Validation of an fMRI-based Olfactory Cue Reactivity Task to Measure the Learned Association between Alcohol Cues and Addictive Behaviour

Çağatay N. Gürsoy[1,2,3], Juliane Nagel[1,2,3], Simon Kern[1,2,3], Martin F. Gerchen[1,4,5], Peter Kirsch[1,4,5], Gordon B. Feld[1,2,3,4]

[1] Department of Clinical Psychology, Central Institute of Mental Health, Medical Faculty Mannheim, University of Heidelberg, Mannheim, Germany
[2] Department of Addiction Behaviour and Addiction Medicine, Central Institute of Mental Health, Medical Faculty Mannheim, University of Heidelberg, Mannheim, Germany
[3] Department of Psychiatry and Psychotherapy, Central Institute of Mental Health, Medical Faculty Mannheim, University of Heidelberg, Mannheim, Germany
[4] Department of Psychology, University of Heidelberg, Germany
[5] Bernstein Center for Computational Neuroscience Heidelberg/Mannheim, Mannheim, Germany

Zentralinstitut für Seelische Gesundheit

Contact cagatay.guersoy@zi-mannheim.de

Aims

- By combining an image and odour based cue reactivity task (CRT), we aim to show the effectivity of olfactory cues compared with the image-only cue reactivity task.
- **Goal:** Enhance the measurement precision of the task.

Methods

Participants

AUDIT: Medium & High Risk
N = 20 (12 females)
Age: Mean = 26, SD = 6.58
Min = 19 Max = 44

Questionnaires

Stanford Sleepiness Scale
Psychomotor Vigilance Test
Alcohol Urge Questionnaire
Sniffin' Sticks Olfaction Test

fMRI Tasks

Image CRT
Image + Olfaction CRT
Monetary Incentive Delay Task

Stimuli Groups

Alcoholic / Non-Alcoholic

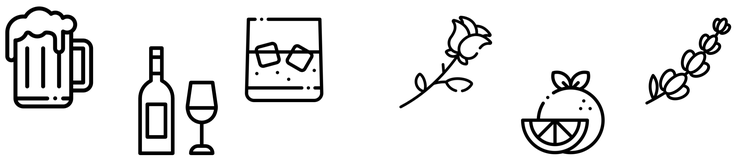
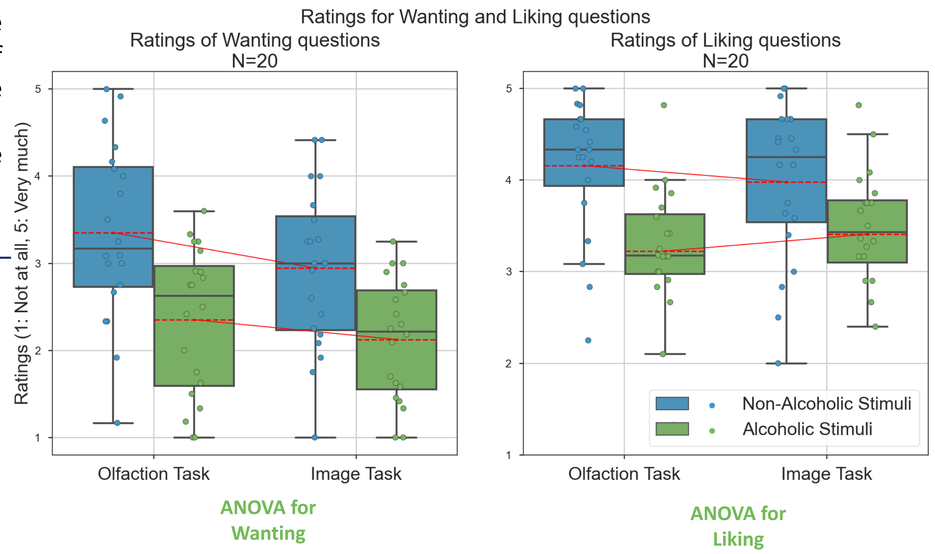


Image + Olfaction CRT

Image CRT

Behavioral Results for Iteration 1



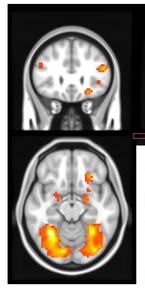
ANOVA for Wanting

Var	F	p-val	np2
Stim types	17.352	0.001	0.477
Task types	10.545	0.004	0.357
Stim X Task	0.928	0.347	0.047

ANOVA for Liking

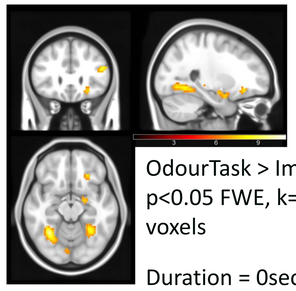
Var	F	p-val	np2
Stim types	16.986	0.001	0.472
Task types	0.001	0.982	0.000
Stim X Task	0.607	0.004	0.360

fMRI Results



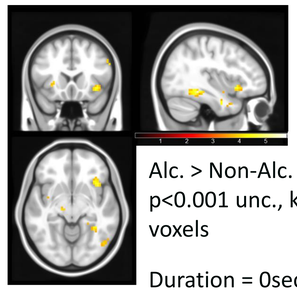
OdourTask > Baseline
p<0.05 FWE, k=0 voxels

Duration = 0sec stick func.



