

SoniWeight Shoes: Investigating Effects and Personalization of a Wearable Sound Device for Altering Body Perception and Behavior

SUPPLEMENTARY MATERIAL

1 SUPPLEMENTARY METHODS

1.1 Participant Inclusion and Exclusion Criteria, Pre-screening and Group Assignment Criteria

1.1.1 Inclusion and Exclusion Criteria. Inclusion criteria include: Self-reported normal hearing acuity; proficiency in Spanish language; being able to understand the study information and give consent; being able to communicate. Participants of any gender will be welcomed; a ratio of 1:1 of those identifying as male and female will be sought for. Exclusion criteria include: being under 18 or above 70 years of age; psychiatric or neurological diagnoses; regular use of medical or recreational psychoactive drugs; disabling orthopaedic or neuromuscular disease that necessitates assistance in walking trials; any condition that might interfere with the sensors' placement (e.g., use of cardiac pacemaker); unable to give informed consent; deafness or acute hearing condition.

1.1.2 Pre-Screening. Participants were pre-screened for disorder eating and body image concerns by means of the Spanish version of the Eating Disorder Examination Questionnaire (EDEQ) [13], and for physical activity levels by means of the Spanish version of the International Physical Activity Questionnaire (IPAQ) [6]. Our objective was to create four groups (LOW IPAQ-LOW EDEQ; LOW IPAQ-HIGH EDEQ; HIGH IPAQ-LOW EDEQ; HIGH IPAQ-HIGH EDEQ), each consisting of 21 participants, based on the predetermined study criteria. Therefore, participants meeting the criteria for a particular group (see section "Group assignment criteria" below) were invited to participate, provided that the group had not reached its maximum capacity. The EDEQ is composed by 28 7-point Likert-type response items ranging from 0 (not at all) to 6 points (markedly). Four sub-scales are formed based on these items, including dietary restraint, shape concerns, weight concerns, and eating concerns, and they are averaged to obtain a single global score, which ranges from 0 to 6 points.

The IPAQ is a tool used to assess an individual's physical activity levels and habits over the past week. It covers work-related, transportation, and leisure-time activities, asking about duration, frequency, and intensity. Responses are used to calculate a person's total physical activity level, expressed in MET minutes per week.

1.1.3 Participants. The participants who participated to the experiment were selected from a total of 181 participants (see details in Table 1) who filled in the questionnaires.

1.1.4 Group assignment criteria. The selection and assignment of participants to the four groups were guided by previous studies that have examined the validity of EDEQ and IPAQ scores in non-clinical samples.

We established the threshold for the "HIGH EDEQ" and "LOW EDEQ" groups on a cut-off score of 1.98 of the EDEQ global score for female participants and 1.09 of the EDEQ global score for male participants, taken into account participants biological sex, study region and other specific considerations related to SED, and that our study targeted a non-clinical sample and not individuals diagnosed with eating disorders or undergoing treatment, as explained below. Several studies have empirically examined the EDEQ global cutoff score that yields an optimal trade-off between sensitivity and specificity using receiver operating characteristic (ROC) curve analysis in female english-speaking

	LOW IPAQ-LOW EDEQ (N=46)	LOW IPAQ-HIGH EDEQ (N=23)	HIGH IPAQ-LOW EDEQ (N=76)	HIGH IPAQ-HIGH EDEQ (N=36)
Age	24.58(7.92)	27.16(9.43)	25.66(8.06)	25.16(5.66)
Weight (kg)	59.48(11.89)	68.17(13.14)	63.69(9.73)	68.23(12.41)
Hips (cm)	89.81(12.39)	94.60(14.09)	87.57(13.92)	99.41(19.61)
Waist (cm)	72.90(10.85)	76.47(9.55)	72.64(13.17)	78.37(11.15)
Height (cm)	166.52(9.39)	167.50(6.99)	170.50(8.54)	168.38(8.41)
EDEQ	0.58 (0.61)	2.64(1.45)	0.63(0.64)	2.62(1.20)
IPAQ	1727(820)	1948(1526)	7338(6488)	8024(8600)

Table 1. Mean(SD) Weight, Hips, Waist, Height, EDEQ score and IPAQ score of pre-screened participants

samples [9] and colleagues found that an EDEQ global score of 2.30 was associated with ideal sensitivity (.92) and specificity (.86) to detect EDs among a community sample of women seeking ED care, though this cutoff was found to be somewhat higher (2.80) in a study of women in primary care settings (Se = .80, Sp = .80; [9]). Similarly, [16] found that an EDEQ global cutoff of 2.50 accurately discriminated between women with and without EDs (Se = .86, Sp = .86). Another study[22] utilized the 2.8 cutoff within a clinical context, specifically assessing individuals undergoing treatment for eating disorders. This criterion effectively tracked symptom progression throughout treatment. Conversely, our study focused on a general population and not individuals diagnosed with eating disorders or undergoing treatment.

Therefore, the application of a clinical cut-off, such as 2.8, to a non-clinical or healthy population may not yield similar interpretations or classifications. This distinction is vital as clinical cut-offs, established within clinical contexts, may not appropriately translate to non-clinical samples due to differences in symptomatology, severity, and the absence of diagnosed disorders within the general population. As stated by [9], screening for low prevalence pathologies such as ED inherently involves challenges. Furthermore, ED psychopathology levels may vary across countries [10]. Also, considering age, sex, body mass index (BMI) [16], and sexual orientation [11, 12], it's crucial to acknowledge the existence of multiple cutoff points. These demographic factors play pivotal roles in determining the appropriateness and accuracy of cutoff scores within various populations.

This variability emphasizes the need for context-specific interpretations. Among all these influential factors, the cutoff point in our study was primarily driven by biological sex and the nature of the sample being non-clinical. Considering gender-specific considerations, the variability in proposed cutoff scores for the EDEQ in female samples—ranging from 1.98 [3, 7] to 2.80 [9]—underscores the absence of a universally agreed-upon threshold for identifying eating disorders in women [15]. As of now, there is a lack of studies within the Spanish context regarding the female representative population [15]. We took the decision to use 1.98 as the threshold for the "HIGH EDEQ" and "LOW EDEQ" groups for female participants since it is one of the lowest scores, putting women at risk for disordered eating [3, 7]. [15] focusing on Spanish male university students suggests that the optimal cut-off point to identify at-risk eating disorder cases in the Spanish male sample is ≥ 1.09 , while for clinical cases, the recommended cut-off point is ≥ 2.41 . Males with eating disorders might show significantly lower EDEQ scores than their female counterparts, suggesting potential variations in optimal cutoffs for this demographic group. That is, it may be that a lower cutoff provides a better balance between sensitivity and specificity among males.

With regards to the IPAQ, it categorizes individuals' physical activity levels into three categories: high, moderate, and low. These categories are determined based on the total amount of physical activity, measured in MET (Metabolic Equivalent of Task) minutes per week, as reported by the individual in response to the questionnaire. High Activity

Level individuals are those who report a high level of physical activity engage in a significant amount of moderate to vigorous physical activity throughout the week. They typically accumulate a substantial number of MET minutes per week, often exceeding 3000 MET minutes. Moderate Activity Level individuals are those with a moderate activity level engage in a reasonable amount of physical activity but not at the intensity or duration of the "high" category. They typically accumulate between 600 and 3000 MET minutes per week. Low Activity Level individuals engage in minimal physical activity. Their total MET minutes per week are typically below 600. We grouped participants as LOW-PA for moderate and low IPAQ and HIGH-PA for high IPAQ. Therefore we used 3000 MET minutes per week as the classification threshold for the LOW-PA and HIGH-PA groups, based on [17].

1.2 SoniWeight Shoes Detailed Description

For the experiment, a setup was sought that would produce the same spectral changes in footstep sounds as in previous research by these and other authors [1, 2, 18, 19, 21]. At the same time, however, it was desirable to reduce its size, increase its portability and, if possible, avoid the need for power sockets. For this reason, a digital version, reduced in size and weight and powered by a USB portable battery, was designed to replace the analogue and hard-wired equalizer used in previous research. This device was designed to accurately mimic the behavior of the analogue equalizer in different sound configurations. This deployment relies on the Bela.io system, a hybrid arrangement that combines a single-board computer (the Beagle Bone Black) with a 1 GHz ARM Cortex A-8 processor with 512 RAM, 4 GB on-board memory and an SD slot, and an audio layer designed by Augmented Instruments Laboratory. The complete system includes, in addition to the Bela.io device itself, a signal acquisition stage consisting of a set of Core Sound binaural microphones with a range of 20 Hz to 20 kHz, and a playback stage consisting of a pair of Sennheiser HDA 300 headphones. The Bela.io device is 9.5 cm wide, 6.5 cm deep, 3.5 cm high and weighs approximately 0.1 kg. The entire new setup weighs approximately 0.6 kg, a significant reduction from the 2 kg of the original setup. Within the Bela.io device, 11 cascaded filters have been implemented using IIR Second-Order Section filters, allowing the behavior of the analogue equalizer to be reproduced for each of the required sound conditions. The peculiarities of the design of these filters and their specific implementation in the Bela.io device can be found in [4]. In order to match the behaviour of this IIR filter cascade exactly to the frequency response of the analogue system under each of the three sound configurations the following steps were performed: a) The frequency response of the original analogue equalizer was measured for the different sound configurations. Details of the measurement procedure can be found in [4]. b) The digital filters of the Bela.io unit were designed to exactly replicate the selected settings on the front end of the analogue equalizer. c) An iterative tuning process was started once the design, tuning and programming of each of the cascaded IIR filters in the Bela.io device was complete: (1) Frequency response measurements of the digital implementation were performed, for the three configurations, (2) comparisons were made between these measurements and those for the original equalizer, as obtained from a), (3) re-adjustments of the IIR filters were conducted, to minimize the observed spectral differences between the original analogue equalizer and the Bela.io implementation. This process was repeated, iteratively, until the observed differences between the analogue equalizer and the digital implementation were considered negligible. Further details about these differences can be seen in Figure 1 and Figure 2.

In addition, to ensure that the system performed the entire filtering process in real time, with no perceptible temporal effects on the participants, a latency measurement of the equipment was performed, details of which can be found in [4]. This allowed the latency of the entire digital system to be quantified at 1.6 ms. This low latency, which is negligible from a perceptual point of view, paves the way for the use of more complex systems based on Bela.io for real-time applications. In addition, to ensure that the system performed the entire filtering process in real time, with no perceptible

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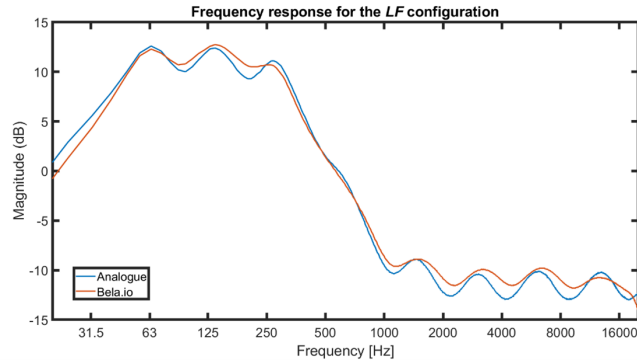


Fig. 1. Frequency Response for the LF condition

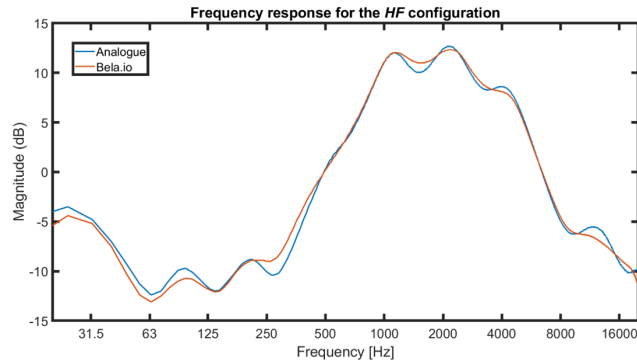


Fig. 2. Frequency Response for the HF condition

1.3 Experiment Environment

The experiment took place in a quiet environment, utilizing a wooden platform (medium-density fiber, 1 cm thick, measuring 10 meters.) The choice of ground and footwear materials is crucial as they have an impact on the resulting sounds [5, 8, 18, 20]. The hard rubber soles in contact with the wooden board produce distinct sounds. The platform was elevated 4 cm from the floor of the room, creating an empty space that enhanced the acoustic conditions. At one of the ends of the wooden runway, a 27" high-resolution screen, as well as a comfortable keyboard was provided, for participants to complete the body visualization task (see 3.4.1).

