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Supplemental information

Localizing 3D motion through the fingertips:

Following in the footsteps of elephants

Adi Snir, Katarzyna Cieřła, Gizem Ozdemir, Rotem Vekslar, and Amir Amedi

Supplemental Data

Instructions given to the participants

Experiment 1:

Before A1 Condition

[In this experiment we will focus on sounds in motion. You will hear a sound that starts in one place in the room and moves to another place. We would like you to say where the sound started, where it ended and its direction. For this we prepared a map of the room for you, the speaker in front of you is number “1” (front) (*give the map to the participant*). For example, if the sound starts right in front of you and moves to your right side, the answer is “1-2-3” (front to right, clockwise), etc. (*all examples are while pointing to the locations in the room and on the map*). If the sound starts in the front right corner and moves to your left side in front of you, the answer is “2-1-8-7” (front-right to left, counter-clockwise), and if the sound starts right behind you and does not move, the answer is “5” (back). The sounds will always be continuous (meaning, they will not jump between corners of the room) and there may be sounds that do not move. Each sound will move only in one direction: clockwise or counter clockwise. If you are not sure where the sound started or ended, you can ask to hear it again, if you still don't know you need to guess. We will be in the next room and hear your answers. Try to stay focused, with your gaze directed to the speaker in the front, and do not follow the sounds with your head.]

Before T Condition

[Now we will do the same task, only you will not hear the sounds but you will feel them on your fingertips instead, using the vibration boxes to your sides. The vibration works just like sound. Each of your fingers is “linked” to a different corner of the room. The right index finger is linked to corner 2 (front-right), the left index finger to corner 8 (front-left), the right middle finger to corner 4 (back-right), and the left middle finger to corner 6 (back-left). For the remaining locations, you will feel vibrations on two fingers at the same time: “1” (front) is the two index fingers, “5” (back) is the two middle fingers, “3” (right) is the two right-hand fingers and “7” (left) is the two left-hand fingers. Try not to overthink the vibrations too much and just try to figure out where the stimuli are coming from, just like you did with the sounds (*go over it with the participant; do several examples: if it's 4-5-6*

(back-right to back-left clockwise) which fingers is it going to be? if it's 4-3-2-1-8 (back-right to front-left counterclockwise), which fingers is it going to be?) Now I'll present the whole circle to you, so you can become familiar with the vibrations (1-2-3-4-5-6-7-8-1) *(front to front, full circle clockwise)*]

Before AT Condition

[Now we will do the same task when you hear the sound and feel the vibrations together. The sound and the vibration are matching, they are the same stimuli.]

Before A2 Condition

[Now we will do the same task you did in the first condition, only sounds without vibrations.]

Experiment 2

Before A Condition

[In this experiment we will focus on sounds in motion. You will hear a sound that starts in one place in the room and moves to another place. We would like you to say where the sound started, where it ended and its direction. For example, *(all examples are while pointing to the locations in the room and in the map)* if the sound starts right in front of you and moves to your right side, the answer will be “front to right clockwise” (“1-2-3”). If the sound starts in the front right corner and moves to your left side in front of you, it will be front-right to left counter-clockwise (“2-1-8-7”), and if the sound starts right behind you and does not move, the answer will be “back” (5). For the vertical movement: if the sound is from the front and goes down, you should say “front or 1, up to down”. If the sound starts in the back left corner in the middle row and moves to the upper right front corner on your left side, you will say “back-left to front-right, (“6-7-8-1-2”) middle to up, clockwise”. The sounds will always be continuous (meaning, they will not jump between corners of the room) and there may be sounds that do not move. Each sound will move only in one direction: clockwise or counter-clockwise. If you are not sure where the sound starts or ends, you can ask to hear it again; if you still don't know, you need to guess. We will be in the next room and hear your answers. Try to stay focused, with your gaze focused on the frontal speaker and not follow the sounds with your head.]