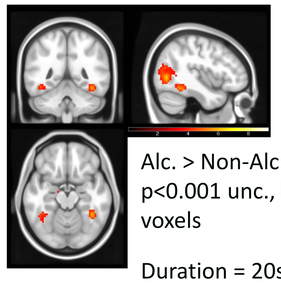
OdourTask > ImgTask
p<0.05 FWE, k=0 voxels

Duration = 0sec stick func.



Alc. > Non-Alc.
p<0.001 unc., k=0 voxels

Duration = 0sec stick func.

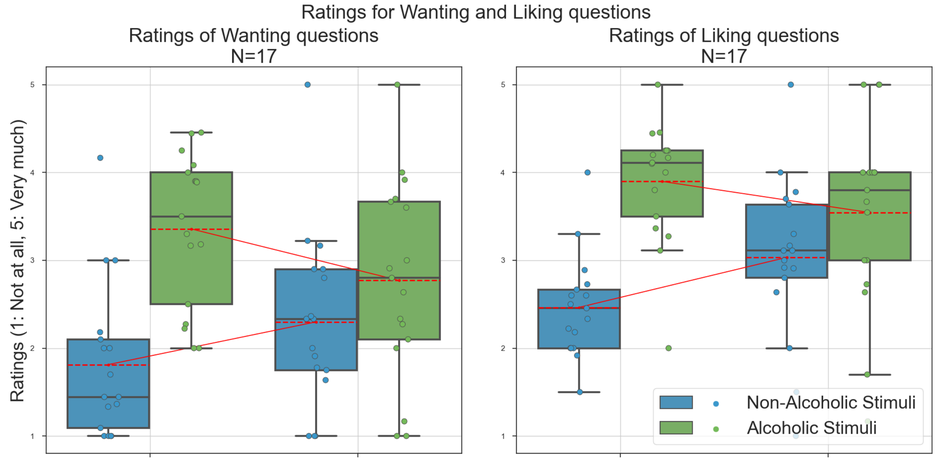


Alc. > Non-Alc.
p<0.001 unc., k=0 voxels

Duration = 20sec boxcar

Behavioral Results for Iteration 2

- A second iteration is currently running with an ambiguous[2] odour combined with boring objects from THINGS[3] database to eliminate the pleasantness effect.



ANOVA for Wanting

Var	F	p-val	np2
Stim types	27.206	0.000	0.630
Task types	0.053	0.821	0.003
Stim X Task	14.599	0.002	0.477

ANOVA for Liking

Var	F	p-val	np2
Stim types	57.666	0.000	0.783
Task types	0.298	0.593	0.018
Stim X Task	10.262	0.006	0.391

Discussion

- Alcoholic stimuli did not elicit convincingly higher responses
- Possible reason: Pleasantness of non-alcoholic stimuli dominating alcoholic stimuli
- Nonetheless, the addition of olfactory stimuli elevated the neural activations towards the cues

Why impulse activation function?

Olfactory brain regions elicit responses towards cues in the first few seconds after the odour was registered by the individual[1]. Hence an impulse-like stick activation function to capture the olfaction related effects.

Literature

[1] Poellinger, A., Thomas, R., Lio, P., Lee, A., Makris, N., Rosen, B. R., & Kwong, K. K. (2001). Activation and Habituation in Olfaction—An fMRI Study. NeuroImage, 13(4), 547–560. https://doi.org/10.1006/nimg.2000.0713

[2] Hebart, M. N., Dickter, A. H., Kidder, A., Kwok, W. Y., Corriveau, A., Wicklin, C. V., & Baker, C. I. (2019). THINGS: A database of 1,854 object concepts and more than 26,000 naturalistic object images. PLOS ONE, 14(10), e0223792. https://doi.org/10/gjfz9s

[3] Bestgen, A.-K., Schulze, P., & Kuchinke, L. (2015). Odor Emotional Quality Predicts Odor Identification. Chemical Senses, 40(7), 517–523. https://doi.org/10.1093/chemse/bjv037

More data & info here!