NTT Press Releases

(Press Release)

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Relation between Audition and Body Explained in Neuroscience Research for the First Time

- An illusion discovered in which the brain misunderstands arm length due to sounds produced by bodily action -

Nippon Telegraph & Telephone Corporation (NTT, CEO: Hiroo Unoura, Tokyo) has conducted the first ever experiments clarifying the relationship between hearing and the perception of body form, such as the length of an arm, in cooperation with Royal Holloway, University of London in the U.K. and the University of Graz in Austria.
This groundbreaking discovery in neuroscience research represents a significant advance in basic research on the relationship between audition and the human body, and holds promise for applications in medical and other fields.
This result appeared in the scientific magazine, “Current Biology” on July, 10.

1. Research Background and Significance

At NTT Communication Science Laboratories (NTT Labs), we use approaches such as information science, psychophysics, and neuroscience to investigate mechanisms underlying our perception, emotion, and motion, for understanding how environmental and social information is processed in human body and brain. The research findings are expected to serve as fundamentals of future information technologies for heart-to-heart communication. In our research, how the sense of the body is formed and maintained is one of the essential questions in understanding interactions between human and environment.

2. Results (Figure 1)

In this research, based on our rich legacy of research done over many years at NTT Labs, we have discovered a new illusion in which people will perceive that his/her arm has stretched if he/she taps the floor and hear the sound produced as originating from farther away than the hand actually is.
Earlier, it has been assumed that the sense of body form is achieved through integration of somatic sense and vision. The role of audition has been largely ignored. This discovery shows for the first time, that audition can influence perception of the shape of his/her own body, which makes it a groundbreaking first step in unraveling the relationship between hearing and the human body.

3. Experiment Overview and Results

Location

NTT Communication Science Laboratories
http://www.kecl.ntt.co.jp/rps/english/index_e.html

Participants

16 males and females aged 20 to 35 years old.

Overview (Figure 2)

- Loudspeakers were placed at six locations over three meters.
- Participants’ vision was restricted using goggles.
- Participants tapped the floor with their right hand at six locations, ten times each, starting directly in front and moving gradually to the right (a total of 60 times, approx. one minute).
- The “sound” of tapping the floor was presented from the loudspeakers, and subjects experience this for one minute (adaptation).
- The right and left arms were stimulated at two points each, and subjects responded whether the tow points were farther apart on the right or on the left arm.
- The tactile judgment was performed 24 times, before and after adaptation, and the proportion of times subjects answered that the distance on the right arm was longer than that on the left arm was compared.

- The loudspeaker locations and sound presentation timing were manipulated as follows:
  - Equal distance (tap location and sound origin were the same)
  - Double distance (sound originated at twice the distance of the tap location)
  - Quadruple distance (sound originated at quadruple the distance of the tap location)
  - Asynchronous (sound was not synchronized with tapping)

Results (Figure 3)

- In the double distance condition, the distance between the two points on the right arm was felt longer after adaptation compared to before adaptation in 12 out of 16 participants, resulting in a statistically significant increase in the proportion of 'the distance was longer on the right arm than the left' responses.
- No significant difference was observed in the equal distance, quadruple distance, or asynchronous conditions.

These results suggest that the brain adapted to the sound coming from twice the distance of the actual tapping, resulting in the illusion that the length of the arm is felt longer than it actually is.

4. Future Development

We will further elucidate the mechanisms how the auditory and somatosensory information is integrated to construct the sense of the body, and explore potential applications in medical fields such as rehabilitation. For example, we will study applications such as a system that uses sound to support rehabilitation of subjects having difficulty perceiving or moving their bodies accurately.

Attachment·Reference

- Figure1: Recent Results
- Figure2: Experiment Overview
- Figure3: Experimental Results

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