1.4 Gait Biomechanics Measures

The total number of steps differs due to the step size of each participant. Acquired measures: gait patterns that include gait cycle, initial strike, contact time and acceleration. An accelerometer sensor, placed on the participants' right ankle was used to obtain the participants' acceleration signal to determine the different stages of the walking experiment task.

1.5 Sensor Placement

A Bitalino PLUX acquisition system (8-Channel biosignalsplux hub) was used to acquire the following physiological signals from the participants: electromyogram (EMG), electrocardiogram (ECG), respiration (RESP), electrodermal activity (EDA) and accelerometer (ACC).

Figure 3 illustrates the locations on the participant's body where the sensors were placed. ECG sensors were placed on the chest to record electrical cardiac signals. A respiration belt sensor was placed on the chest to measure the rate and relative respiration amplitudes. The EDA sensors were positioned on the non-dominant hand (on the index and middle finger) to measure activity of the sympathetic nervous system as a physiological marker of stress or emotional arousal. EMG sensors (two sets) were positioned on (1) midcervical paraspinal, (2) T-12 paraspinal and vastus medialis. ECG sensors were placed on the chest to record electrical cardiac signals. A respiration belt sensor was placed on the chest to measure the rate and relative respiration amplitudes. Two EDA electrodes were positioned on the palmar side of the middle phalanges of the first and second digits of the non- dominant hand to measure activity of the sympathetic nervous system as a physiological marker of stress or emotional arousal .

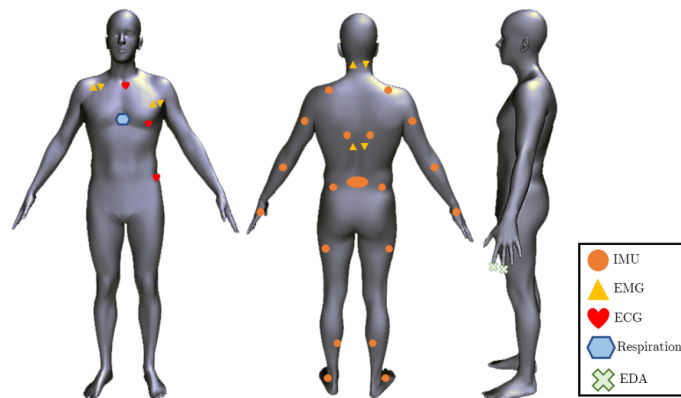


Fig. 3. Sensors locations

The data acquired by the Rokoko's smart suit was directly logged to the computer at the end of each condition using the Rokoko's Studio software. The Bitalino Hub sent the data to be stored in the computer using Opensignals software. Using the devices' APIs it was possible to start the acquisition process synchronously, stop the recording and manage the acquired files.

1.6 Questionnaire on Body feelings

Participants were asked to answer the question "How did you feel during the experience?" from 1 to 9, selecting accordingly a figure from each of 3 different scales. Each scale showed different kind of feelings: happy/positive vs

unhappy/negative, aroused/excited vs unaroused/calm, dominant/important vs submissive/awed (slightly frightened). From 1 (Unhappy, Negative), to 9 (Happy, Positive). From 1 (Unaroused, Calm), to 9 (Aroused, Excited). From 1 (Submissive, Awed), to 9 (Dominant, Important). Then they were asked to select, from 1 to 7 the number they thought that best expressed their level of agreement with the sentences below. "During the experience I felt:" Slow/Quick, Light/Heavy, Weak/Strong, Crouched, Stooped/Elongated, Extended. Very Feminine/Very Masculine. Participants were then asked in which extent they agreed with the following statements, from 1 (I strongly disagree), to 7 (I strongly agree). During the experience it seemed like the sounds I heard were produced by my own footsteps/ body. During the experience it seemed the feeling of my body was less vivid than normal. During the experience the feelings about my body were surprising and unexpected. During the experience it seemed like I could really tell where my feet were.

1.7 Procedure

1.7.1 Pre-experimental Session. Prior to the experiment, the participants were asked to read the information sheet and complete the consent form and the following questionnaires: International Physical Activity Questionnaire (IPAQ) (Spanish validated version), Multidimensional Body Self Relations Questionnaire (MBSRQ) (Spanish validated version), Eating Disorder Examination Questionnaire (EDEQ), Sensory Imagery vividness - the Betts questionnaire (Spanish validated version). Demographics: Age, Gender (male, female, non-binary, prefer not to say), Sex (man, woman, inter-sexual, prefer not to answer), professional experience, anthropometric measurements (height, weight, waist and hip circumferences), Gender self-report [Spanish validated-version] including answering to questions about gender perception and gender aspiration : "I consider myself to be very feminine/masculine" – "I wish to be very feminine/masculine" (7-point Likert-type response items). Eligible participants were invited to the experimental session in the laboratory.

1.7.2 Participant Preparation and Practice Phase. The experiment was performed individually. Prior to the start of the experiment, the experimenter measured participants' weight and height to determine BMI and ensured that the measures provided by the participants during the pre-screening are accurate. Then the participants were assisted to wear the smart suit, to attach the microphones to the experimental shoes, and to wear the headphones. They were then introduced to the Body visualization task and were asked to adjust twice the avatar using the Body Visualizer (the initial avatar weight varied to either 75% or 125% of the participant's actual weight in randomized order to obtain a baseline measure of participant's body image prior to being exposed to the experimental manipulations. Participants were also asked to complete the questionnaires on emotional state and body feelings to collect baseline data on those measures. After participants were provided with task instructions, they completed a practice phase, involving walking along the corridor with all the equipment on and performing all the tasks, to get acclimated to wearing all the equipment and ensure they understood the procedure correctly.

1.7.3 Experiment Execution. The walking experiment is a single-session that took place in the laboratory. Participants were required to complete two repetitions of the three experimental conditions (i.e., High Frequency, Low Frequency and Control). Participants completed a set of two repetitions of the three conditions, with their order randomized across participants. In each experimental trial, participants were asked to "walk-in-place" (i.e., walk without any positional displacement) for 10 seconds (marching phase, while receiving sound feedback on their footsteps. Note that the marching phase allows participants to get used to the sound feedback and increases sound exposure. After a go-ahead signal, participants started the walking phase, in which they walked at their comfortable speed for 6 rounds along the runway while receiving sound feedback on their footsteps. At the end of the marching phase and after each of the 6 rounds,

participants were asked to rate their felt body weight by providing a number from 1 to 7 (i.e., using 7-point Likert-type response items, ranging from light to heavy). The poster, printed and placed on the wall at each corridor end, was used to show to participants this question on felt body weight. The walking phase took on average 1-1.5 minutes for each condition. The experimenter added a particular trigger/sign to mark the trial onset, and the end of the corridor events with the objective of facilitating the subsequent analysis of the sensor data.

At the end of the walking phase (i.e., once the six runway rounds are completed), participants were asked to complete the Body visualisation task (i.e. to adjust twice the avatar using the Body Visualizer, with the initial avatar weight will vary, 75% or 125% of the participant’s actual weight, in a randomized order), the questionnaires on emotional state and body feelings, and the body maps. Participants were given any information or feedback about their performance on the tasks at any point during the experiment. The full procedure took approximately 70 minutes. Following completion of the experiment, participants were fully debriefed. The acquired data and signals were processed and finally saved in a CSV file.

1.8 Body Maps Areas

Body maps were divided, according to Table2, in the areas showed in Figure 4.

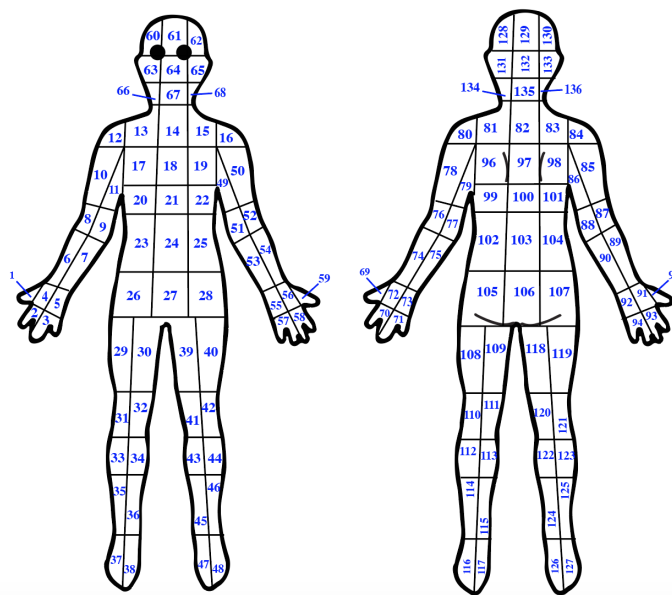


Fig. 4. Body Maps division in 136 areas

Table 2. Body maps areas division

Zone	Area Number,
FLOuterHand	[56,58,59].
FLInnerHand	[55,57].
FLPalm	[55,56].
FLRingPink	[57].

