



HAL
open science

Touching Sounds

Eric O Boyer, L Vandervoorde, F Bevilacqua, S Hanneton

► **To cite this version:**

Eric O Boyer, L Vandervoorde, F Bevilacqua, S Hanneton. Touching Sounds: Perception of the curvature of Audio Virtual Surfaces. VR2015 IEEE Virtual Reality Conference, Mar 2015, Arles, France. hal-01265593

HAL Id: hal-01265593

<https://hal.sorbonne-universite.fr/hal-01265593>

Submitted on 25 Feb 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License

Touching Sounds

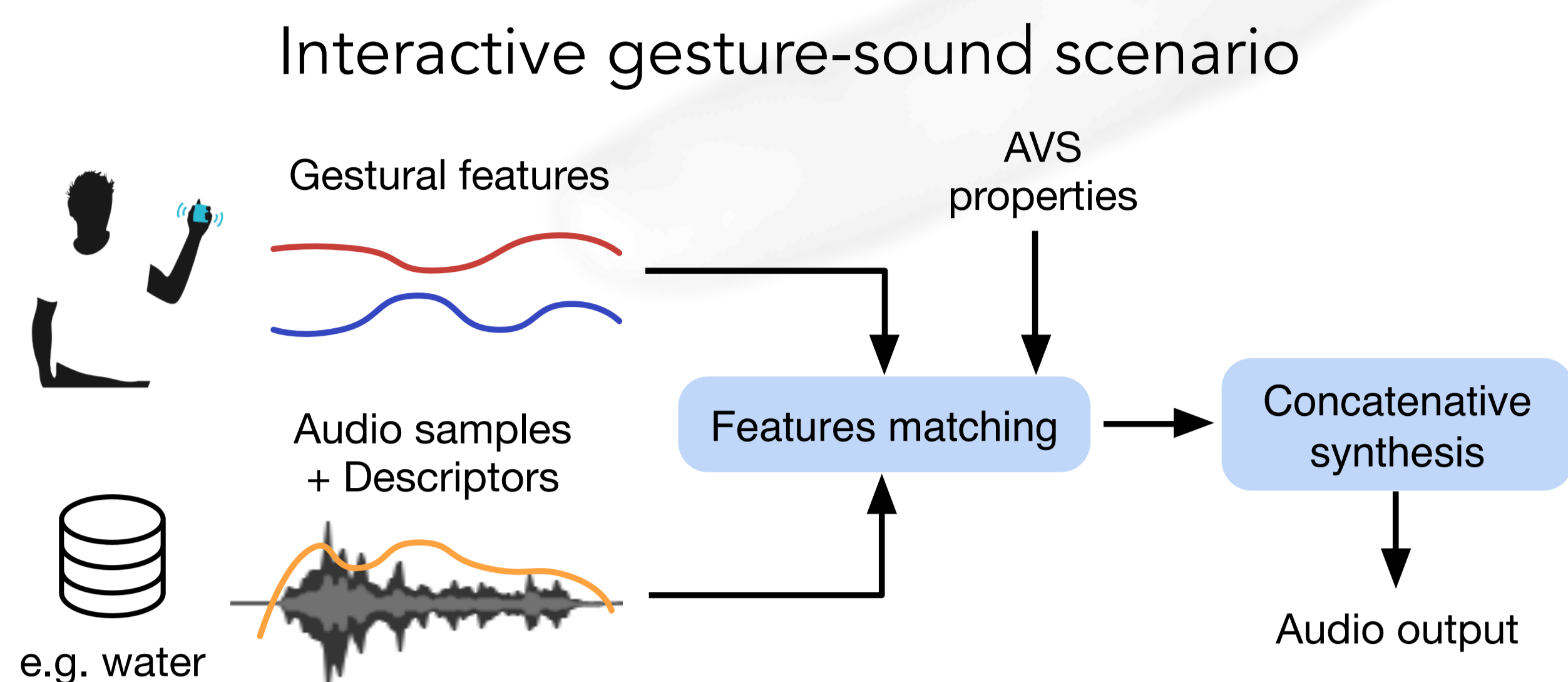
Perception of the curvature of Audio Virtual Surfaces

