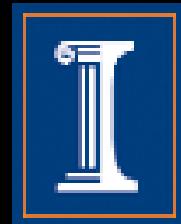


THE ROLE OF FEEDBACK (AND ATTENTION) IN VISUAL PROCESSING

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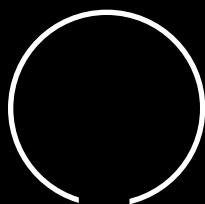
Background

- Feedback/recurrent processing necessary for visual awareness (e.g. Breitmeyer, 2007; Di Lollo, Enns, & Rensink, 2000; Lamme & Roelfsema, 2000)
- Attention and frontoparietal activity implicated in visual awareness (e.g. Driver & Mattingley, 1999; Beck et al., 2001; Crick & Koch, 2003; Baars, 2005; Dehaene et al., 2006)
- What is the relationship between attention and feedback in promoting visual awareness?

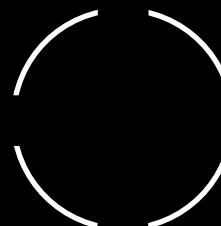
Backwards masking

- Decreased visibility of one stimulus due to presence of a subsequent stimulus

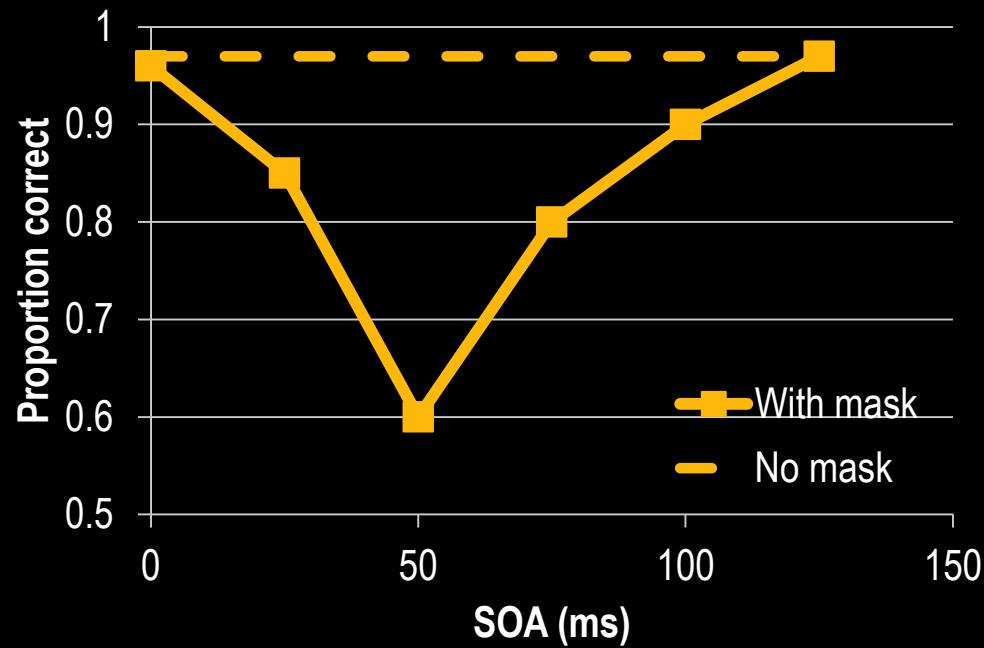
Object 1
(target)