FLIndexMiddle	[58],
FLThumb	[59],
FLForeArm	[53,54],
FLInnerForeArm	[53],
FLOuterForeArm	[54],
FLElbow	[51,52],
FLInnerElbow	[51],
FLOuterElbow	[52],
FLUpperArm	[16,49,50],
FLShoulder	[16],
FLInnerUpperArm	[49],
FLOuterUpperArm	[50],
FLOuterArm	[16,50,52,54],
FLInnerArm	[49,51,53],
FLArm	[16,49,50,51,52,53,54,55,56,57,58,59],
FForehead	[60,61,62],
FRTemple	[60],
FLTemple	[62],
FMiddleForehead	[61],
Nose	[64],
FEars	[63,65],
FREar	[63],
FLEar	[65],
FMouthChin	[67],
FRNeck	[66],
FLNeck	[68],
FNeck	[66,67,68],
FMiddleFace	[63,64,65],
FRMiddleFace	[60,63,66],
FLMiddleFace	[62,65,68],
FHead	[60,61,62,63,64,65,66,67,68],
FLInnerFoot	[47],
FLOuterFoot	[48],
FLFoot	[47,48],
FLInnerShin	[45],
FLOuterShin	[46],
FLShin	[45,46],
FLInnerKnee	[41],
FLOuterKnee	[42],
FLKnee	[41,42],
FLInnerCalf	[43],
FLOuterCalf	[44],
FLCalf	[43,44],
FLInnerThigh	[39],
FLOuterThigh	[40],
FLThigh	[39,40],
FLLeg	[39,40,41,42,43,44,45,46,47,48],
FLOuterLeg	[40,42,44,46,48],
FLInnerLeg	[39,41,43,45,47],
FLUpperInnerLeg	[39,41],
FLUpperOuterLeg	[40,42],
FLLowerInnerLeg	[43,45],
FLLowerOuterLeg	[44,46],
FRHip	[26],
FLHip	[28],
FHips	[26,27,28],
FWaist	[23,24,25],
FChest	[17,18,19,20,21,22],
FUpperChest	[17,18,19],
FLowerChest	[20,21,22],
FClavicle	[13,14,15],
FFullClavicle	[12,13,14,15,16],
FShoulder	[12,16],
FLowerTorso	[23,24,25,26,27,28],
FUpperTorso	[13,14,15,16,17,18,19,20,21,22],
FRUpperTorso	[13,17,20],
FLUpperTorso	[15,19,22],
FRLowerTorso	[23,26],
FLLowerTorso	[25,28],

FbellyButton	[24],
FMiddleTorso	[14,18,21,24,27],
FTorso	[13,14,15,17,18,19,20,21,22,23,24,25,26,27,28],
FRHand	[5,4,3,2,1],
FROuterHand	[4,2,1],
FRInnerHand	[5,3],
FRPalm	[4,5],
FRRingPink	[3],
FRIndexMiddle	[2],
FRThumb	[1],
FRForeArm	[7,6],
FRInnerForeArm	[7],
FROuterForeArm	[6],
FRElbow	[9,8],
FRInnerElbow	[9],
FROuterElbow	[8],
FRUpperArm	[12,11,10],
FRShoulder	[12],
FRInnerUpperArm	[11],
FROuterUpperArm	[10],
FROuterArm	[12,10,8,6],
FRInnerArm	[11,9,7],
FRArm	[12,11,10,9,8,7,6,5,4,3,2,1],
FRInnerFoot	[38],
FROuterFoot	[37],
FRFoot	[38,37],
FRInnerShin	[36],
FROuterShin	[35],
FRShin	[36,35],
FRInnerKnee	[32],
FROuterKnee	[31],
FRKnee	[32,31],
FRInnerCalf	[34],
FROuterCalf	[33],
FRCalf	[34,33],
FRInnerThigh	[30],
FROuterThigh	[29],
FRThigh	[30,29],
FRLeg	[30,29,32,31,34,33,36,35,38,37],
FROuterLeg	[29,31,33,35,37],
FRInnerLeg	[30,32,34,36,38],
FRUpperInnerLeg	[30,32],
FRUpperOuterLeg	[29,31],
FRLowerInnerLeg	[34,36],
FRLowerOuterLeg	[33,35],
BHead	[128,129,130,131,132,133,134,135,136],
BNape	[134,135,136],
BLNape	[134],
BRNape	[136],
BLowerHead	[131,132,133],
BUpperHead	[128,129,130],
BSkull	[128,129,130,131,132,133],
BBottom	[105,106,107],
BWaist	[102,103,104],
BLowerChest	[99,100,101],
BUpperBack	[81,82,83],
BFullShoulders	[80,81,82,83,84],
BShoulders	[80,84],
BChest	[96,97,98,99,100,101],
BSpine	[82,97,100,103,106],
BLBack	[81,96,99,102,105],
BRBack	[83,98,101,104,107],
BLowerTorso	[102,103,104,105,106,107],
BUpperTorso	[81,82,83,96,97,98,99,100,101],
BScapula	[96,98],
BUpperSpine	[82,97],
BLowerSpine	[103,106],
BLBottom	[105],
BRBottom	[107],

BLHand	[73,72,71,70,69],
BLOuterHand	[72,70,69],
BLInnerHand	[73,71],
BLPalm	[73,72],
BLRingPink	[71],
BLIndexMiddle	[70],
BLThumb	[69],
BLForeArm	[75,74],
BLInnerForeArm	[75],
BLOuterForeArm	[74],
BLElbow	[77,76],
BLInnerElbow	[77],
BLOuterElbow	[76],
BLUpperArm	[80,79,78],
BLShoulder	[80],
BLInnerUpperArm	[79],
BLOuterUpperArm	[78],
BLOuterArm	[80,78,76,74],
BLInnerArm	[79,77,75],
BLArm	[80,79,78,77,76,75,74,73,72,71,70,69],
BRHand	[92,91,94,93,95],
BROuterHand	[91,93,95],
BRInnerHand	[92,94],
BRPalm	[92,91],
BRRingPink	[94],
BRIndexMiddle	[93],
BRThumb	[95],
BRForeArm	[90,89],
BRInnerForeArm	[90],
BROuterForeArm	[89],
BRElbow	[88,87],
BRInnerElbow	[88],
BROuterElbow	[87],
BRUpperArm	[84,86,85],
BRShoulder	[84],
BRInnerUpperArm	[86],
BROuterUpperArm	[85],
BROuterArm	[84,85,87,89],
BRInnerArm	[86,88,90],
BRArm	[84,86,85,88,87,90,89,92,91,94,93,95],
BLInnerFoot	[117],
BLOuterFoot	[116],
BLFoot	[117,116],
BLInnerShin	[115],
BLOuterShin	[114],
BLShin	[115,114],
BLInnerKnee	[111],
BLOuterKnee	[110],
BLKnee	[111,110],
BLInnerCalf	[113],
BLOuterCalf	[112],
BLCalf	[113,112],
BLInnerThigh	[109],
BLOuterThigh	[108],
BLThigh	[109,108],
BLLeg	[109,108,111,110,113,112,115,114,117,116],
BLOuterLeg	[108,110,112,114,116],
BLInnerLeg	[109,111,113,115,117],
BLUpperInnerLeg	[109,111],
BLUpperOuterLeg	[108,110],
BLLowerInnerLeg	[113,115],
BLLowerOuterLeg	[112,114],
BRInnerFoot	[126],
BROuterFoot	[127],
BRFoot	[126,127],
BRInnerShin	[124],
BROuterShin	[125],
BRShin	[124,125],
BRInnerKnee	[120],

BROuterKnee	[121].
BRKnee	[120,121].
BRInnerCalf	[122].
BROuterCalf	[123].
BRCalf	[122,123].
BRInnerThigh	[118].
BROuterThigh	[119].
BRThigh	[118,119].
BRLeg	[118,119,120,121,122,123,124,125,126,127].
BROuterLeg	[119,121,123,125,127].
BRInnerLeg	[118,120,122,124,126].
BRUpperInnerLeg	[118,120].
BRUpperOuterLeg	[119,121].
BRLowerInnerLeg	[122,124].
BRLowerOuterLeg	[123,125].

2 SUPPLEMENTARY RESULTS

2.1 Overall

2.1.1 Effects on immediate feedback on perceived weight. Analysing the answers participants gave to the immediate feedback question undergone during the walking phases, we observed that there were, overall, significant differences across conditions also for this question ($F=32.17$, $p<0.001$, $\eta_p^2 = 0.28$): Participants felt lighter in the High frequency with respect to the Low Frequency ($z=-7.17$, $p<0.001$) and the Control condition ($z=-2.95$, $p=0.009$); they also felt lighter in the Control with respect to the Low Frequency condition ($z=-5.97$, $p<0.001$). A significant difference across the trial walking phases was found ($F=3.25$, $p=0.00385$, $\eta_p^2 = 0.04$). When considering as a between-subjects factor the participant's EDEQ group (i.e. high vs low EDEQ score), and the corresponding phase of the experimental trial, there was a significant interaction between sound condition and EDEQ group for this question ($F=2.041$, $p=0.0184$, $\eta_p^2 = 0.03$);

2.1.2 Differences according to eating disorder symptomatology (EDEQ). Effects on Gait biomechanics

Apart from the analyses reported in the main text that consider as a between-subjects factor the participant's EDEQ group (i.e. high vs low EDEQ score), we conducted ANOVAs with participant's EDEQ score as covariate. These showed significant overall effects of sound condition on inter-step interval ($F=4.16$, $p=0.049$, $\eta_p^2 = 0.04$) and a triple interaction with repetition for the number of steps ($F=3.96$, $p=0.002$, $\eta_p^2 = 0.05$), maximum velocity ($F=3.43$, $p=0.035$, $\eta_p^2 = 0.03$) and upward foot acceleration ($F=3.55$, $p=0.031$, $\eta_p^2 = 0.02$). Separate ANOVAs for repetition 1 showed interactions between EDEQ and sound condition for number of steps ($F=6.20$, $p=0.002$, $\eta_p^2 = 0.07$), maximum velocity ($F=3.33$, $p=0.038$, $\eta_p^2 = 0.04$) and upward foot acceleration ($F=3.43$, $p=0.035$, $\eta_p^2 = 0.04$). In the high frequency condition participants with low levels of ED moved faster, with reduced knee flexion values and completed more steps, while, participants with higher EDEQ scores, moved slower and with higher values of knee flexion, completing less steps during the trials. In the low frequency condition participants with low EDEQ scores have higher values of knee flexion angle than in the high condition and complete less steps. Participants with high levels of ED had lower values of knee flexion angle and completed more and longer steps in comparison with the high frequency condition. Overall, high levels of ED seem to slow down participants

Leg muscular activation. When adding the EDEQ score as a covariate, there were significant differences across conditions, for participants with higher EDEQ score the modified sound conditions correspond to lower values of EMG, ($F=5.254$, $p=0.0062$, $\eta_p^2 = 0.06$).

Hip flexion and shoulder sway. Regarding the hip flexion angle maximum value, using EDEQ score as a covariate there was an interaction between sound and EDEQ, ($F=3.61$, $p=0.029$, $\eta_p^2 = 0.05$), participants with higher EDEQ scores

are associated with higher values of hip flexion in the high frequency condition, while participants with low EDEQ score, have higher hip flexion for the low frequency condition.

Regarding thorax extension, using EDEQ score as a covariate there was an interaction between sound condition and EDEQ, ($F=3.13$, $p=0.046$, $\eta_p^2 = 0.04$), participants with higher EDEQ scores are associated with lower values of thorax extension in the high frequency condition compared to the control, while participants with low EDEQ score, have higher thorax extension in the high frequency condition compared to the control and low condition.

Electrodermal Activity EDA sensor data analysis provided significant differences across condition using EDEQ score as a covariate. Participants with higher levels of eating disorders symptomatology have lower values of EDA mean for all conditions, additionally, while participants with low EDEQ score have lower values of EDA mean for the lower condition, compared to the high condition, high levels of EDEQ correspond to higher values of EDA for the low frequency condition, compared to the high. ($F=4.868$ $p=0.009$, $\eta_p^2 = 0.07$). When considering as a between-subjects factor the participant's EDEQ group (i.e. high vs low EDEQ score), there was a significant interaction between sound condition and EDEQ group for Mean EDA value ($F=3.93$, $p=0.0218$, $\eta_p^2 = 0.04$).

2.1.3 Differences according to level of physical activity (IPAQ). . **Effects on Body feelings**

When adding the participant's EDEQ score as a covariate there was a triple interaction between sound, repetition and EDEQ for feeling the sound as being more surprising ($F=3.75$ $p=0.025$ $\eta_p^2 = 0.04$).