E. O. Boyer^{1,2}, L. Vandervoorde², F. Bevilacqua¹, S. Hanneton²

¹ {Sound Music Motion} Interaction - STMS – Ircam – CNRS UPMC, Paris, France

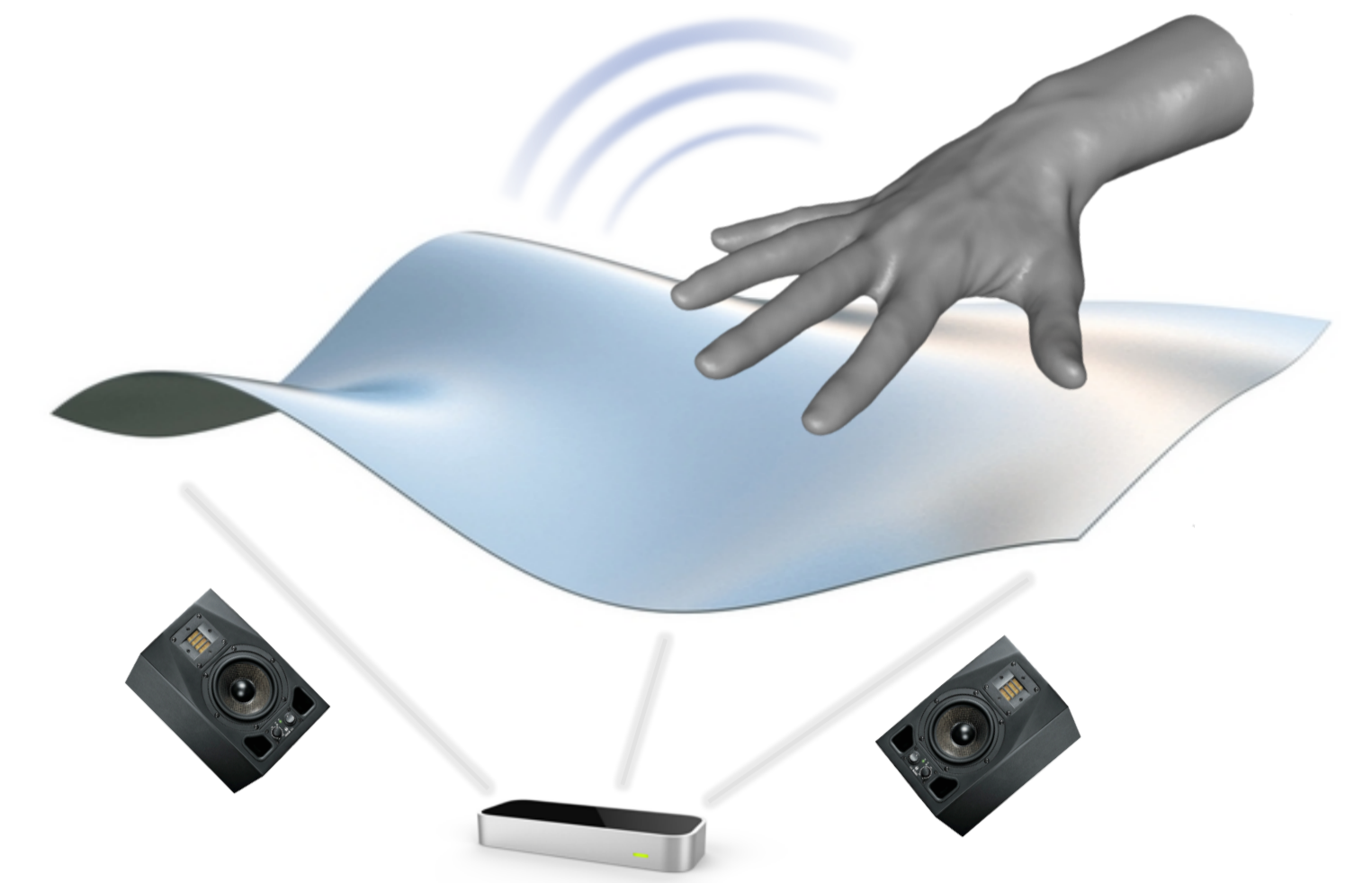
² Psychology of Perception Lab – UMR CNRS 8242, Paris Descartes University, France

The concept of Audio Virtual Surfaces (AVS)



We define an Audio Virtual Surface as a responsive region in space the user can interact with, through interactive sonification.

