Affecting emotional experience with auditory-vibrotactile heartbeat false feedback

Chalmers Room Acoustics Group – Multisensory Applications
Division of Applied Acoustics
CHALMERS UNIVERSITY OF TECHNOLOGY, Sweden

Ana Tajadura, Aleksander Väljamäe & Daniel Västfjäll

PRESENCCIA IST-2006-27731
www.presenccia.org

• Introduction

W. James (1890) hypothesized that emotions are our perception of physiological changes. Studies have demonstrated that induced physiological state changes can influence one's emotional responses to stimuli (e.g. Schachter & Singer (1962)). We tested how the presentation of false heartbeat feedback to participants (N=24) via auditory and (or) tactile stimulation can affect their physiological state and likewise their emotional attitude to positive and negative images. In addition, distant versus close sound reproduction conditions (loudspeakers vs. headphones) were used to identify whether an "embodied" experience can occur, i.e. participants associating the heartbeat with their own, and modulate the emotional responses.

- **Goal:** Influence affective state by means of acoustic & vibrotactile cues + meaning
- **Two-dimensional affective response:** (Lang,1990)
  - Valence (pleasure): *'the organism's disposition to assume either an appetitive or defensive behavioral set'*
  - Arousal (excitement): *'the organism's disposition to react with varying degrees of energy or force'.*

• Method

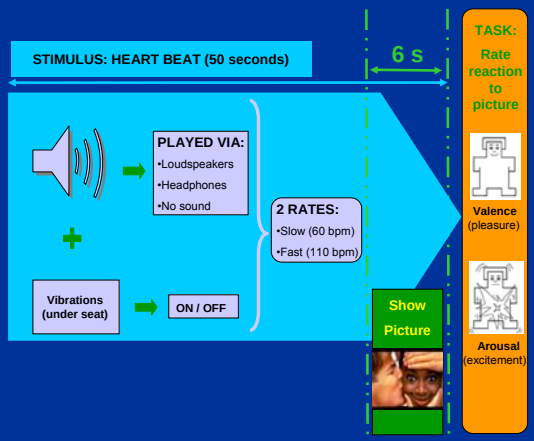
• Stimuli

Parameters varied were:

- **3 sound conditions**: (1) no sound; (2) distant (loudspeakers - LS); (3) close (headphones – HP).
- **2 vibrations** under the seat: on / off.
- **2 rates of the false heart beat**: 60 bpm / 110 bpm. bpm= beats per minute
- **2 valence values of the images** (**positive** / **negative**)

Pictures: from the International Affective Picture System (IAPS – Lang, 2005). Presented in the last 6 s of the trial.

- Arousal = 5 (over 9) for all pictures
- Valence ≈ 7 for **positive pictures**
  ≈ 3 for **negative pictures**



• Measures

- Physiological response → Heart rate
- Self-report → Valence and arousal for pictures (Self Assessment Manikin – SAM, (Lang,1980))
- Free-recall → Pictures remembered
- Individual differences → Imagery vividness

• Hypothesis

- **H1**: Heart rate adaptation to presented heart beat false feedback (physiological effect): **EMBODIMENT**
  - **H1.1**: pictures will be rated as more arousing in the 'high rate' condition (emotional effect)
  - **H1.2**: High arousing pictures will be more memorable
- **H2**: vibrations → will increase the effect
- **H3**: Differences between close vs. distant sound conditions (Headphones vs. Speakers): **EMBODIMENT**
- **H4**: Correlation with individual differences: Imagery

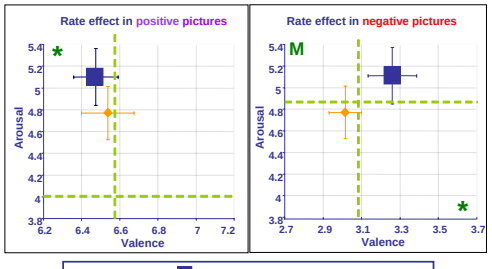
• Results

•Effects of Sound:

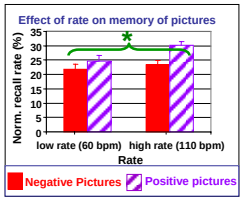
- **Effects on SAM ratings:** Significant effect on valence & arousal ($p<0.01$) for positive pictures
- **Effects on physiology** → small (≈1 bpm variation after 40 s) but significant ($p<0.05$) **H1**

• Effects of Rate:

False heartbeat feedback significantly amplified emotional responses to pictures (SAM ratings) :



At average 13 from 32 pictures were recalled (data below is individually normalized)



H1.1

H1.2

- High heart rate → higher arousal value & enhanced memory
- Slow heart rate → relaxing effect (for negative pictures)

• Auditory Imagery correlates with Vibration: **H4**

In the presence of vibrations & when facing negative pictures ($p<0.001$):

- Good imagers→ rate pictures as 'less negative'
- Bad imagers → rate pictures as 'more negative'

H2

H3

• Effects of Vibration:

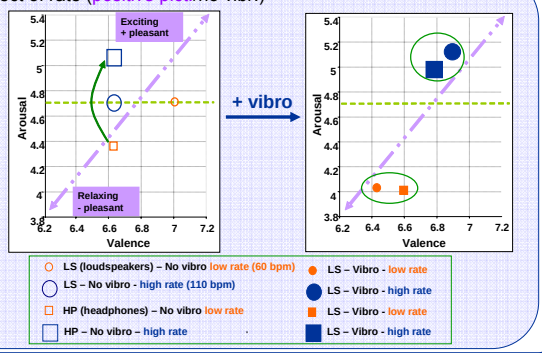
Interaction between vibrations (under the seat) and heartbeat sound, depending on:

- Spatial location (HP vs. LS): "Tactile capture of audition"? (Caclin, 2002); Physiological change in participants' heart rate ($p<0.01$)
- Picture type

For positive pictures, vibrations:
- reveal the effect of rate for LS
- equalize the effects of LS and HP

For negative pictures, vibrations:
- ↓ the effect of high rate in LS
- ↑ the effect of high rate in HP

Effect of rate (positive pict./no vibr.)



• Conclusions

Experimental results show that false heartbeat feedback significantly affects emotional responses to pictures. High-rate heartbeat sound resulted in higher arousal ratings and enhanced picture memory. The small physiology adaptation could be related to the short exposure period (< 50 s) or the interaction with imagery (e.g. complex interactions with valence and arousal found in Lang et al. 1990).

Seat vibrations showed interaction with reproduction of the heartbeat sound depending on its spatial location (tactile capture of audition?) and picture type. A relationship between auditory imagery and vibratory stimulation has also been observed.

•**References:**
•W. James (1890). *The Principles of Psychology.*
•Schachter & Singer (1962) Psychol. Review, 69, 379-99.
•Sheehan (1967). *J. Clinical Psych.*,23,386-389.
•Lang (1980). *Technology in mental health care delivery systems*,119-167.
•Lang, Bradley & Cuthbert (1990). *Psychol Rev.*,*97* (3),377-95.
•Lang, Bradley & Cuthbert (2005). *Tech. Report A-6.* Univ. Florida, FL.
•Bolls, Lang & Potter (2001). *Com. Research*,28(5),627-651.
•Caclin,Soto-Faraco,Kingstone & Spence(2002).*Percept.Psychophys. 64*,616–630.

Contact: ana.tajadura@gmail.com