Effects on Gait biomechanics

The ANOVAs with participant's IPAQ score as covariate showed a triple interaction with sound condition and repetition for number of steps ($F=3.23$, $p=0.042$, $\eta_p^2 = 0.01$).

Leg muscular activations

Using IPAQ score as a covariate significant differences were found across conditions for muscle activation mean ($F=5.391$, $p=0.00546$, $\eta_p^2 = 0.07$). Overall participants with high levels of PA correspond to high values of EMG activation means and lower values of duration for the high frequency condition, while participants with low levels of PA have higher values of EMG activation means and lower values of duration for the low frequency condition,

Lateral Hip and Shoulder Sway Using IPAQ score as a covariate, an interaction was found between sound and levels of PA, ($F=4.162$, $p=0.0176$, $\eta_p^2 = 0.06$): for participants with higher levels of PA all sound conditions provoked higher values of hip flexion. For the high frequency condition participants with LOW IPAQ have lower values of hip flexion compared to the low frequency condition, while for participants with high levels of PA the high frequency condition is associated with drastically bigger values of hip flexion angle compared to the low frequency condition.

Electrocardiac Activity ANOVAs performed on the number of successive RR intervals that differ by more than 50ms showed differences across conditions, when adding IPAQ score as a covariate ($F=3.13$, $p=0.047$, $\eta_p^2 = 0.04$), and for Root mean square of successive RR interval difference ($F=3.24$, $p=0.042$, $\eta_p^2 = 0.04$), according to [14] high levels of Physical activity promote higher HRV values, additionally with the modulated sound this phenomena is increased.

2.1.4 Differences according to sensory imagery vividness. **Questionnaire Results** Apart from the interactions already reported in the main paper, for felt weight we found an interaction between gustatory imagery vividness score, repetition and sound condition ($F=3.42$ $p=0.035$, $\eta_p^2 = 0.01$). Separate analyses for each repetition on the perceived weight scores showed significant interaction effects only for the second repetition ($F=3.83$, $p=0.024$, $\eta_p^2 = 0.05$). We observe more pronounced differences in felt body weight due to sound condition for people with high gustatory imagery scores, who felt the heaviest with LF; in those with low imagery scores we observe they felt the lightest with HF.