The sound is produced in response to the presence of the user and/or physical properties.



Goals

- Explore sensory substitution of touch by sound for interaction with virtual objects
- Evaluate perceptual abilities in gestural interactions
- Develop interactive scenarios offering richer perceptual experience

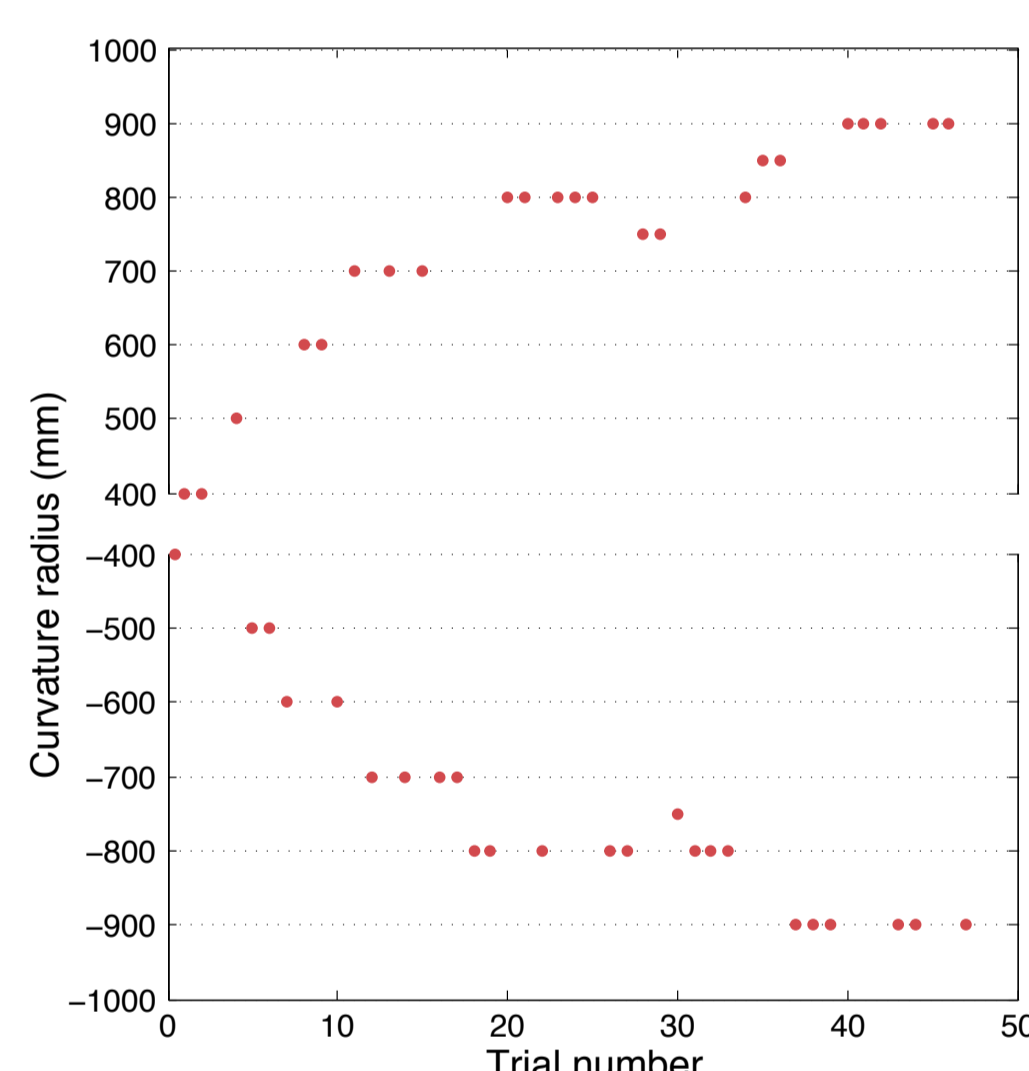
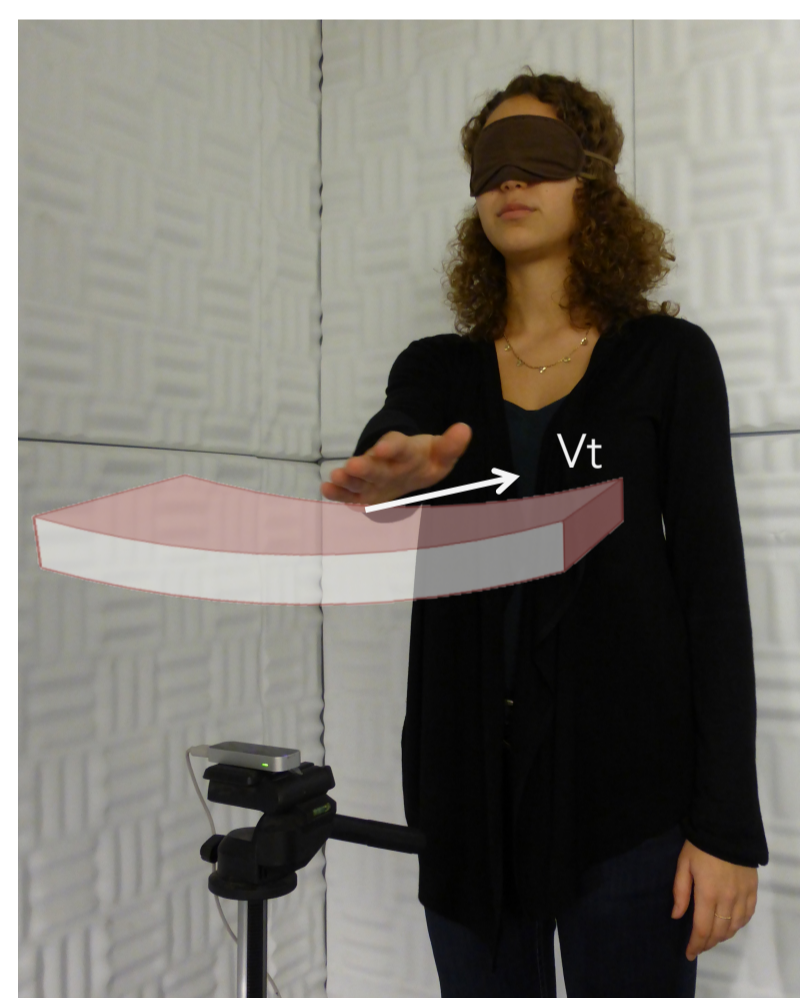
Experiment: determination of the curvature perception threshold of a 8 cm thick plate AVS