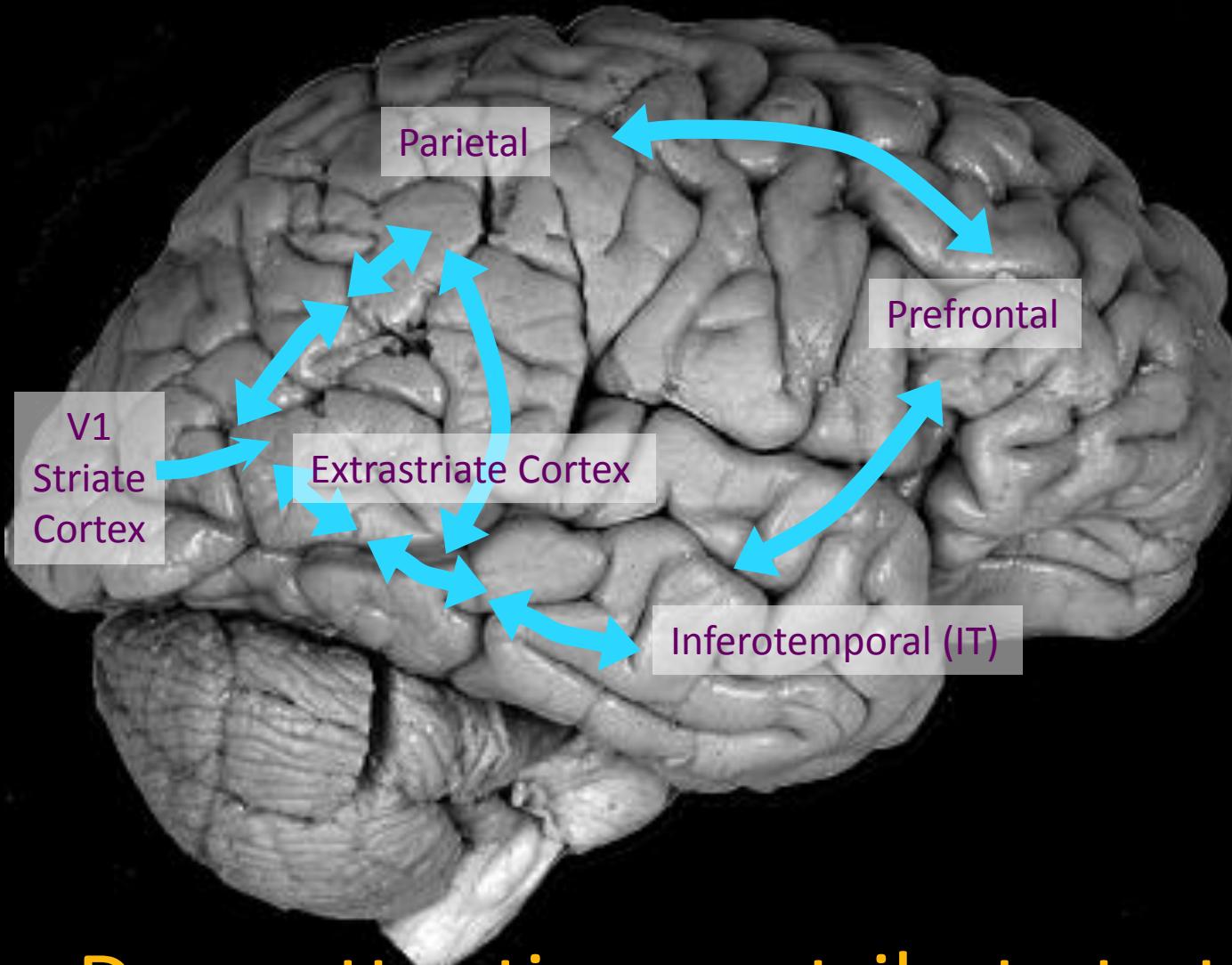


Object 2
(mask)



Backwards masking (metacontrast)

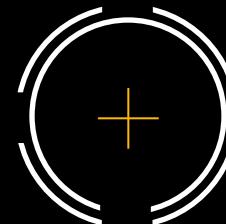




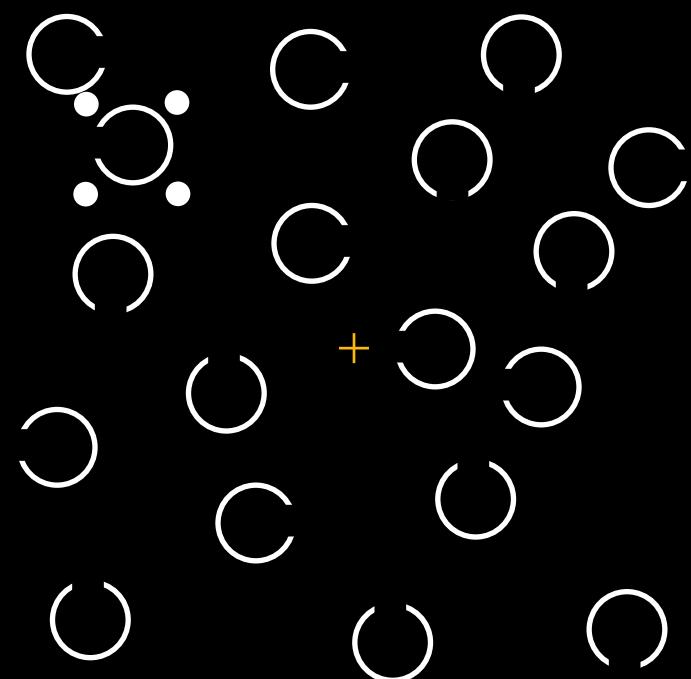
Does attention contribute to this
feedback?