2.2 Results - Graphs

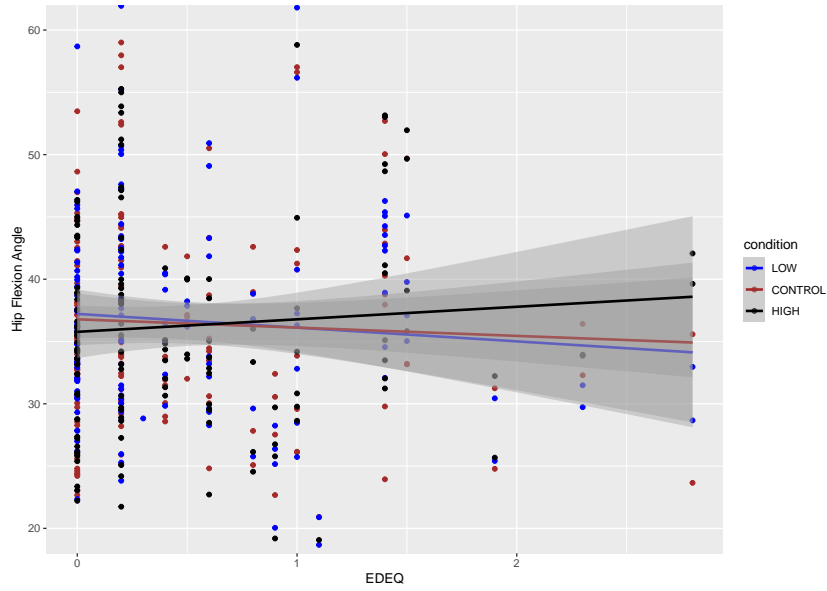


Fig. 5. Hip flexion variation for SED groups

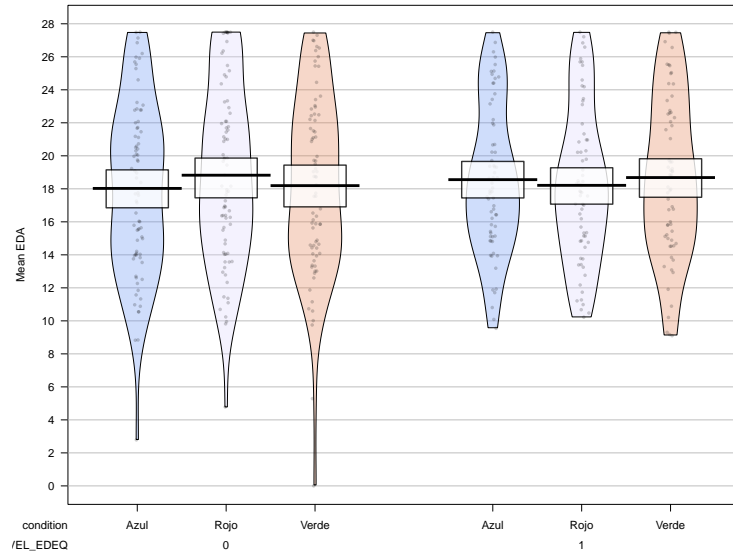


Fig. 6. EDA mean variation for SED groups

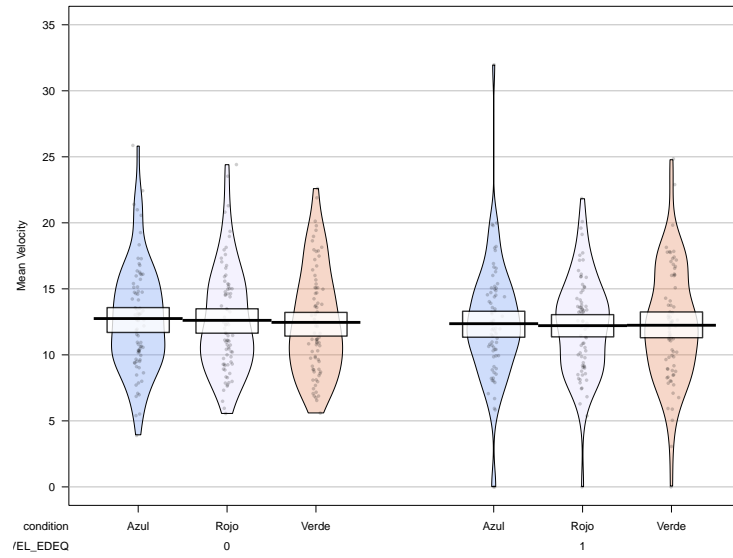


Fig. 7. Covariant Mean Velocity EDEQ

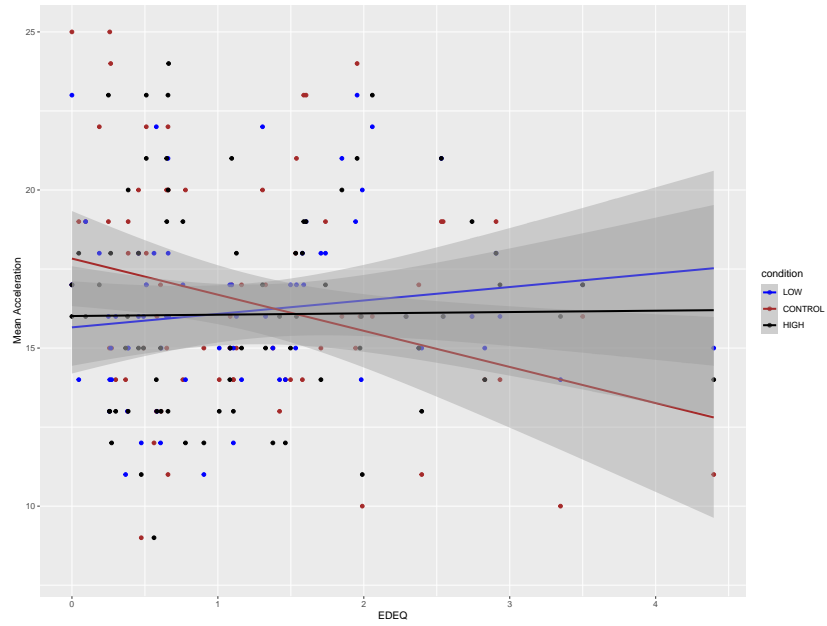


Fig. 8. Covariant Steps Number EDEQ

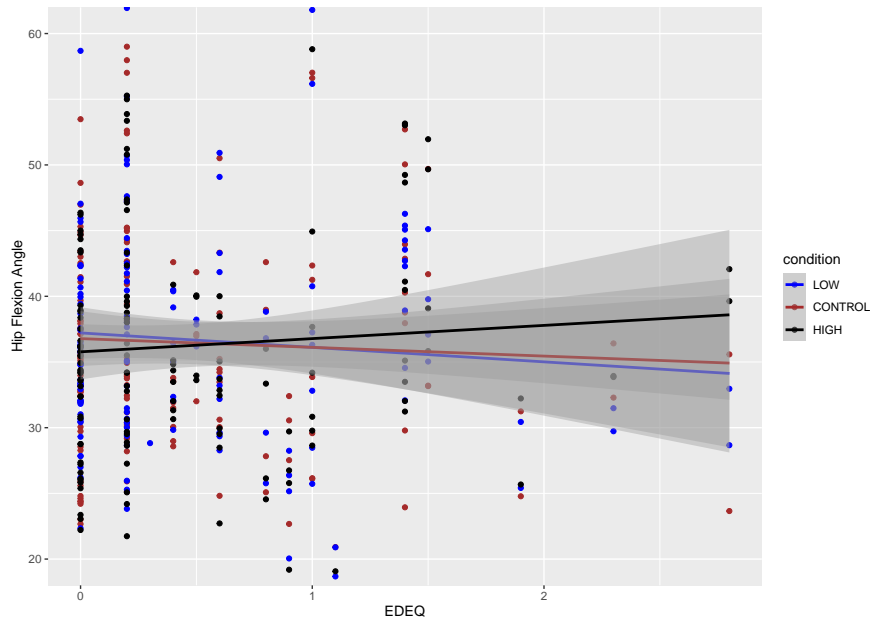


Fig. 9. Covariant Hip EDEQ

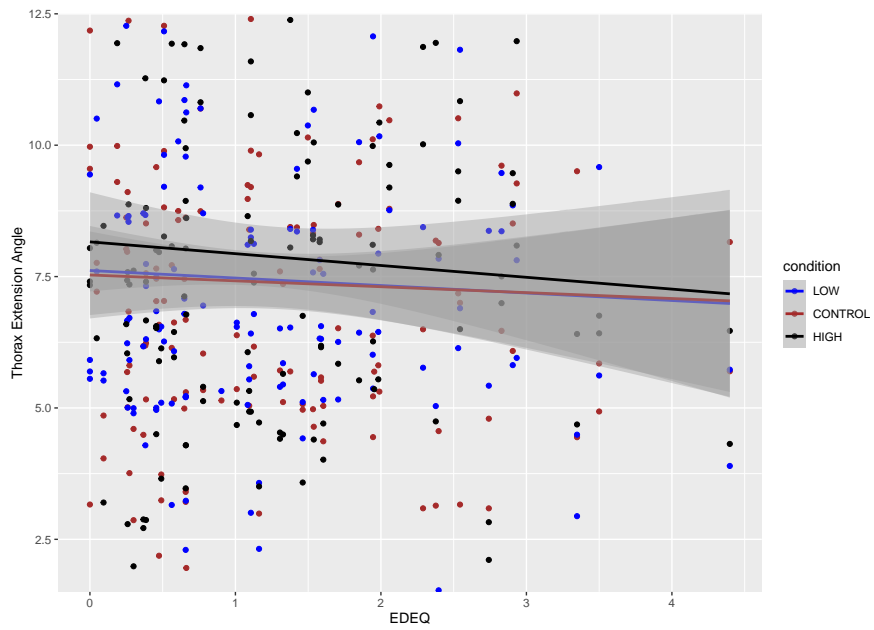


Fig. 10. Thorax extension variation for SED groups

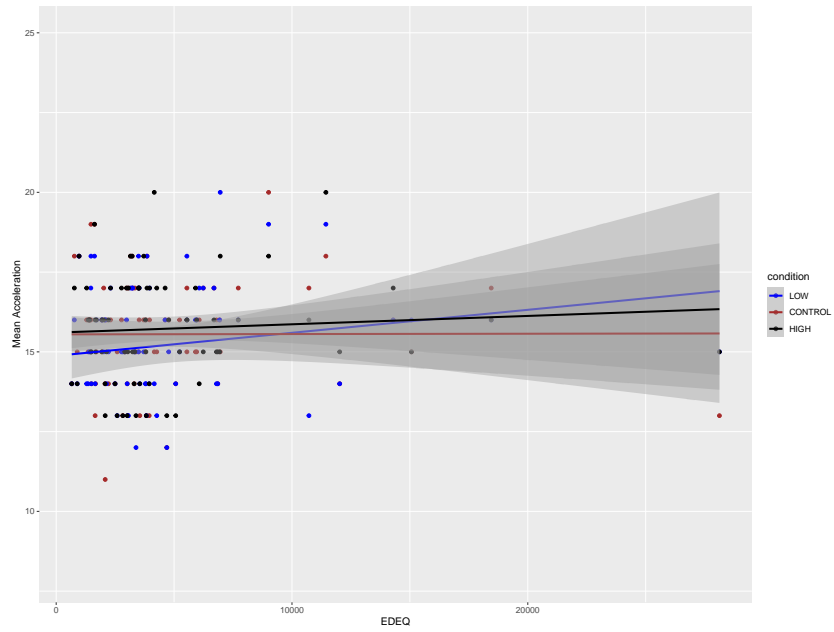


Fig. 11. Number of steps for PA Group

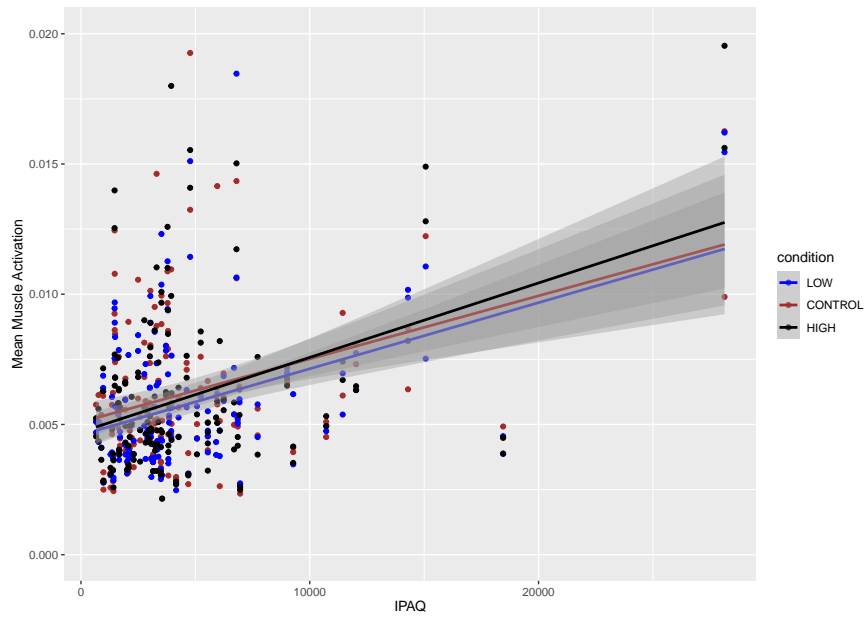


Fig. 12. EMG Activation for PA Group

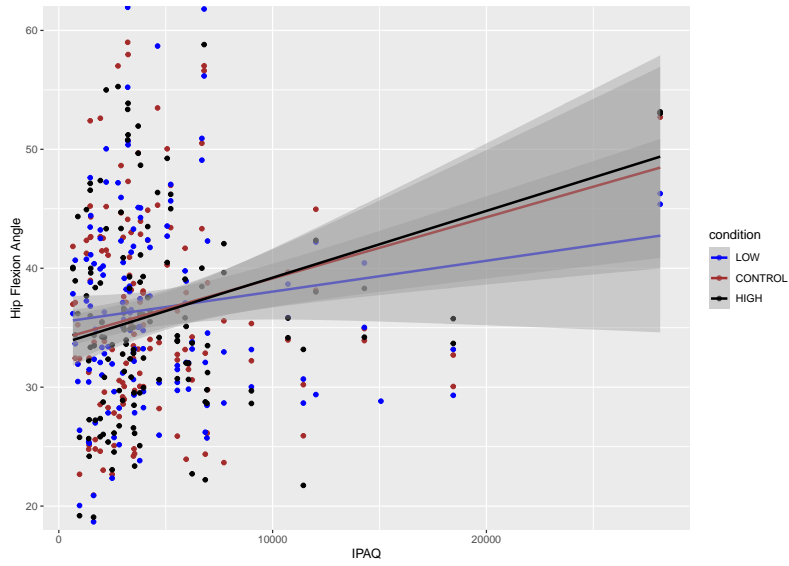


Fig. 13. Hip's flexion angle for PA Group

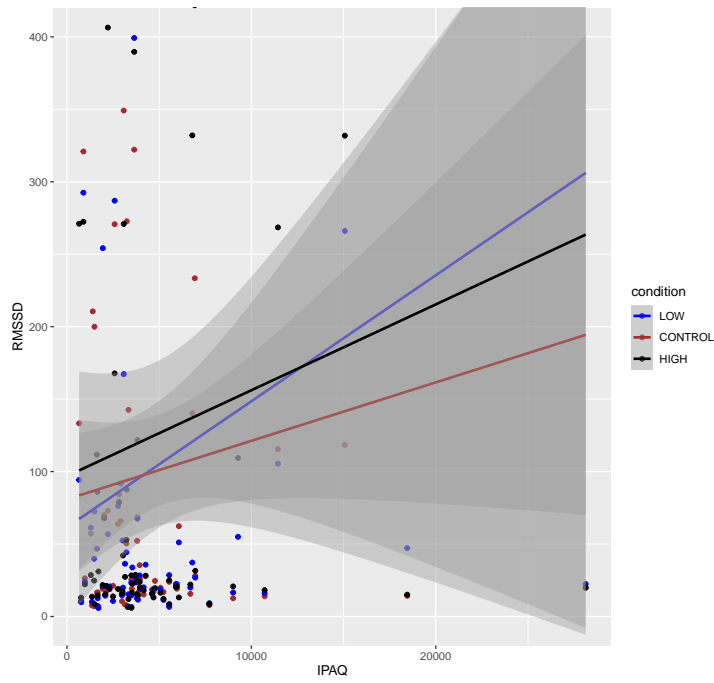


Fig. 14. RMSSD variation for PA Group

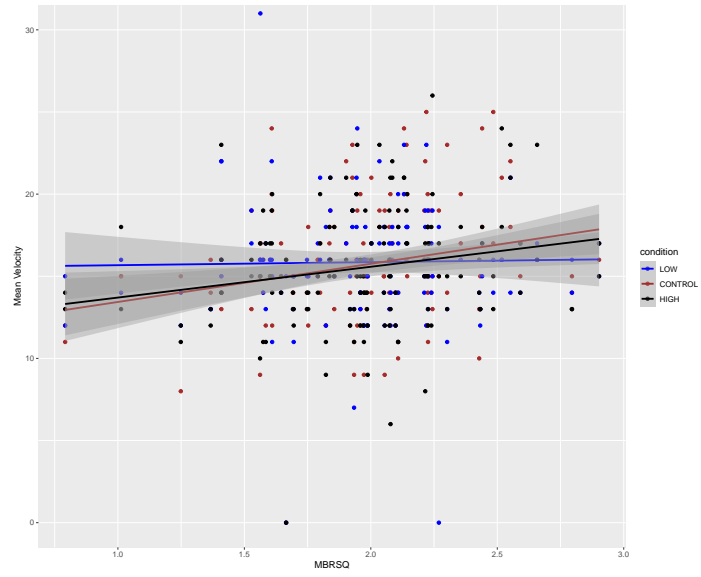


Fig. 15. Number of steps variation for MBSRQ individual differences

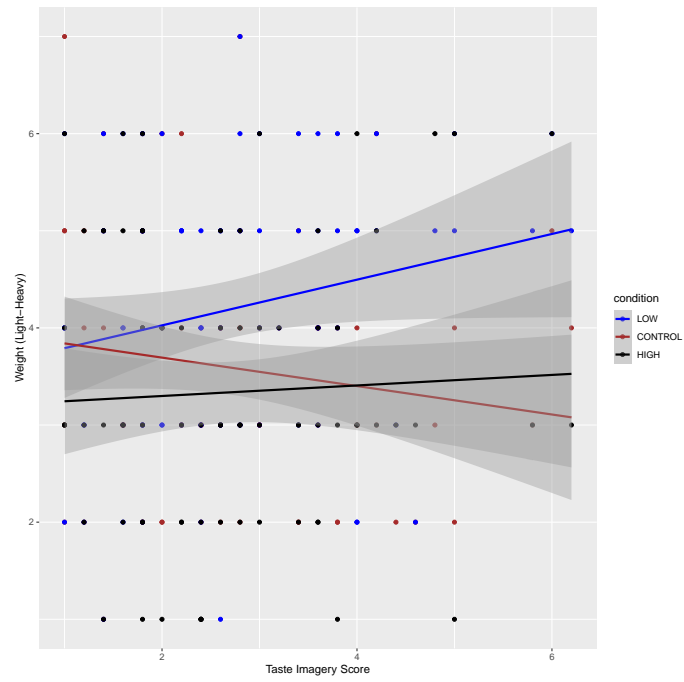


Fig. 16. Weight score variation for Taste imagery individual differences

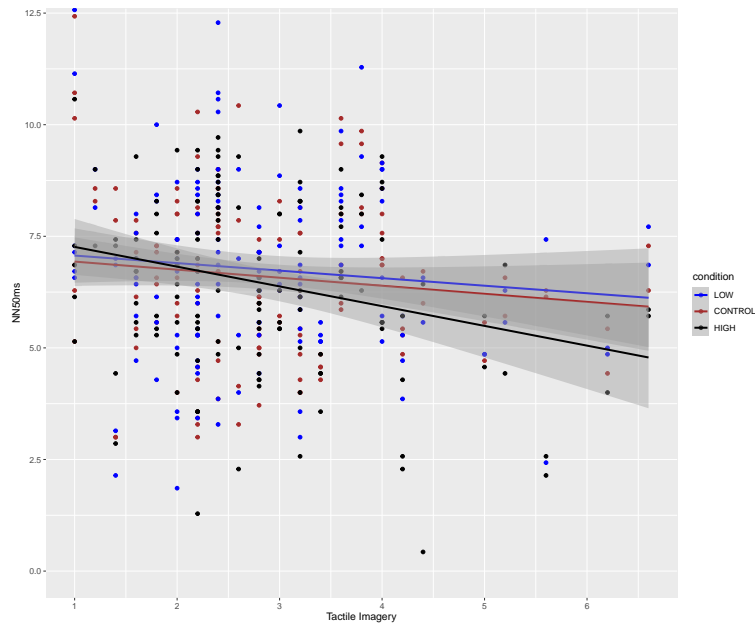


Fig. 17. Heart Rate Variation for Tactile imagery individual differences

2.3 Body Maps Results - Graphs

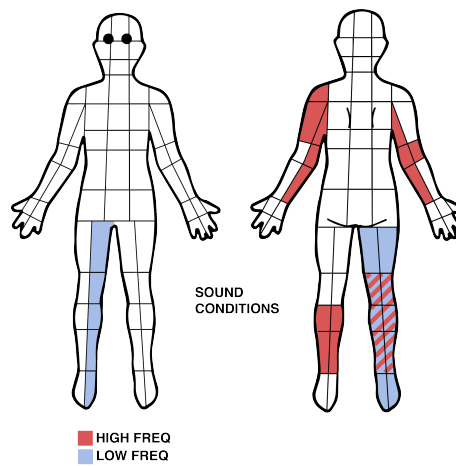


Fig. 18. Body Map results for overall sound effects

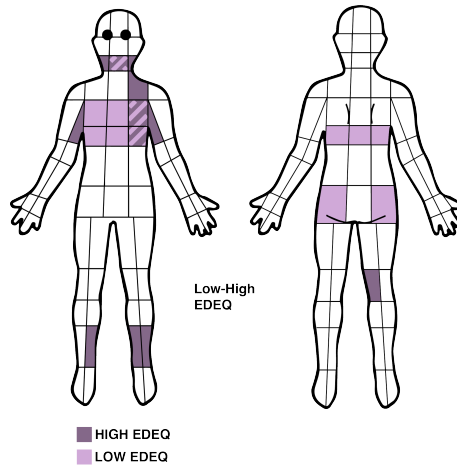


Fig. 19. Body Map results on LOW EDEQ Group

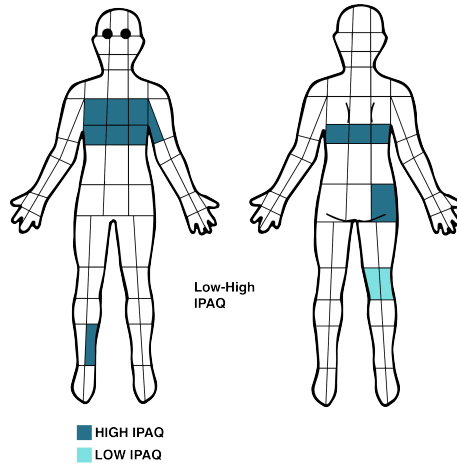


Fig. 20. Body Map results for HIGH IPAQ Group

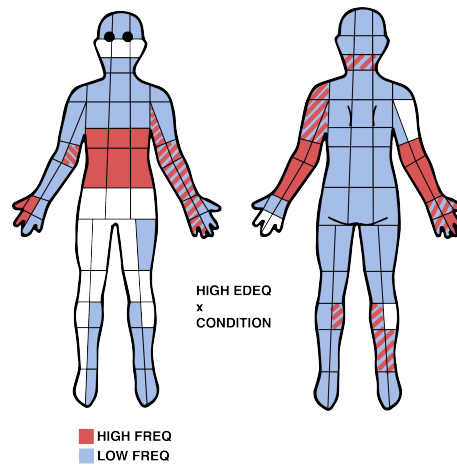


Fig. 21. Body Map results for sound effects on HIGH EDEQ Group

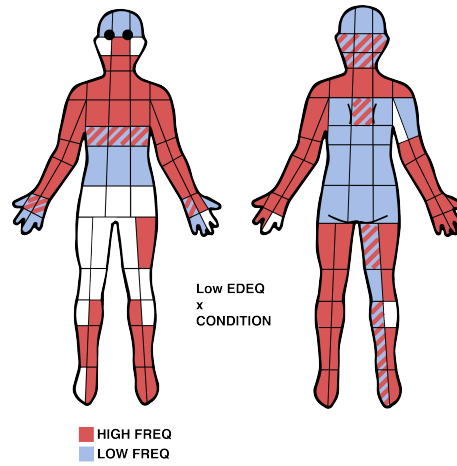


Fig. 22. Body Map results for sound effects on LOW EDEQ Group

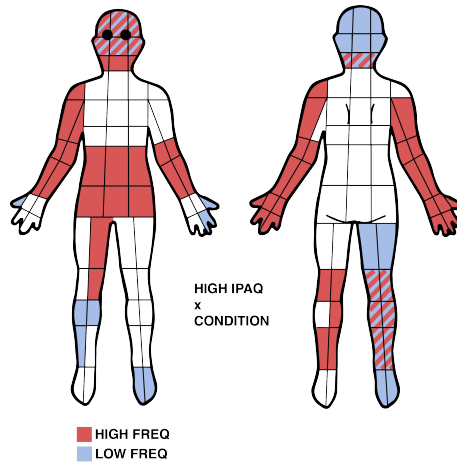


Fig. 23. Body Map results for sound effects on HIGH IPAQ Group

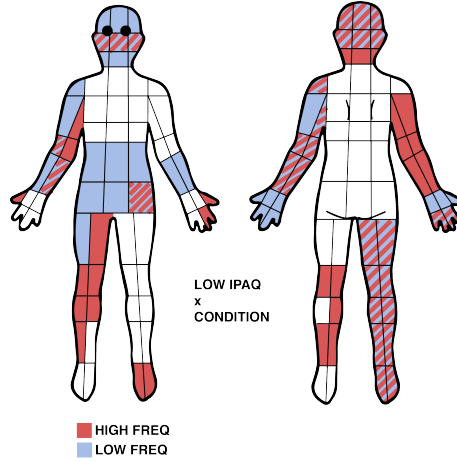


Fig. 24. Body Map results for sound effects on LOW IPAQ Group

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Table 3. Body-effect sonification design framework with design implications based on the effects of altered footstep sound feedback observed in this and previous studies with healthy, sub-clinical and clinical populations. Color indicates if effects found in this study were congruent (Green) or incongruent (Red) with those observed in previous studies. Blue color shows that the effect had not been previously investigated or not reported.

Low Frequency								
	General population	Chronic pain (CRPS)	Stroke	ED symptomatology	PA level	Body weight	Body concerns	Feminine/ masculine wish
Emotional feelings		Dominant [5]		Dominant				
Body feelings	Heavy [2, 6, 7]], slow [6], masculine [2, 7], strong [2], less proprioception, surprise [7]	Quick, strong, better proprioception, surprise, agency [5]		More vivid experience, less proprioception		Heavier participants felt more masculine [7]	People with high body concerns, felt stronger and more surprised	Larger effect on felt heaviness for women [2]
Body visualization	Bigger/heavier body [7]							Bigger/heavier body when more masculine wish [7]
Gait biomechanics	Longer foot-ground contact time [4], less leg acceleration [7], more hip sway	Longer foot-ground contact time [5]	Reduction in foot stance and stride time asymmetry, inversion in foot force asymmetry [3]			Heavier participants applied less leg force and acceleration [7]	People with body concerns moved faster	