Randomized adaptive staircase procedure on curvature radius R

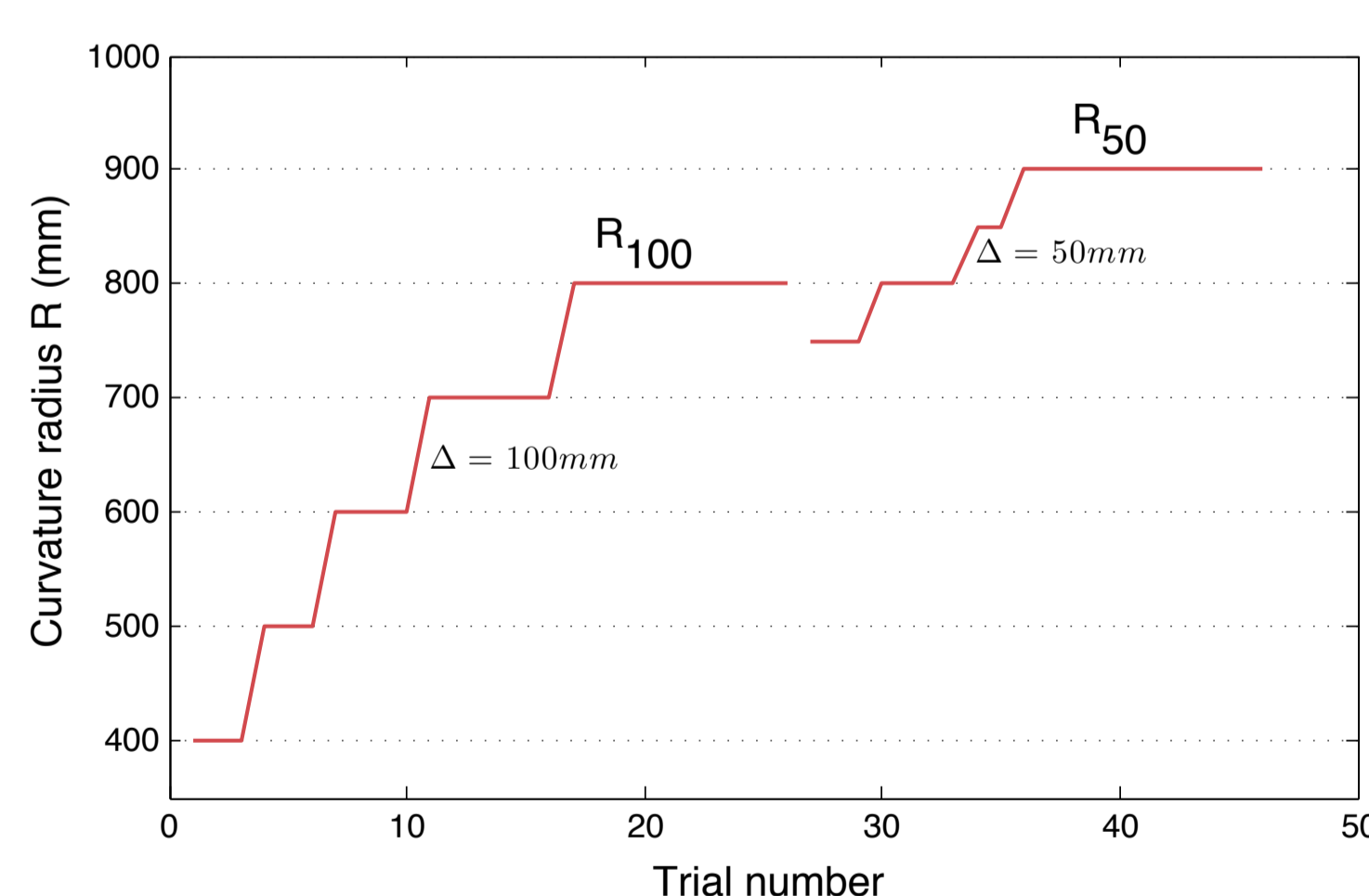
Q: is the plate concave or convex ?

