Visual mechanisms that code inter-interactant distance exhibit psychophysical adaptation

Carl Bunce[a], Katie Gray[b] & Richard Cook[a]

[a] Department of Psychological Sciences, Birkbeck, University of London, UK
[b] School of Psychology and Clinical Language Sciences, University of Reading, Reading, UK

c.bunce@mail.bbk.ac.uk

Birkbeck UNIVERSITY OF LONDON

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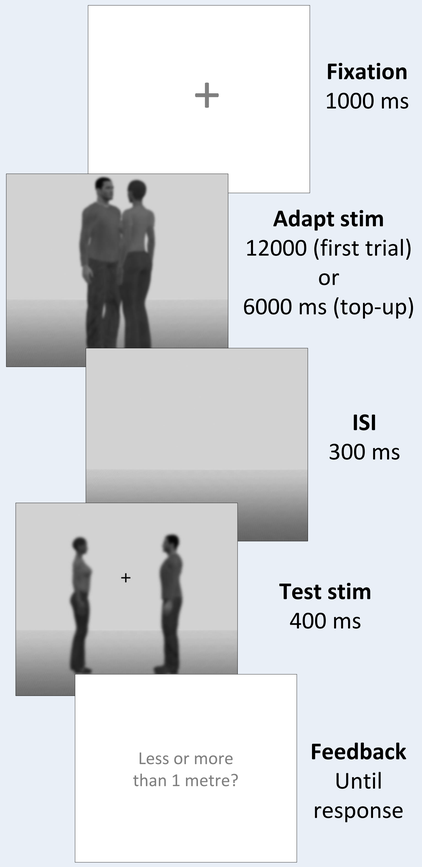
Background & Research Question

- Distance between interacting individuals ("inter-interactant distance") is an important cue when interpreting social interactions[1,2]. However, it is unclear how this property is encoded by the visual system
- Psychophysical adaptation refers to the tendency for prolonged exposure of a sensory input to bias subsequent perception in a systematic way (e.g., adapting to downward motion makes things appear to travel upwards)[3,4]
- Explanations for this phenomenon vary[5], but existence of aftereffects are generally regarded as evidence for that property benefiting from dedicated representation[6]
- We sought to determine whether inter-interactant distance aftereffects can be induced and test the extent they are transferable across stimulus categories

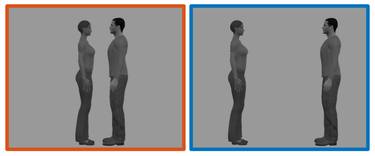
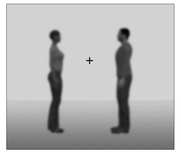
Methods

- Participants judged whether two people were standing more or less than 1 metre apart under 3 blocked conditions: having adapted to small distances ('close adapt'), having adapted to large distances ('far adapt'), and in absence of any adaptation ('baseline')
- The judged test stimuli represented 7 levels of distance from 0.7 to 1.3m in 10 cm steps
- The appearance of the adapt stimuli varied between experiments, but figures were always positioned 0.5 m (close adapt) or 1.5 m (far adapt) apart. Images were presented at a larger scale than test stim and slowly pulsed in size in order to prevent retinotopic adaptation[7]
- Psychometric functions were fit to responses and point of subjective equivalence (PSE) calculated for each condition



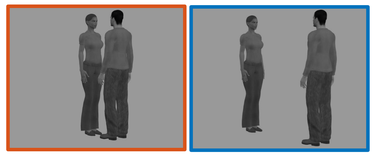
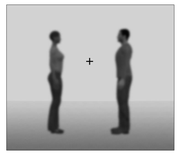
Results

Exp. 1: Does adaptation to extreme inter-interactant distances induce distance aftereffects? (N=20)

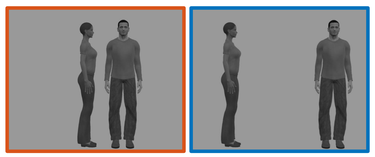
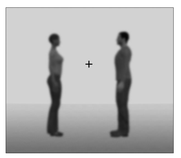
Adapt to:  Tested on: 

- Consistent with classic adaptive aftereffects, adapting to close and far distances induced robust perceptual shifts in opposite directions

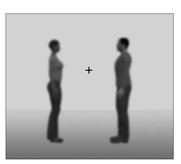
Exp. 2: Are these aftereffects viewpoint-dependent? (N=30)