Physiological responses		-		Higher EDA for high SED	Lower EDA for inactive and active participants			
Pain	-	-						
PA facilitation	More difficult [7]		Faster to complete a walking track [3]					
Body part affected	Lower body	Limb with pain [5]		Rear body, upper head, mouth, chin, chest, arms, hands, neck, distal lower limbs for high SED. Upper head, lower chest, back for low SED	Head, feet, right leg for active participants. Limbs, head, lower chest, waist for inactive			
High Frequency								
	General population	Chronic pain (CRPS)	Stroke	ED symptomatology	PA level	Body weight	Body concerns	Gender
Emotional feelings	Happy [4], aroused [7]	-			People with low PA felt happier. People with high PA felt more aroused			
Body feelings	Quick [1, 3, 6], light [2, 4, 6, 7], strong [4], straighter [4], feminine [2, 7], better proprioception [4], surprise	Quick, light, better proprioception, surprise, agency [5]		Slow [6], less proprioception	People with low PA felt straighter	Lighter participants felt more feminine [7]	People with high body concerns, felt weaker and more surprised	
Body visualization	Smaller/lighter body [4, 7]	Larger perceived body part (interaction with pain condition) [5]		Bigger/heavier body (inverted pattern) [6]		Smaller/lighter body for heavier participants [7]		Smaller/lighter body when more feminine wish [7]
Gait biomechanics	More leg acceleration [1, 4] and velocity [1]. Higher muscle activation	-	Inversion in asymmetries in foot acceleration, stance and stride time, reduction in foot force asymmetry [3]	Longer stride times, less acceleration (inverted pattern) [6]			People with low body concerns moved faster. People with high body concerns with higher hip sway.	
Physiological responses	More EDA [4], lower heart rate, higher SDNN and RMSSD	-		Higher EDA for high SED	Lower EDA for active participants		Lower heart rate for low body concerns, higher heart rate for high body concerns	
Pain		Unpleasant pain [5]						
PA facilitation				1		Larger facilitation for heavier participants [7]		
Body part affected	Upper body	Limb with pain [5]	Limb with pain [5]	Arms, lower chest, waist, neck, hands for low SED. Upper chest, distal arms and legs for high SED	More changes for active participants (chest, waist, arms, hands, face, mouth, neck). Limbs for inactive			

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SoniWeight Shoes: Investigating Effects and Personalization of a Wearable Sound Device for Altering Body Perception and Behavior

SUPPLEMENTARY TABLES

1 BODY MAP RESULTS - AREA MEANS

Table 4. LOW VS HIGH EDEQ

Zone	Significance level	LOW EDEQ	HIGH EDEQ
FLInnerUpperArm	**	0.06	0.07
FMouthChin	*	0.01	0.01
FLNeck	*	0.01	0.02
Fneck	*	0.02	0.02
FLInnerShin	*	0.12	0.15
FLOuterShin	*	0.11	0.14
FLShin	*	0.12	0.15
Fchest	*	0.11	0.14
FLowerChest	**	0.08	0.05
FLUpperTorso	*	0.11	0.17
FRInnerUpperArm	*	0.05	0.06
FRInnerShin	*	0.11	0.14
BLowerChest	*	0.1	0.07
BLBottom	*	0.1	0.08
BRBottom	*	0.1	0.08
BRInnerKnee	*	0.14	0.15

Table 5. LOW VS HIGH IPAQ

Zone	Significance Level	LOW IPAQ	HIGH IPAQ
Fchest	*	0.07	0.18
FLowerChest	**	0.02	0.11
FRInnerUpperArm	*	0.02	0.08
FRInnerShin	*	0.07	0.16
BLowerChest	*	0.04	0.13
BRBottom	*	0.04	0.12
BRInnerKnee	*	0.2	0.1
BRKnee	*	0.21	0.12