-> correct 3 in a row: R increased

-> non correct in 10: threshold is reached



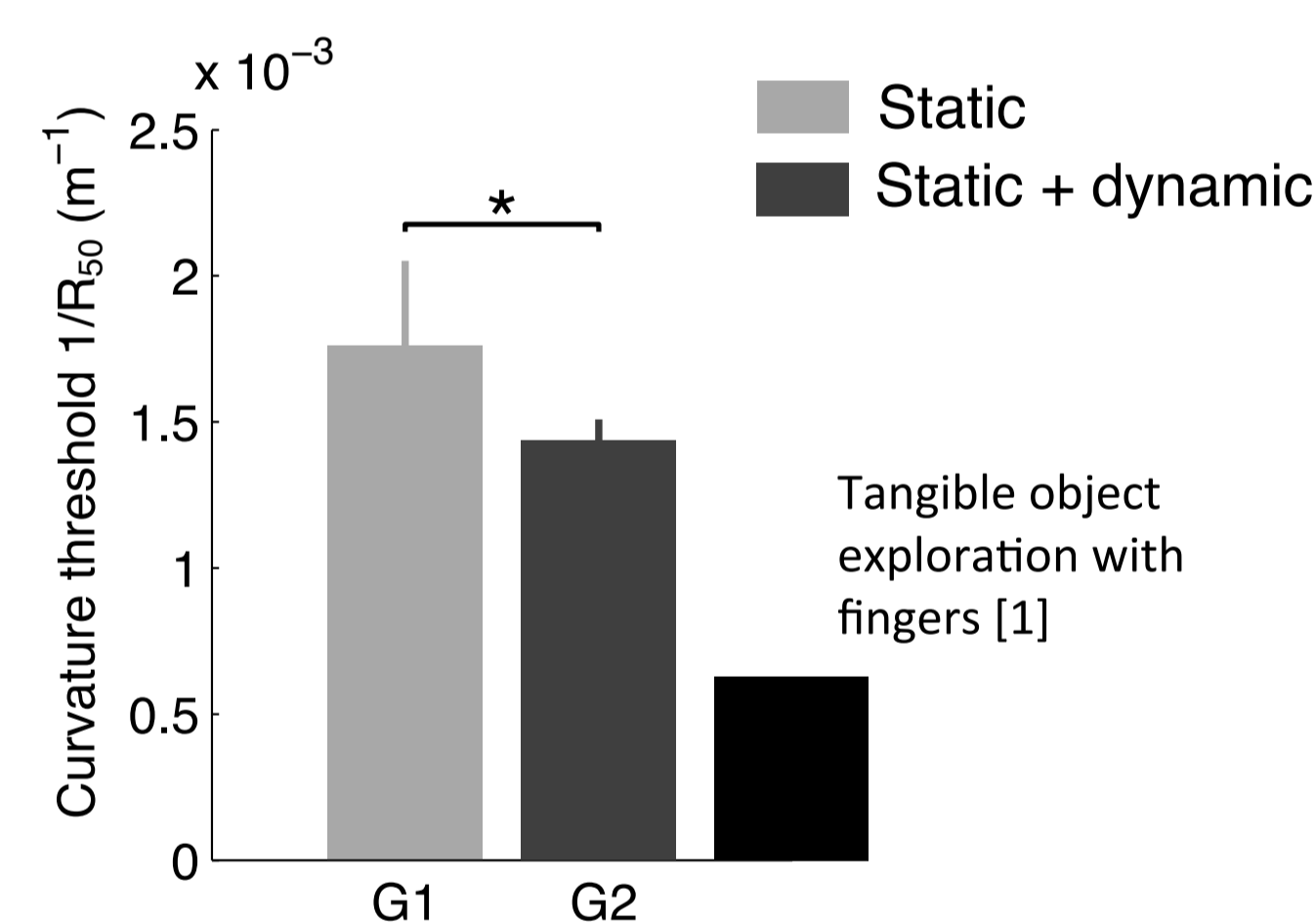
N=18
VAS
+ LeapMotion
+ Max.
2 groups
Speakers
Data:
Hand position
+ response time
+ questionnaire.