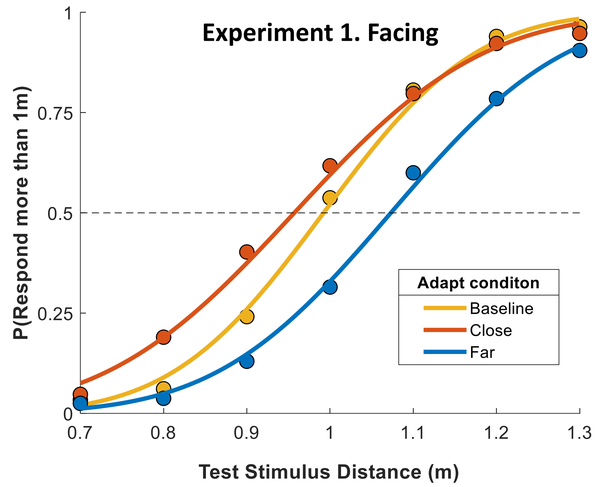
Adapt to:  Tested on: 

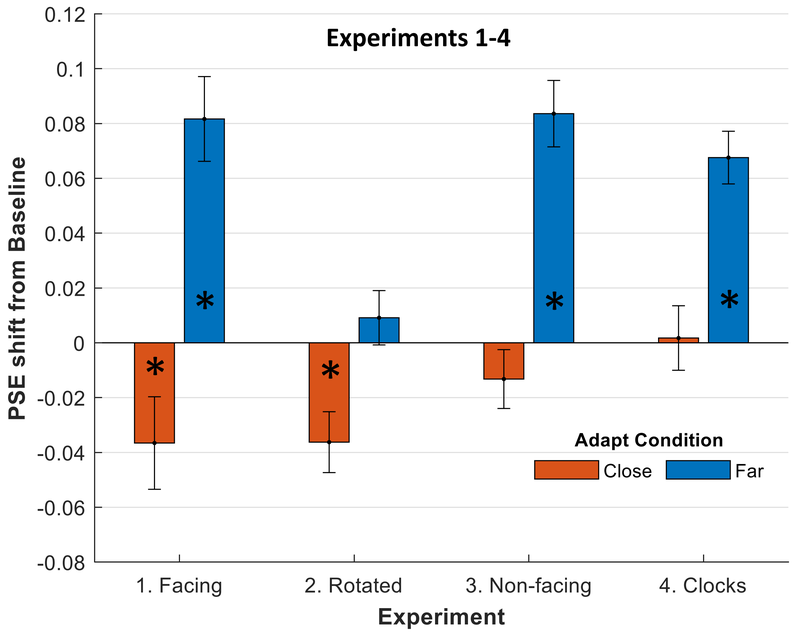
Exp. 3: Do aftereffects from non-interacting individuals transfer to interacting individuals? (N=20)

Adapt to:  Tested on: 

Exp. 4: Do aftereffects from objects transfer to humans? (N=20)

Adapt to:  Tested on: 





Conclusion

- Adaptation is thought to reflect the ongoing calibration of the visual system to the ambient environment[5]. A visual diet of people standing close together or far apart (e.g., social distancing) would appear to bias our subsequent perceptual experiences of the interactions around us
- It's possible inter-interactant distance is represented via opponent-coding whereby distinct neural populations are tuned to small and large distances and adaptation modulates the relative excitability of these populations[8]
- Mixed evidence of transfer effects across stimulus categories may suggest this property is coded by a general mechanism that is agnostic to stimulus class

References

1. Hall, E.T. (1963). A system for the notation of proxemic behavior. *American Anthropologist*, *65(5)*, 1003-1026.
2. Hall, E.T. (1966). The Hidden Dimension: Doubleday.
3. Thompson, P., & Burr, D. (2009). Visual aftereffects. *Current Biology*, *19*, 11-14.
4. Addams, R. (1834). An account of a peculiar optical phenomenon seen after having looked at a moving body. *London and Edinburgh Philosophical Magazine and Journal of Science*, *5*, 373-374.
5. Webster M.A. (2015). Visual Adaptation. *Annual review of vision science*, *1*, 54-567.
6. Mollon, J.D. (1974). After-effects and the brain. *New Scientist*, *61*, 479-482.
7. Koldewyn, K., Hanus, P., & Balas, B. (2014). Visual adaptation of the perception of "life": Animacy is a basic perceptual dimension of faces. *Psychonomic Bulletin and Review*, *21(4)*, 969–975.
8. Lawson, R.P., Clifford, C.W.G., & Calder, A.J. (2009). About turn: The visual representation of human body orientation revealed by adaptation. *Psychological Science*, *20(3)*, 363-371.