

# Face aftereffects demonstrate interdependent processing of expression and sex

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**Background** Cognitive models of face perception have proposed that functionally different aspects of faces (e.g. expression, sex and identity) are processed independently<sup>1,2,3</sup>. Although previous studies have demonstrated *interdependent* processing of identity and sex<sup>4</sup> and of identity and expression<sup>5</sup>, evidence for interdependent processing of sex and expression is equivocal<sup>3,6</sup>. Using a visual adaptation paradigm, we demonstrate that expression aftereffects, whereby exposure to an expression decreases sensitivity to that expression, can be simultaneously induced in opposite directions for male and female faces (Exp 1). These sex-contingent expression aftereffects could not be explained by possible effects of sex differences in expression production (Exp 2). Furthermore, sex-contingent adaptation occurred between sex categories, but did not occur when equivalent shape differences among adapting faces were within a sex category (Exp 3). Collectively these findings reveal interdependent processing of sex and expression and suggest that sex-contingent aftereffects reflect adaptation of neurons that code high-level aspects of faces<sup>7</sup> and cannot be explained by adaptation of neurons coding only physical aspects of face patterns<sup>7</sup>.

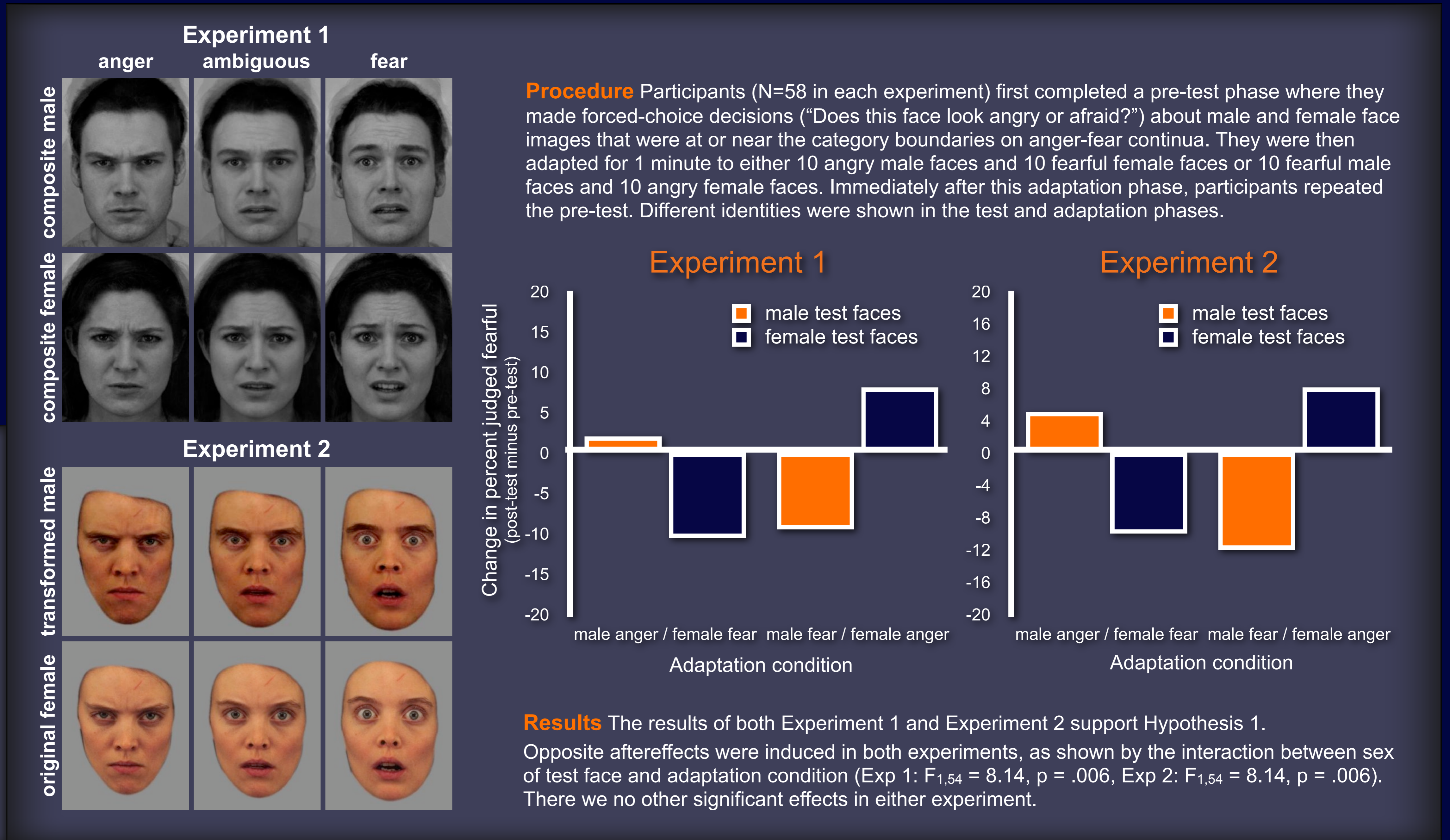
## Experiments 1 and 2 - Interdependent processing of expression and sex