Auditory feedback

G1- Static: presence in/out of the plate

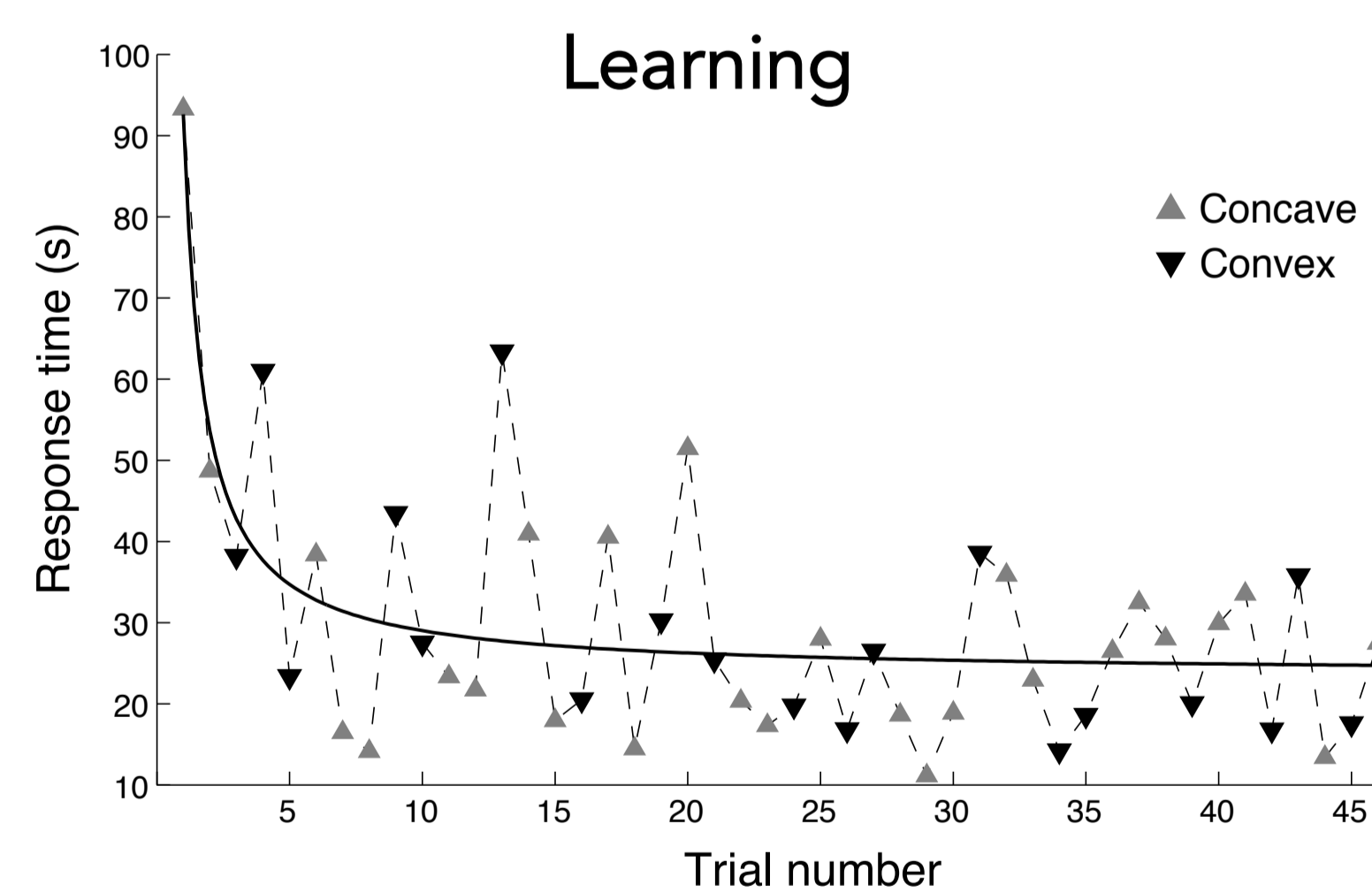
G2- Satic + dynamic feedback (Vt)