Backward masking

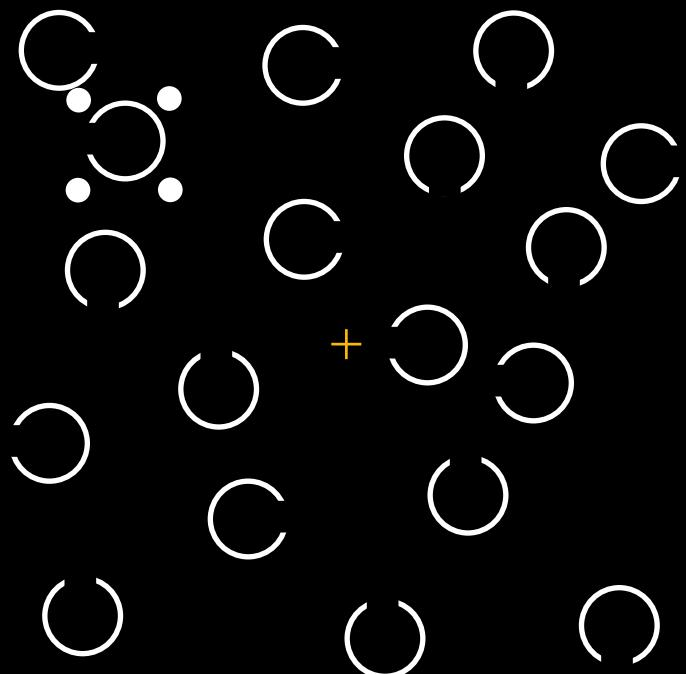
- Metacontrast



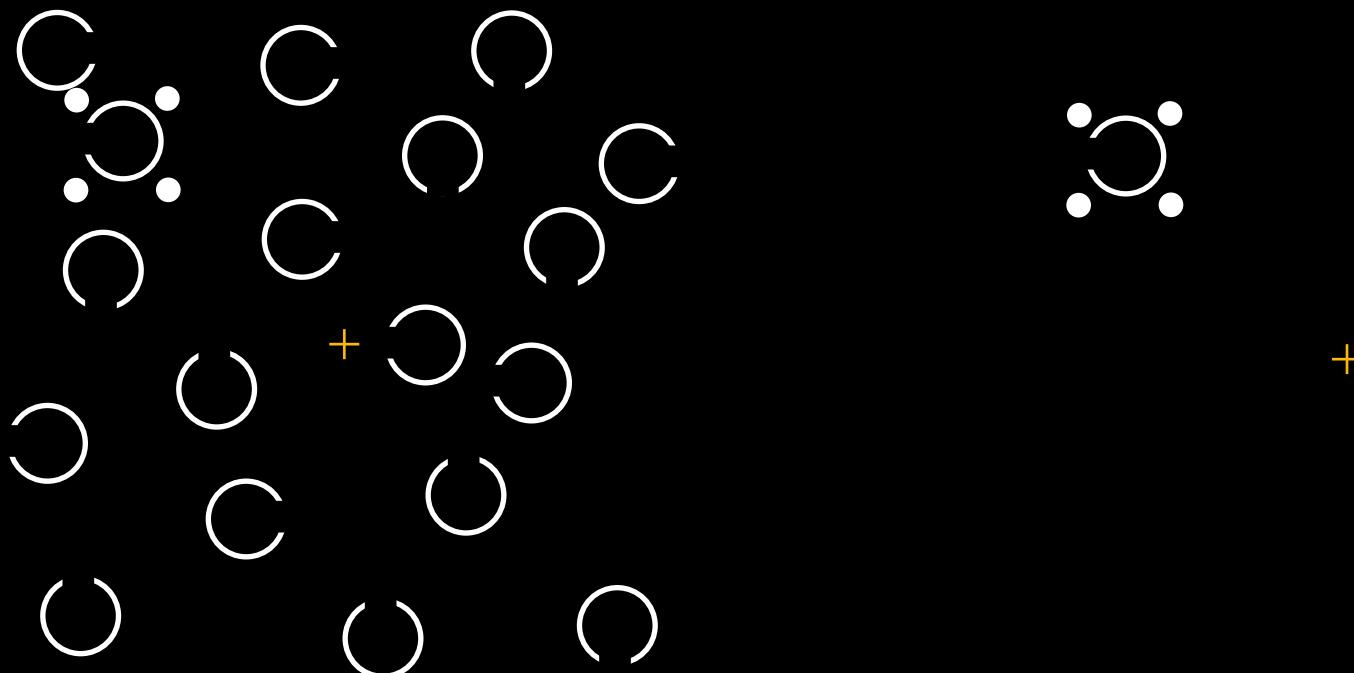
- Object substitution
masking (OSM)