Table 6. Only Sound Conditions

Zone	Significance Level	Control	Low	High
FRInnerLeg	*	0.35	0.44	0.43
BLInnerForeArm	*	0.02	0.01	0.04
BLInnerElbow	**	0.03	0.01	0.06
BLShoulder	*	0.06	0.1	0.13
BLOuterUpperArm	*	0.05	0.04	0.09
BLInnerArm	*	0.04	0.04	0.09
BRInnerForeArm	*	0.02	0.01	0.05
BRElbow	*	0.03	0.01	0.05
BRInnerElbow	**	0.03	0.01	0.05
BRInnerArm	*	0.03	0.07	0.1
BLInnerShin	*	0.05	0.1	0.12
BLOuterShin	*	0.06	0.1	0.14

Zone	Significance Level	Control	Low	High
BLShin	*	0.06	0.12	0.14
BLOuterCalf	*	0.09	0.11	0.16
BLCalf	*	0.09	0.13	0.17
BLLowerInnerLeg	*	0.1	0.16	0.16
BLLowerOuterLeg	*	0.1	0.15	0.18
BRInnerShin	*	0.05	0.1	0.13
BROuterShin	*	0.05	0.1	0.12
BRShin	*	0.06	0.1	0.14
BRKnee	*	0.12	0.16	0.2
BRInnerCalf	*	0.08	0.12	0.16
BRCalf	*	0.1	0.13	0.18
BROuterLeg	*	0.27	0.37	0.31
BRInnerLeg	*	0.27	0.38	0.33
BRLowerInnerLeg	**	0.09	0.16	0.19
BRLowerOuterLeg	*	0.1	0.16	0.17

Table 7. LOW EDEQ + SOUND CONDITIONS

Zone	Significance Level	Control	Low	High
FLInnerHand	**	0.01	0.03	0.02
FLPalm	***	0.01	0.02	0.02
FLRingPink	**	0	0.02	0.01
FLThumb	***	0	0.02	0.01
FLForeArm	***	0.04	0.04	0.04
FLInnerForeArm	***	0.01	0.03	0.03
FLElbow	*	0.02	0.03	0.07
FLInnerElbow	***	0.02	0.02	0.07
FLOuterElbow	*	0.02	0.02	0.05
FLShoulder	***	0.07	0.03	0.09
FLOuterArm	*	0.13	0.08	0.14
FLInnerArm	***	0.05	0.09	0.1
FLArm	**	0.19	0.18	0.2
FForehead	***	0.05	0.1	0.05
Nose	***	0	0	0
FMouthChin	***	0	0.01	0.03
FRNeck	***	0.01	0	0.02
FLInnerFoot	**	0.14	0.17	0.2
FLOuterFoot	**	0.15	0.17	0.2
FLFoot	*	0.15	0.17	0.2
FLInnerShin	*	0.08	0.11	0.16
FLOuterShin	*	0.07	0.1	0.15
FLShin	*	0.08	0.11	0.17
FLOuterThigh	**	0.13	0.12	0.16
FLLowerInnerLeg	**	0.09	0.16	0.19
FWaist	***	0.12	0.26	0.17
FLowerChest	***	0.06	0.1	0.08
FShoulder	**	0.09	0.05	0.09
FUpperTorso	*	0.12	0.14	0.15
FRUpperTorso	*	0.11	0.12	0.12
FLUpperTorso	*	0.09	0.12	0.12
FbellyButton	***	0.09	0.2	0.12
FROuterHand	***	0.01	0.04	0.02
FRInnerHand	***	0.01	0.03	0.02
FRPalm	***	0.01	0.02	0.02
FRRingPink	***	0	0.02	0.01
FRIndexMiddle	***	0	0.02	0.01
FRThumb	***	0	0.02	0.01
FRForeArm	***	0.03	0.03	0.05
FROuterForeArm	***	0.03	0.03	0.05

Zone	Significance Level	Control	Low	High
FRInnerElbow	***	0.01	0	0.05
FROuterElbow	*	0.02	0.01	0.05
FRUpperArm	*	0.11	0.09	0.15
FRShoulder	*	0.08	0.05	0.08
FROuterUpperArm	*	0.06	0.07	0.09
FROuterArm	*	0.13	0.09	0.15
FRInnerArm	***	0.03	0.05	0.11
FRInnerFoot	**	0.15	0.18	0.19
FROuterShin	**	0.08	0.09	0.16
FRInnerCalf	**	0.07	0.1	0.12
FRLowerInnerLeg	*	0.11	0.14	0.19
BHead	***	0.05	0.06	0.05
BNape	**	0.02	0	0.02
BLowerHead	**	0.01	0.03	0.03
BUpperHead	***	0.03	0.06	0.04
BSkull	***	0.03	0.06	0.04
BLowerChest	***	0.07	0.12	0.1
BUpperBack	**	0.13	0.08	0.1
BFullShoulders	***	0.13	0.1	0.15
BShoulders	*	0.09	0.07	0.14
BChest	**	0.09	0.14	0.12
BLowerTorso	**	0.27	0.28	0.24
BUpperSpine	***	0.08	0.1	0.11
BLPalm	**	0	0	0.03
BLThumb	*	0	0	0.02
BLForeArm	***	0.02	0.01	0.03
BLInnerForeArm	***	0.01	0	0.03
BLOuterForeArm	**	0.02	0.01	0.03
BLElbow	***	0.01	0.01	0.05
BLOuterElbow	***	0.01	0.01	0.04
BLUpperArm	***	0.1	0.08	0.17
BLInnerUpperArm	***	0.02	0.03	0.07
BLOuterUpperArm	**	0.04	0.02	0.09
BLOuterArm	***	0.11	0.07	0.16
BLInnerArm	***	0.02	0.03	0.07
BRHand	***	0	0	0.03
BROuterHand	***	0	0	0.03
BRInnerHand	***	0	0	0.03
BRPalm	***	0	0	0.03
BRRingPink	***	0	0	0.01
BRIndexMiddle	***	0	0	0.01
BRThumb	***	0	0	0.01
BRForeArm	***	0.02	0.02	0.07
BRInnerForeArm	***	0.01	0.01	0.04
BRElbow	***	0.01	0	0.04
BRInnerElbow	***	0.01	0	0.04
BROuterElbow	***	0.01	0	0.04
BRShoulder	***	0.09	0.07	0.13
BLOuterFoot	***	0.15	0.15	0.17
BLFoot	***	0.15	0.15	0.17
BLInnerCalf	*	0.09	0.13	0.14
BLInnerThigh	*	0.07	0.06	0.13
BLOuterThigh	**	0.06	0.06	0.14
BLLeg	***	0.3	0.3	0.32
BLOuterLeg	***	0.29	0.28	0.32
BLInnerLeg	***	0.27	0.29	0.3
BRInnerFoot	***	0.15	0.16	0.18
BROuterFoot	***	0.15	0.16	0.18
BRFoot	*	0.15	0.16	0.18
BRInnerShin	**	0.04	0.07	0.11
BROuterShin	**	0.04	0.07	0.11
BRShin	*	0.05	0.07	0.12

Zone	Significance Level	Control	Low	High
BRInnerCalf	*	0.07	0.09	0.14
BRInnerThigh	*	0.06	0.08	0.11
BROuterThigh	***	0.07	0.08	0.1
BRThigh	***	0.07	0.08	0.12
BRInnerLeg	**	0.27	0.33	0.31
BRUpperOuterLeg	**	0.16	0.19	0.21

Table 8. HIGH EDEQ + SOUND CONDITIONS

Zone	Significance Level	Control	Low	High
FLInnerHand	**	0.04	0.04	0.06
FLPalm	***	0.01	0.04	0.07
FLRingPink	**	0.02	0.04	0.02
FLThumb	***	0.01	0.02	0.01
FLForeArm	***	0.01	0.06	0.06
FLInnerForeArm	***	0.01	0.06	0.06
FLElbow	*	0.07	0.08	0.1
FLInnerElbow	***	0.06	0.07	0.1
FLOuterElbow	*	0.05	0.08	0.06
FLShoulder	***	0.05	0.11	0.1
FLOuterArm	*	0.12	0.21	0.17
FLInnerArm	***	0.1	0.12	0.14
FLArm	**	0.13	0.23	0.2
FForehead	***	0.05	0.06	0.02
Nose	***	0.02	0	0
FMouthChin	***	0.01	0.01	0
FRNeck	***	0.01	0.01	0
FLInnerFoot	**	0.17	0.23	0.18
FLOuterFoot	**	0.17	0.21	0.18
FLFoot	*	0.17	0.23	0.19
FLInnerShin	*	0.14	0.17	0.14
FLOuterShin	*	0.13	0.17	0.13
FLShin	*	0.14	0.17	0.15
FLOuterThigh	**	0.13	0.19	0.13
FLLowerInnerLeg	**	0.18	0.21	0.18
FWaist	***	0.11	0.12	0.15
FLowerChest	***	0.04	0.06	0.06
FShoulder	**	0.08	0.14	0.11
FUpperTorso	*	0.18	0.21	0.23
FRUpperTorso	*	0.13	0.19	0.18
FLUpperTorso	*	0.12	0.2	0.18
FbellyButton	***	0.08	0.1	0.12
FROuterHand	***	0.01	0.05	0.05
FRInnerHand	***	0.01	0.06	0.05
FRPalm	***	0	0.04	0.05
FRRingPink	***	0.01	0.05	0.04
FRIndexMiddle	***	0.01	0.04	0.04
FRThumb	***	0	0.02	0
FRForeArm	***	0.02	0.07	0.06
FROuterForeArm	***	0.02	0.07	0.06
FRInnerElbow	***	0.04	0.07	0.07
FROuterElbow	*	0.04	0.08	0.06
FRUpperArm	*	0.12	0.21	0.15
FRShoulder	*	0.07	0.12	0.11
FROuterUpperArm	*	0.08	0.11	0.07
FROuterArm	*	0.12	0.24	0.18
FRInnerArm	***	0.08	0.13	0.11
FRInnerFoot	**	0.18	0.23	0.18
FROuterShin	**	0.13	0.18	0.15