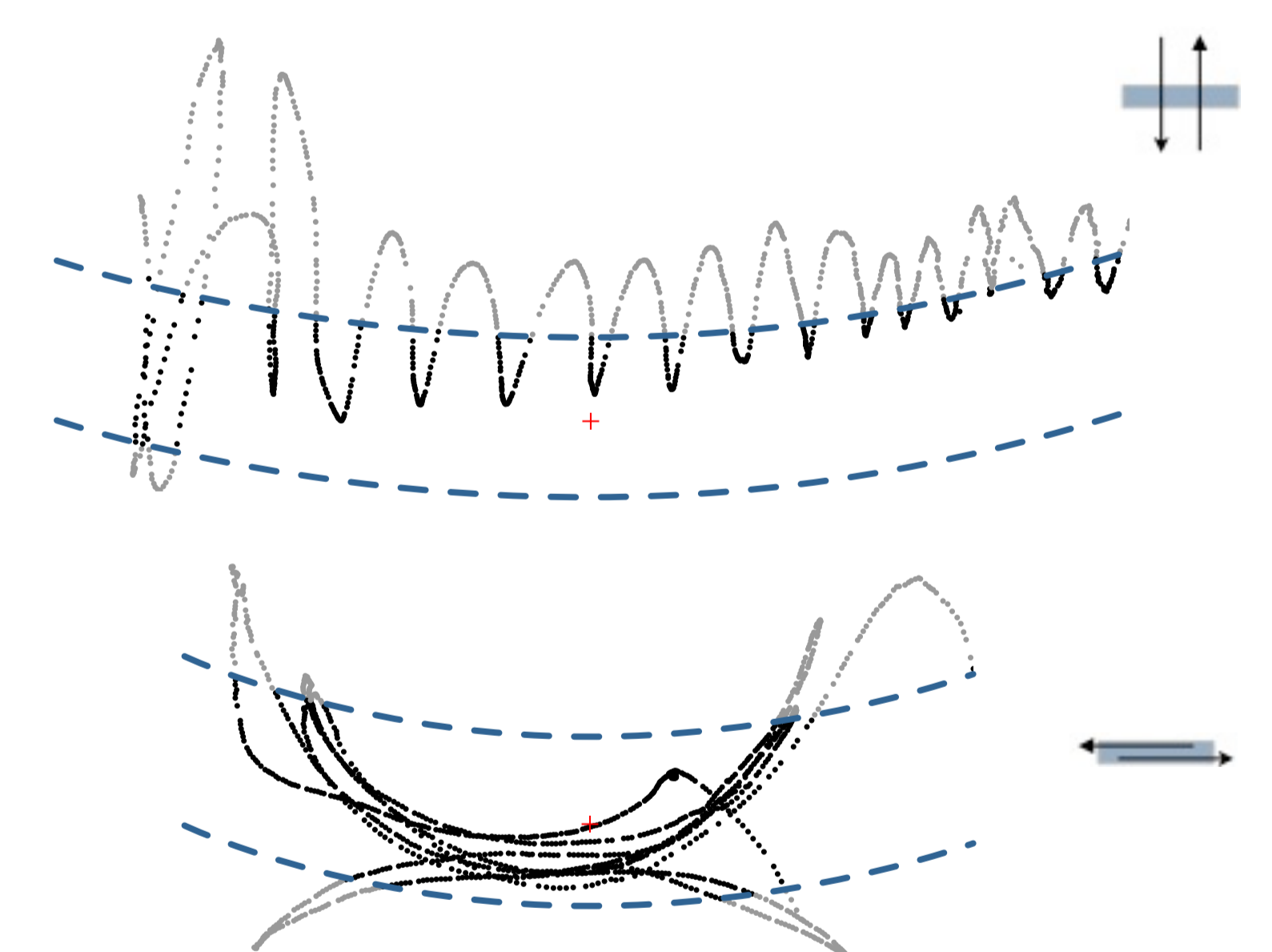
The G2 reached a higher level of perception, and the variance was reduced. 75% of them declared feeling tactile-like sensations.

% of participants	Static	Static+dynamic
Bothered by the blindness	87 %	25 %
Feeling tactile sensations	50 %	75 %

Learning



Gestural strategies



Conclusions

- Users are able to perceive properties of an object with **auditory feedback only**.
- **Auditory-motor representations** emerge from the interaction and shape exploratory gestures.
- The setup offers a tactile to auditory **sensory substitution** paradigm.
- Synesthesia and tactile sensations need to be further studied in interactive scenarios.

Check out our virtual bath tub demo !



Cited literature

[1] J. F. Norman, A. M. L. Kappers, J. R. Cheeseman, C. Ronning, K. E. Thomason, M. W. Baxter, A. B. Calloway, and D. N. Lamirande, "Aging and curvature discrimination from static and dynamic touch.," *PLoS One*, vol. 8, no. 7, p. e68577, Jan. 2013.

Acknowledgements

This work was supported in part by the ANR (French National Research Agency) Legos project (11 BS02 012)