**Hypothesis 1** It is possible to induce expression aftereffects in opposite directions for faces that differ in sex, demonstrating interdependent processing of expression and sex.

**Hypothesis 2** This is not possible, indicating independent processing of expression and sex.

**Experiment 1 Stimuli** Male and female anger-fear continua were manufactured by morphing from angry prototypes to fearful prototypes.

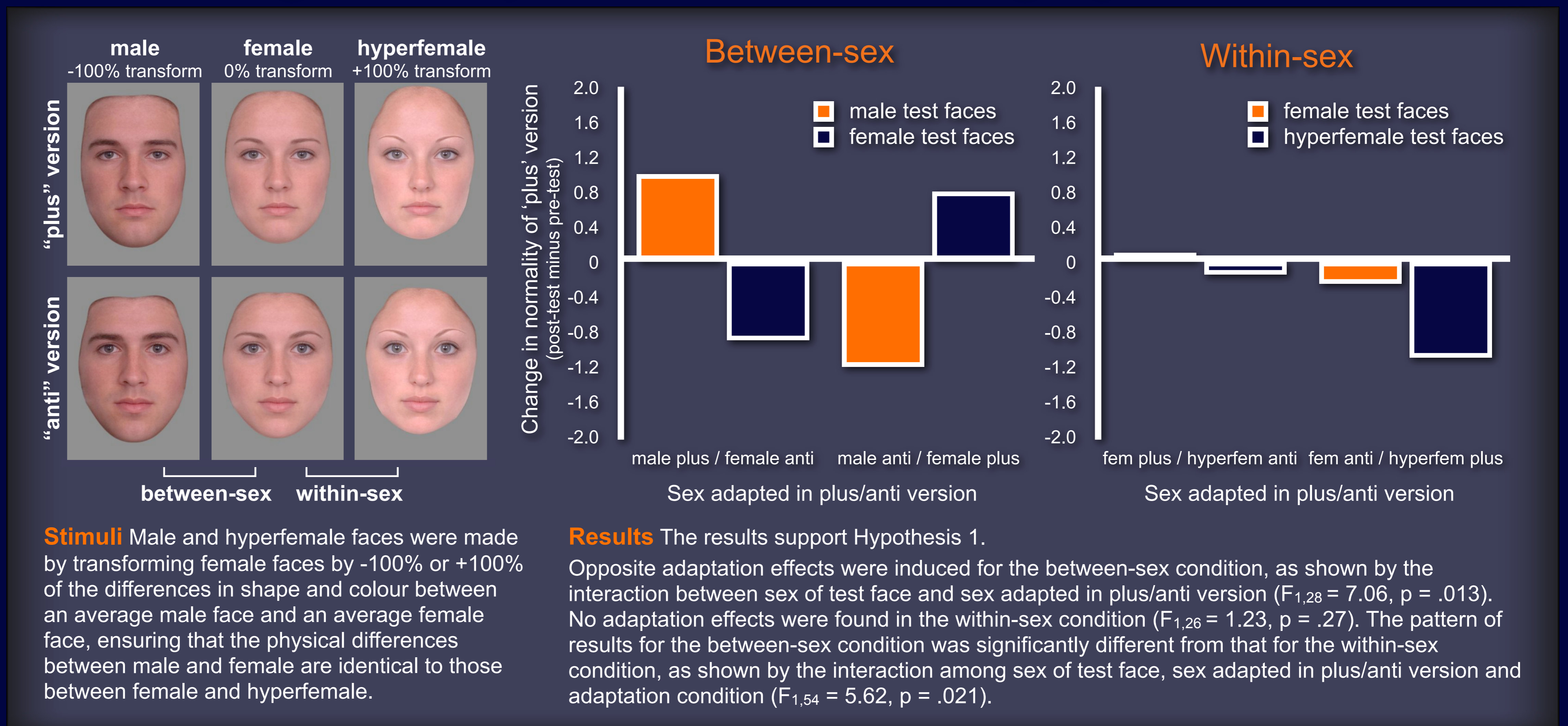
**Experiment 2 Stimuli** Sex-transformed 'male' versions of female faces were made by transforming female faces by +100% of the differences in shape and colour between an average female face and an average male face. This method ensures that the physical differences between angry and fearful male and angry and fearful female faces are identical.