Object substitution masking (OSM)

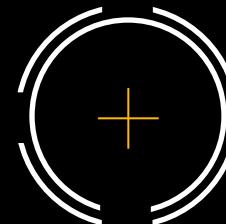


Object substitution masking (OSM)

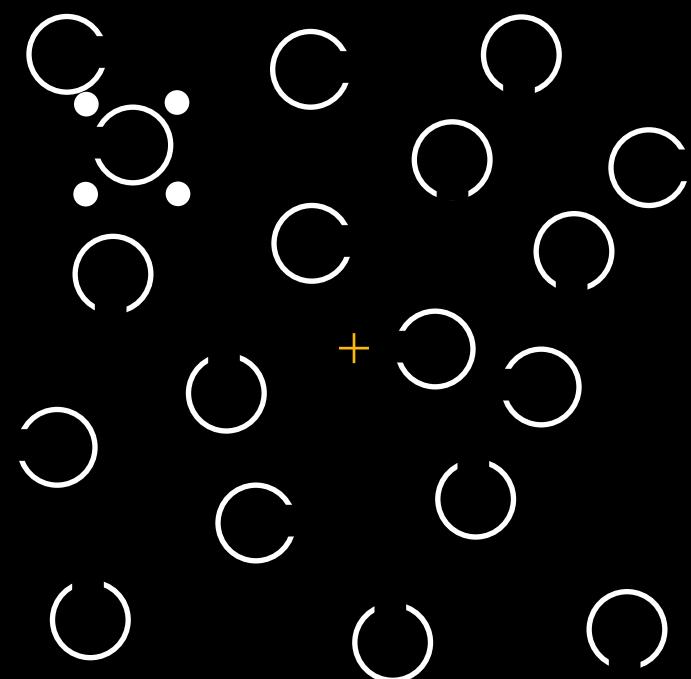


Backward masking

- Metacontrast

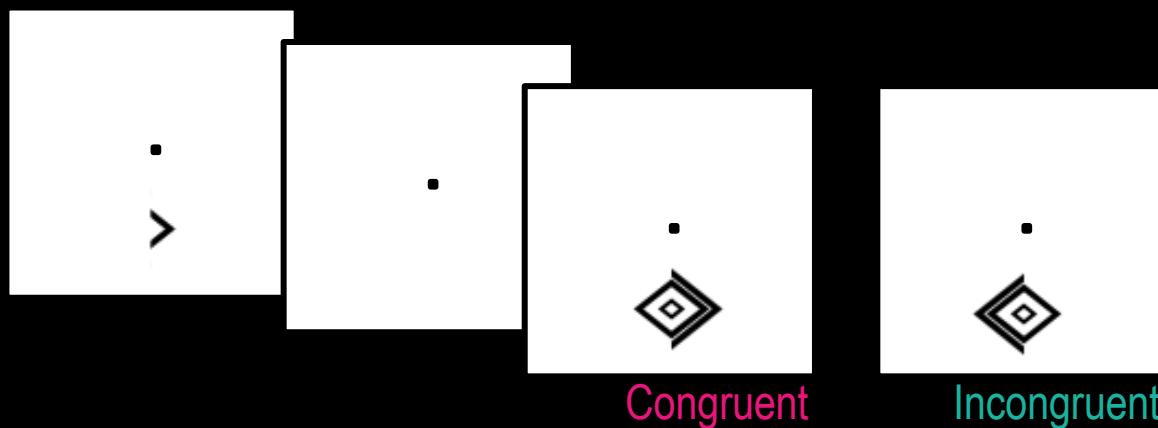


- Object substitution
masking (OSM)