Zone	Significance Level	Control	Low	High
FRInnerCalf	**	0.13	0.12	0.14
FRLowerInnerLeg	*	0.17	0.2	0.17
BHead	***	0.08	0.11	0.08
BNape	**	0	0.02	0.02
BLowerHead	**	0.06	0.08	0.06
BUpperHead	***	0.04	0.05	0
BSkull	***	0.08	0.1	0.06
BLowerChest	***	0.06	0.08	0.06
BUpperBack	**	0.14	0.19	0.21
BFullShoulders	***	0.15	0.24	0.21
BShoulders	*	0.08	0.18	0.11
BChest	**	0.14	0.18	0.14
BLowerTorso	**	0.19	0.26	0.25
BUpperSpine	***	0.21	0.18	0.19
BLPalm	**	0.01	0.04	0.02
BLThumb	*	0.01	0.02	0
BLForeArm	***	0.04	0.05	0.07
BLInnerForeArm	***	0.02	0.01	0.06
BLOuterForeArm	**	0.04	0.04	0.07
BLElbow	***	0.07	0.02	0.07
BLOuterElbow	***	0.05	0.02	0.05
BLUpperArm	***	0.12	0.17	0.14
BLInnerUpperArm	***	0.05	0.06	0.07
BLOuterUpperArm	**	0.07	0.06	0.08
BLOuterArm	***	0.12	0.18	0.18
BLInnerArm	***	0.06	0.06	0.12
BRHand	***	0.01	0.04	0.04
BROuterHand	***	0.01	0.04	0.04
BRInnerHand	***	0.01	0.02	0.04
BRPalm	***	0.01	0.04	0.02
BRRingPink	***	0.01	0.01	0.02
BRIndexMiddle	***	0.01	0.01	0.02
BRThumb	***	0.01	0.02	0
BRForeArm	***	0.05	0.04	0.07
BRInnerForeArm	***	0.02	0.01	0.06
BRElbow	***	0.06	0.02	0.07
BRInnerElbow	***	0.05	0.01	0.07
BROuterElbow	***	0.05	0.02	0.06
BRShoulder	***	0.08	0.18	0.08
BLOuterFoot	***	0.13	0.18	0.12
BLFoot	***	0.13	0.18	0.12
BLInnerCalf	*	0.07	0.12	0.13
BLInnerThigh	*	0.07	0.15	0.1
BLOuterThigh	**	0.08	0.15	0.1
BLLeg	***	0.27	0.42	0.32
BLOuterLeg	***	0.27	0.42	0.32
BLInnerLeg	***	0.25	0.42	0.3
BRInnerFoot	***	0.13	0.18	0.13
BROuterFoot	***	0.13	0.18	0.14
BRFoot	*	0.13	0.18	0.14
BRInnerShin	**	0.07	0.13	0.14
BROuterShin	**	0.06	0.14	0.13
BRShin	*	0.07	0.14	0.15
BRInnerCalf	*	0.1	0.15	0.19
BRInnerThigh	*	0.07	0.15	0.11
BROuterThigh	***	0.06	0.15	0.11
BRThigh	***	0.07	0.15	0.11
BRInnerLeg	**	0.29	0.44	0.36
BRUpperOuterLeg	**	0.13	0.21	0.2

Table 9. LOW IPAQ + SOUND CONDITIONS

Zone	Significance Level	Control	Low	High
FLIndexMiddle	*	0.06	0.06	0.06
FLThumb	***	0	0.01	0.01
FLInnerForeArm	***	0.01	0.05	0.02
FLOuterForeArm	***	0.01	0.05	0.02
FLElbow	***	0.05	0.05	0.06
FLInnerElbow	***	0.05	0.05	0.06
FForehead	***	0.07	0.12	0.05
FRTemple	***	0.05	0.08	0.05
FLTemple	***	0.05	0.1	0.05
FMiddleForehead	***	0.07	0.08	0.02
Nose	***	0.02	0	0
FEars	***	0.06	0.07	0.1
FRear	***	0.05	0.07	0.08
FLear	***	0.06	0.07	0.1
FRNeck	*	0.01	0	0
FMiddleFace	***	0.06	0.07	0.1
FLMiddleFace	***	0.1	0.13	0.11
FHead	***	0.13	0.15	0.11
FOutterFoot	**	0.14	0.19	0.2
FLFoot	**	0.14	0.19	0.21
FLHip	***	0.1	0.11	0.11
FLowerTorso	*	0.26	0.27	0.21
FLLowerTorso	**	0.15	0.23	0.18
FRThumb	***	0	0.01	0.01
FRForeArm	***	0.01	0.06	0.04
FROuterForeArm	***	0.01	0.06	0.04
FRElbow	***	0.05	0.04	0.05
FROuterElbow	***	0.02	0.04	0.04
FROuterArm	**	0.12	0.14	0.13
FRInnerArm	**	0.05	0.07	0.08
FRInnerKnee	*	0.21	0.26	0.31
FROuterKnee	**	0.21	0.25	0.31
FRKnee	**	0.21	0.26	0.32
FROuterCalf	***	0.13	0.1	0.17
FRcalf	***	0.13	0.1	0.17
FRInnerThigh	*	0.08	0.14	0.17
FROuterThigh	*	0.14	0.15	0.14
FRUpperInnerLeg	**	0.25	0.29	0.33
FRLowerOuterLeg	*	0.14	0.13	0.2
BHead	***	0.07	0.08	0.08
BNape	***	0.01	0.01	0.02
BLNape	***	0.01	0	0.02
BUpperHead	***	0.05	0.06	0.04
BSkull	***	0.06	0.07	0.06
BLPalm	***	0	0.02	0
BLRingPink	***	0.02	0.04	0.02
BLIndexMiddle	***	0.02	0.04	0.02
BLThumb	*	0	0.01	0
BLForeArm	***	0.01	0.02	0.04
BLInnerForeArm	***	0.01	0.01	0.02
BLOuterForeArm	***	0.01	0.01	0.04
BLOuterElbow	***	0.02	0.01	0.02
BLShoulder	***	0.07	0.07	0.07
BLInnerUpperArm	***	0.04	0.04	0.04
BLOuterArm	***	0.12	0.1	0.11
BLInnerArm	***	0.05	0.04	0.06
BLArm	***	0.14	0.14	0.12
BRHand	***	0	0.02	0.01
BROuterHand	***	0	0.02	0.01

Zone	Significance Level	Control	Low	High
BRInnerHand	***	0	0.02	0.01
BRPalm	***	0	0.02	0
BRRingPink	***	0	0.01	0.01
BRIndexMiddle	***	0	0.01	0.01
BRThumb	***	0	0.01	0
BRForeArm	***	0.01	0.04	0.05
BROuterForeArm	***	0.01	0.02	0.05
BRElbow	***	0.04	0.01	0.04
BROuterElbow	***	0.02	0.01	0.02
BRInnerUpperArm	***	0.02	0.02	0.04
BROuterUpperArm	**	0.04	0.05	0.05
BLInnerShin	***	0.02	0.06	0.08
BLShin	*	0.04	0.08	0.12
BLOuterKnee	*	0.13	0.18	0.19
BLKnee	*	0.13	0.18	0.19
BLInnerCalf	**	0.1	0.13	0.14
BROuterFoot	**	0.14	0.18	0.18
BRFoot	**	0.14	0.18	0.18
BRInnerShin	***	0.04	0.07	0.1
BROuterShin	*	0.02	0.08	0.08
BRShin	***	0.04	0.08	0.11
BRInnerKnee	**	0.14	0.21	0.25
BROuterKnee	**	0.14	0.19	0.23
BRKnee	**	0.14	0.21	0.27
BRInnerCalf	***	0.12	0.14	0.19
BRCalf	***	0.12	0.15	0.19
BRLeg	*	0.31	0.44	0.38
BROuterLeg	*	0.29	0.42	0.35
BRInnerLeg	***	0.31	0.43	0.38
BRUpperInnerLeg	***	0.15	0.25	0.27
BRLowerInnerLeg	*	0.12	0.19	0.2

Table 10. HIGH IPAQ + SOUND CONDITIONS

Zone	Significance	Control	Low	High
FLIndexMiddle	*	0.03	0.04	0.01
FLThumb	***	0.01	0.03	0.01
FLInnerForeArm	***	0.01	0.04	0.06
FLOuterForeArm	***	0.04	0.03	0.07
FLElbow	***	0.04	0.06	0.1
FLInnerElbow	***	0.03	0.04	0.1
FForehead	***	0.03	0.05	0.03
FRTemple	***	0.03	0.05	0.03
FLTemple	***	0.03	0.03	0.03
FMiddleForehead	***	0.03	0.05	0.03
Nose	***	0	0	0
FEars	***	0.08	0.1	0.08
FRear	***	0.08	0.1	0.08
FLear	***	0.07	0.1	0.08
FRNeck	*	0.01	0.01	0.02
FMiddleFace	***	0.08	0.1	0.08
FLMiddleFace	***	0.12	0.11	0.14
FHead	***	0.12	0.14	0.14
FLOuterFoot	**	0.17	0.19	0.18
FLFoot	**	0.17	0.2	0.18
FLHip	***	0.11	0.11	0.14
FLowerTorso	*	0.23	0.27	0.28
FLLowerTorso	**	0.17	0.18	0.22
FRThumb	***	0.01	0.03	0.02
FRForeArm	***	0.04	0.04	0.07
FROuterForeArm	***	0.04	0.04	0.07
FRElbow	***	0.03	0.05	0.08
FROuterElbow	***	0.03	0.05	0.07
FROuterArm	**	0.13	0.17	0.19
FRInnerArm	**	0.06	0.1	0.13

Zone	Significance	Control	Low	High
FRInnerKnee	*	0.15	0.17	0.18
FROuterKnee	**	0.18	0.17	0.15
FRKnee	**	0.2	0.19	0.19
FROuterCalf	***	0.1	0.11	0.1
FRCalf	***	0.1	0.14	0.12
FRInnerThigh	*	0.13	0.16	0.18
FROuterThigh	*	0.12	0.16	0.17
FRUpperInnerLeg	**	0.2	0.24	0.24
FRLowerOuterLeg	**	0.14	0.21	0.17
BHead	***	0.06	0.08	0.05
BNape	***	0.01	0.01	0.02
BLNape	***	0	0	0.01
BUpperHead	***	0.02	0.05	0.01
Bskull	***	0.05	0.08	0.04
BLPalm	***	0.01	0.01	0.05
BLRingPink	***	0.01	0.01	0.03
BLIndexMiddle	***	0.01	0.01	0.03
BLThumb	*	0.01	0.01	0.02
BLForeArm	***	0.04	0.03	0.06
BLInnerForeArm	***	0.02	0	0.06
BLOuterForeArm	***	0.04	0.03	0.06
BLOuterElbow	***	0.03	0.02	0.06
BLShoulder	***	0.05	0.13	0.17
BLInnerUpperArm	***	0.03	0.05	0.1
BLOuterArm	***	0.11	0.14	0.22
BLInnerArm	***	0.03	0.05	0.12
BLArm	***	0.11	0.17	0.24
BRHand	***	0.01	0.01	0.05
BROuterHand	***	0.01	0.01	0.05
BRInnerHand	***	0.01	0	0.05
BRPalm	***	0.01	0.01	0.05
BRRingPink	***	0.01	0	0.02
BRIndexMiddle	***	0.01	0	0.02
BRThumb	***	0.01	0.01	0.01
BRForeArm	***	0.05	0.02	0.09
BROuterForeArm	***	0.04	0.02	0.07
BRElbow	***	0.03	0.01	0.07
BROuterElbow	***	0.03	0.01	0.07
BRInnerUpperArm	***	0.02	0.07	0.09
BROuterUpperArm	**	0.03	0.08	0.1
BLInnerShin	***	0.07	0.13	0.15
BLShin	*	0.08	0.14	0.16
BLOuterKnee	*	0.11	0.1	0.12
BLKnee	*	0.11	0.1	0.13
BLInnerCalf	**	0.07	0.12	0.13
BROuterFoot	**	0.14	0.16	0.15
BRFoot	**	0.14	0.16	0.15
BRInnerShin	***	0.07	0.12	0.15
BROuterShin	*	0.07	0.12	0.15
BRShin	***	0.08	0.12	0.16
BRInnerKnee	**	0.08	0.1	0.12
BROuterKnee	**	0.09	0.1	0.12
BRKnee	**	0.1	0.11	0.14
BRInnerCalf	***	0.05	0.1	0.14
BRCalf	***	0.08	0.11	0.16
BRLeg	*	0.28	0.34	0.31
BROuterLeg	*	0.27	0.33	0.29
BRInnerLeg	*	0.24	0.34	0.29
BRUpperInnerLeg	***	0.13	0.17	0.16
BRLowerInnerLeg	*	0.07	0.14	0.17