1.69$, $p > .20$ (Exp 1), and $F(1,15) = 0.00$, $p > .99$ (Exp 2).

Separate t-tests showed a significant difference between the 0 versus 100 ms intervals;

- for Central sounds,
  $t(19) = 3.14$, $p = .005$ (Exp 1) and $t(15) = 3.48$, $p = .003$ (Exp 2).
- for Lateral sounds,
  $t(19) = 3.45$, $p = .003$ (Exp 1) and $t(15) = 3.40$, $p = .004$ (Exp 2).



DISCUSSION

- JNDs in the 100 ms interval were lower (i.e., better performance) than in the 0 ms interval, which is indicative of temporal ventriloquism.
- Overall disturbing effect of lateral sounds.
- **Most importantly**, the temporal ventriloquist effect was the same for central and lateral sounds.

Thus, introducing a spatial disparity between the sound and light had no effect on the amount of temporal ventriloquism. These results therefore challenge the common view that similarity in space is a crucial constraint for cross-modal interactions in general. Rather, it seems that only in tasks were space is relevant, like detecting or discriminating a stimulus at an unknown location, one will observe intersensory effects of spatial correspondence.

REFERENCES

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