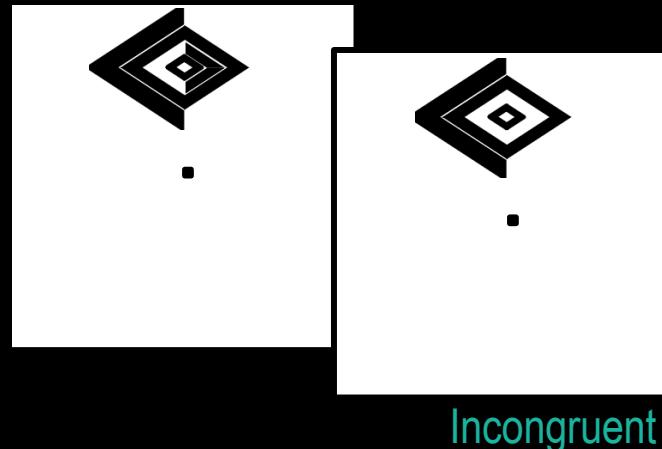
Masked priming

- Masked priming requires attention (Finkbeiner & Palermo, 2009; Kentridge et al, 2008; Marzouki, Grainger, & Theeuwes, 2007; Sumner et al., 2006; Van den Bussche et al., 2010; Marzouki, Meeter, & Grainger, 2008; Tapia et al., 2011, 2013)