Before T Condition

[Now we will do the same task, only you won't hear the sounds but you will feel them on your fingertips using the vibration boxes to your sides. Each of your fingers is linked to a different corner of the room, the right index finger is linked to the front-right (2) corner, the left index finger to the front-left (8) corner, the right middle finger to the back-right (4) corner, and the left middle finger to the back-left (6) corner. For the remaining locations, you will feel vibrations on two fingers at the same time: front (1) is the two index fingers, back (5) is the two middle fingers, right (3) is the two right-hand fingers and left (7) is the two left-hand fingers. Try not to overthink the vibrations too much and just try to figure out where the stimuli is coming from, just like you did with the sounds (go over it with the participant; do some examples, e.g.: if it's back-right to back-left clockwise (4-5-6), which fingers is it going to be? if it's back-right to front-left counterclockwise (4-3-2-1-8), which fingers is it going to be?) Now I'll present the whole circle to you, so you can become familiar with the vibrations.]

Experiment 3

Before A1 Condition

[In this experiment we will focus on sounds in motion. You will hear a sound that starts in one place in the room and moves to another place. We would like you to say where the sound started, where it ended and its direction. For this we prepared a map of the room for you; the speaker in front of you is number "1" (front) (*give the map to the participant*). For example, if the sound starts right in front of you and moves to your right side, the answer is "1-2-3" (front to right, clockwise) (*all examples are while pointing to the locations in the room and on the map*). If the sound starts in the front-right corner and moves to your left side in front of you, the answer is "2-1-8-7" ("front-right to left, counterclockwise"), and if the sound starts right behind you and does not move, the answer is "5" (back). The sounds will always be continuous (meaning, they will not jump between corners of the room) and there may be sounds that do not move. Each sound will move only in one direction: clockwise or counter-clockwise. If you are not sure where the sound started or ended, you can ask to hear it again; if you still don't know you need to guess. We will be in the next room and hear your answers. Try to stay focused, with your gaze directed to the speaker in the front, and do not follow the sounds with your head.]

Before AN Condition

[In this part your task is exactly the same but you will hear white noise at the same time as the sound stimuli. Try to focus only on the sound (as you heard in condition 1) and say where the sound started, where it ended and its direction.]

Before ATN Condition

[Now you will do the same task, only you will both hear the sounds and the white noise and also feel vibrations on fingertips using the vibration boxes to your sides. The vibration works just like the sound. Each of your fingers is “linked” to a different corner of the room, the right index finger is linked to corner 2 (front-right), the front index finger to corner 8 (front-left), the right middle finger to corner 4 (back-right), and the left middle finger to corner 6 (back-left). For the remaining locations, you will feel vibrations on two fingers at the same time: 1 (front) is the two index fingers, 5 (back) is the two middle fingers, 3 (right) is the two right-hand fingers, and 7 (left) is the two left-hand fingers. Try not to overthink the vibrations too much and just try to figure out where the stimuli is coming from, just like you did with the sounds (*go over it with the participant; do some examples, e.g.: if it's back-right to back-left clockwise (4-5-6), which fingers is it going to be? if it's back-right to front-left counterclockwise (4-3-2-1-8), which fingers is it going to be?*) Now I'll present the whole circle to you, so you can become familiar with the vibrations.]

Experiment 4

Before the "No Cue" Condition

[In this experiment, you will hear eight sounds. We will now play each sound for you separately. They will represent a: “dog”, “cat”, “owl”, “crow”, “cricket”, “bear”, “train”, and “helicopter” (*play one by one*). Each set of sounds consisting of the eight sounds you will hear is called a "scene". During the experiment, you will hear a scene and then hear it again. In some cases, one of the sounds will disappear in the second presentation of the scene. For example, in the second scene the “owl” will disappear. Your task is to say whether the two scenes you heard are identical or different.]

Before the "Visual Cue" Condition

[Now we will repeat the task you did but add a visual text cue. Before the scene is played for the first time, you will see on the iPad in front of you the name of the sound that may disappear in the second presentation of the scene. In other words, if you see the word "dog"

on the iPad, and there will be a difference between the first and second scene, the difference will be that the sound of a barking dog disappeared.]

Before the "Tactile Cue" Condition

[Now we will repeat the task you did but add a tactile cue. When the scene is playing for the first time, you will also feel vibrations on your fingertips from the devices on your sides. The vibrations will correspond to the sound that may disappear in the second presentation of the scene. In other words, if what you feel on the fingertips matches with a cat sound you hear in the scene, and there will be a difference between the first and second scene, the difference will be that the sound of the cat disappeared.]