## Experiment 3 - Contingent adaptation reflects category, not structure

**Hypothesis 1** It is possible to induce opposite aftereffects for faces that differ in both structure and category (between-sex), but not for faces that differ in structure but not category (within-sex), indicating that the neurons being adapted are those that code high-level aspects of faces<sup>7</sup> (e.g. sex).

**Hypothesis 2** It is possible to induce opposite aftereffects for both between-sex and within-sex conditions, indicating that the neurons being adapted are those that code structural aspects of different face patterns<sup>7</sup>.



**Conclusions** Experiment 1 demonstrated interdependent processing of sex and expression, indicating that expression can be processed in different ways depending on the sex of a face (see also<sup>6</sup>). Experiment 2 controlled for possible effects of sex differences in expression production by manipulating the sex of faces using computer graphic methods. Although cognitive models of face perception suggest that functionally different aspects of faces are processed independently<sup>1,2,3</sup>, our findings for interdependent processing of sex and expression are consistent with more recent neural models of face processing. For example, our findings are consistent with models that suggest physical and social aspects of faces are processed by different neural mechanisms but that these mechanisms can interact<sup>8</sup>. Experiment 3 showed that sex-contingent aftereffects occur when the groups of faces are from different categories (i.e. male versus female), but not when the physical differences between the groups of faces are identical but the faces are from the same category (i.e. female versus hyperfemale). These results indicate that the neurons being adapted are those that code high-level aspects of faces and cannot be explained by adaptation of neurons coding physical characteristics of different face patterns<sup>7</sup>.

**References** [1] Bruce & Young (1986) *Brit J Psychol*, 77, 305–327. [2] Young (1998) *Face and mind*. Oxford University Press. [3] Le Gal & Bruce (2002) *Percept Psychophys*, 64, 230–243. [4] Rossion (2002). *Vis Cog*, 9, 1003–1020. [5] Ganel & Goshen-Gottstein (2004) *J Exp Psychol: Hum Percept Perform*, 30, 583–597. [6] Atkinson et al. (2005) *Percept Psychophys*, 67, 1199–1213. [7] Rotshtein et al. (2005) *Nature Neurosci*, 8, 107–113. [8] Haxby et al. (2000) *Trends Cog Sci*, 4, 223–233.

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