- Priming in Metacontrast

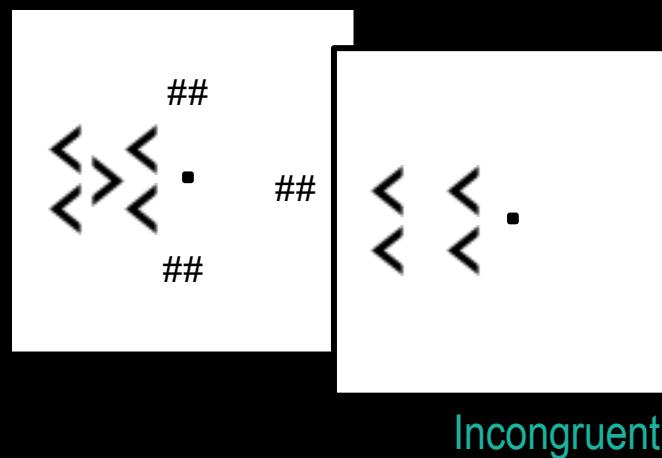


Comparing masked priming

- Metacontrast



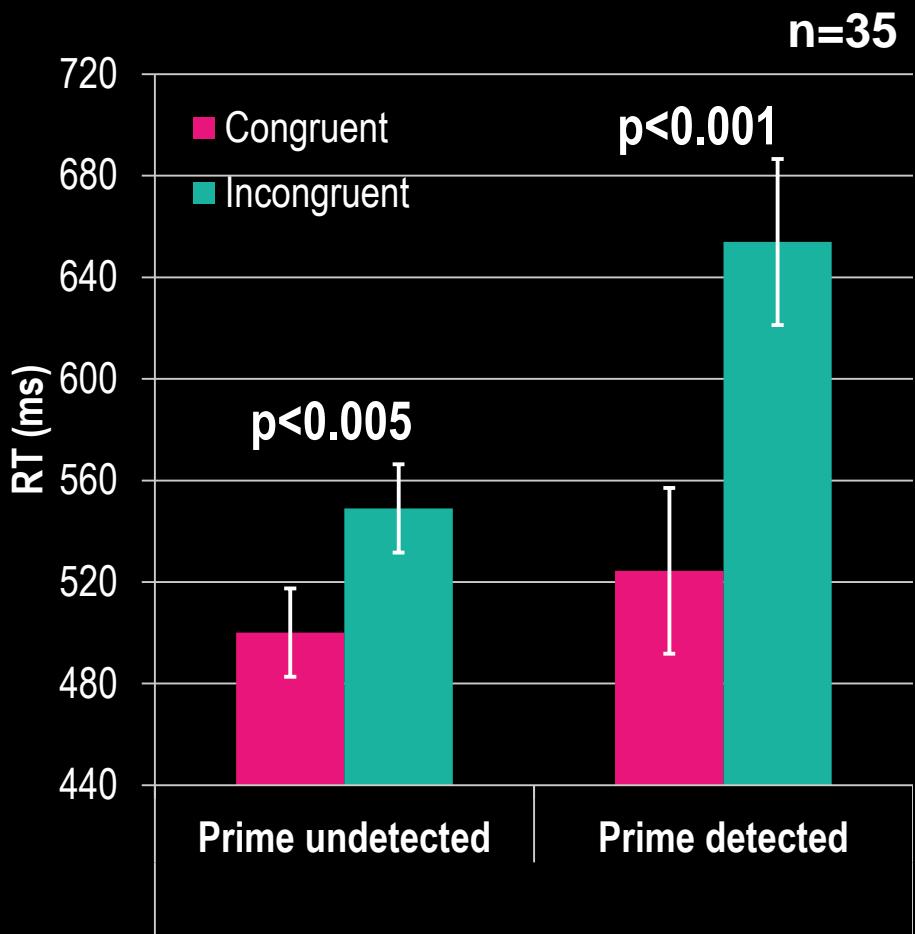
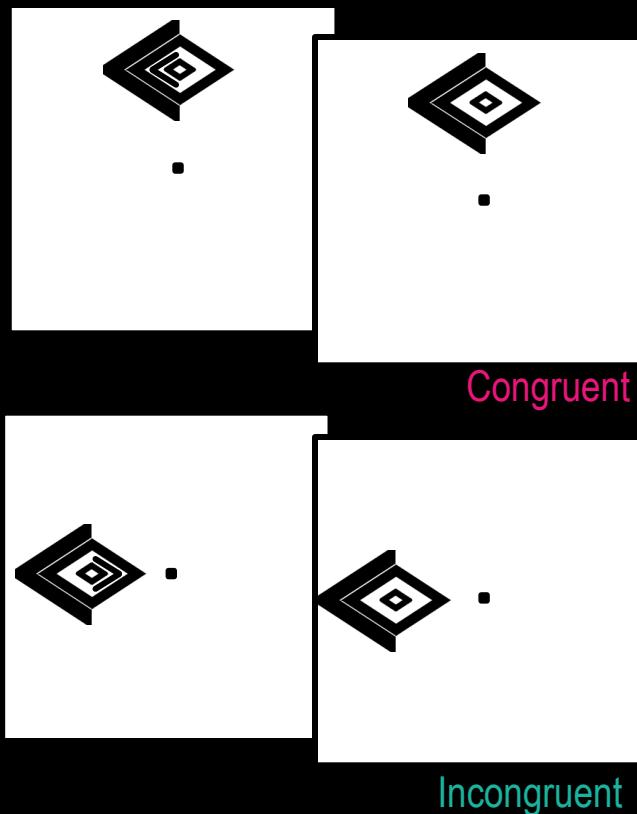
- Object substitution masking (OSM)



Predictions

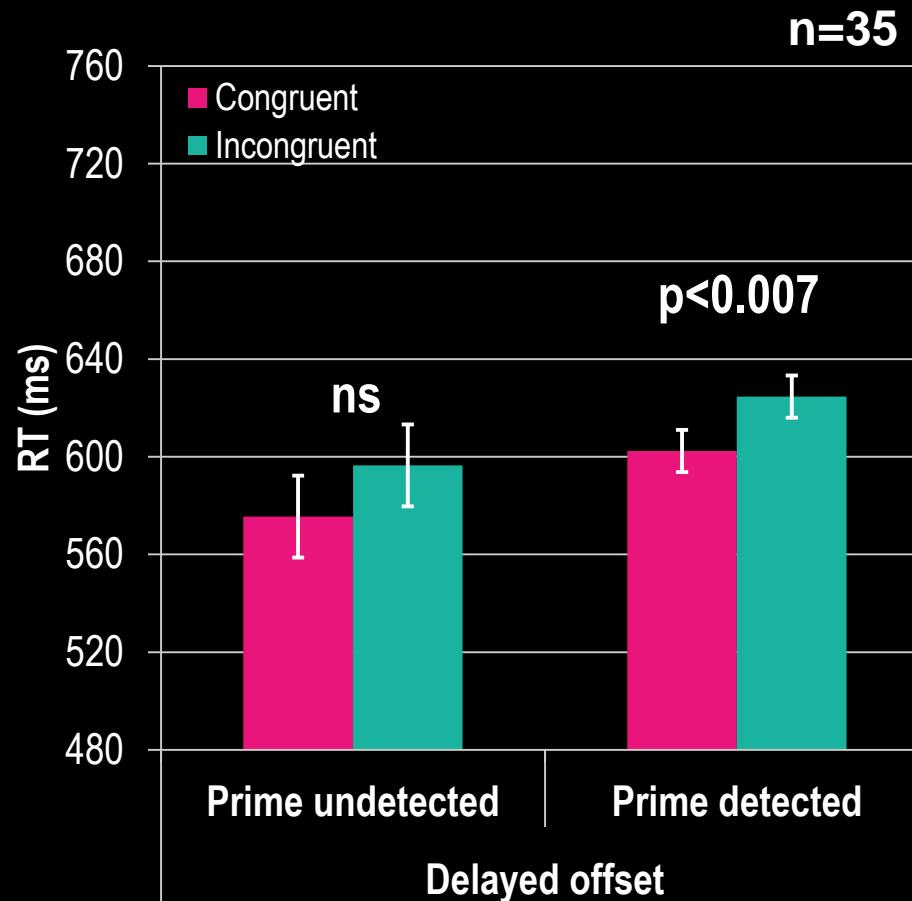
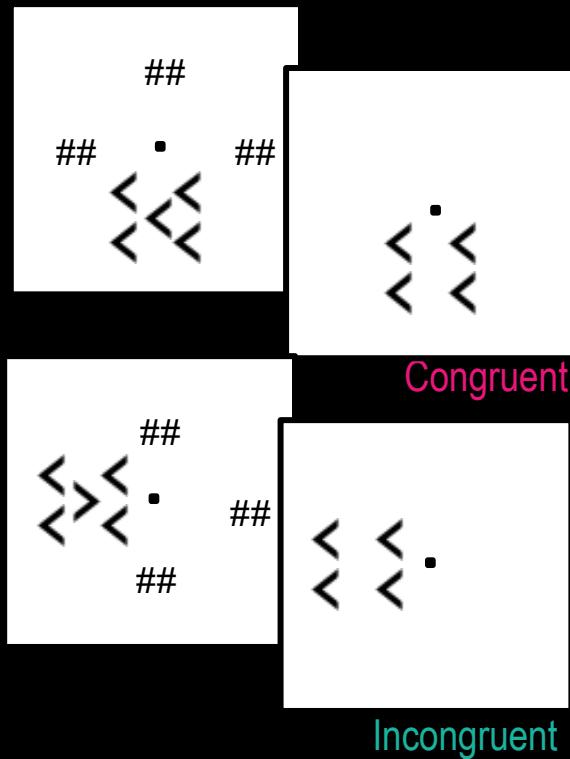
- Since priming depends on attention then...
- Object Substitution Masking
 - No priming for unseen OSM primes because attention is not focused on prime.
- Metacontrast
 - Priming for unseen metacontrast prime because attention is focused on the prime.

Priming in metacontrast



Significant priming with seen and
unseen targets

Priming in OSM

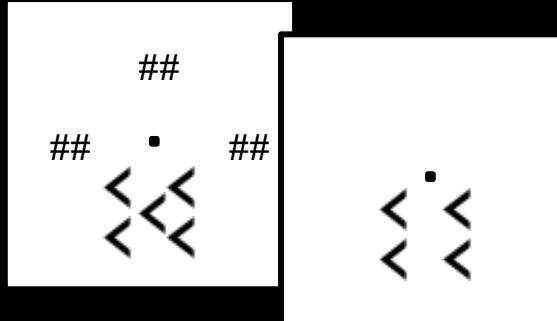


No priming with unseen targets

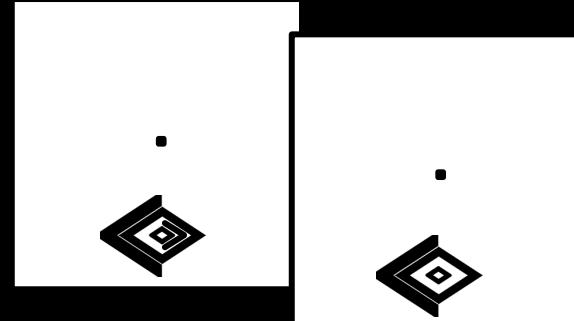
Masked priming summary

- Priming in metacontrast for both seen and unseen primes.
- Priming in OSM only for seen primes.

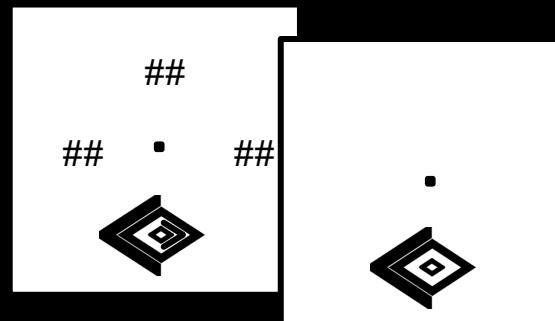
Object Substitution Masking



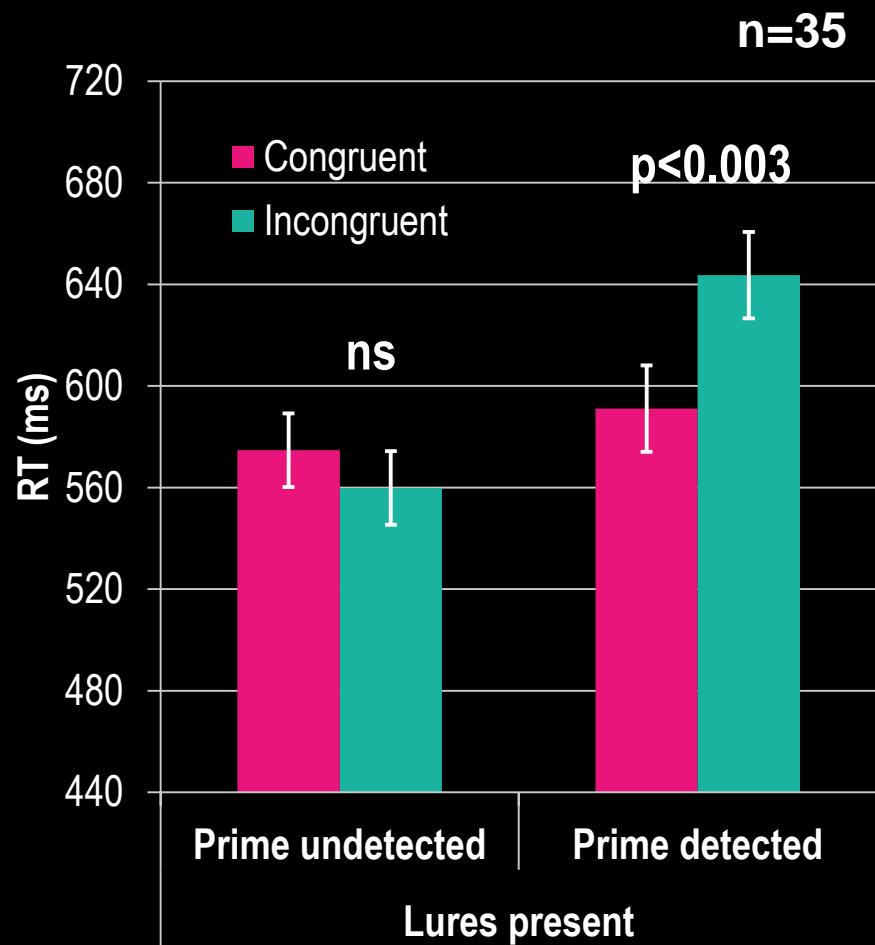
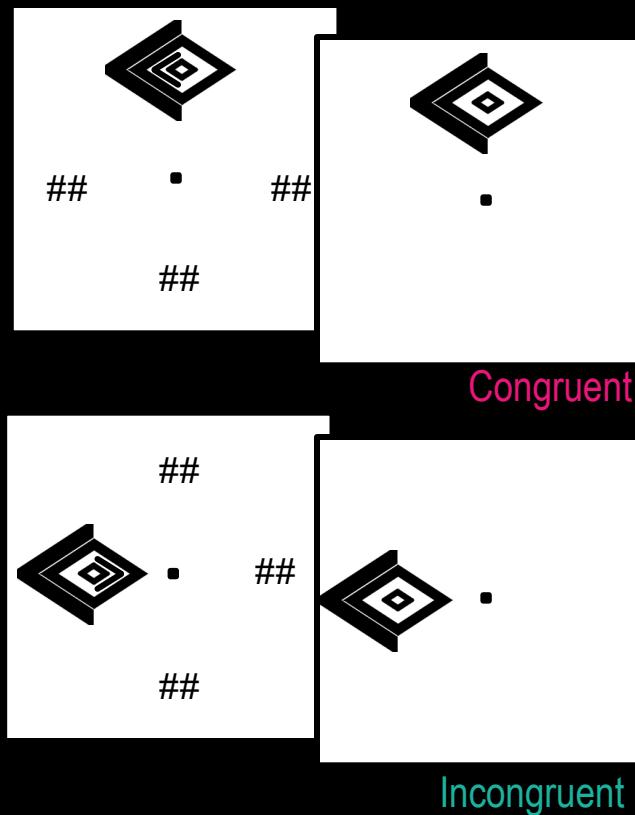
Metacontrast Masking



Metacontrast Masking with Lures



Priming in metacontrast with Lures



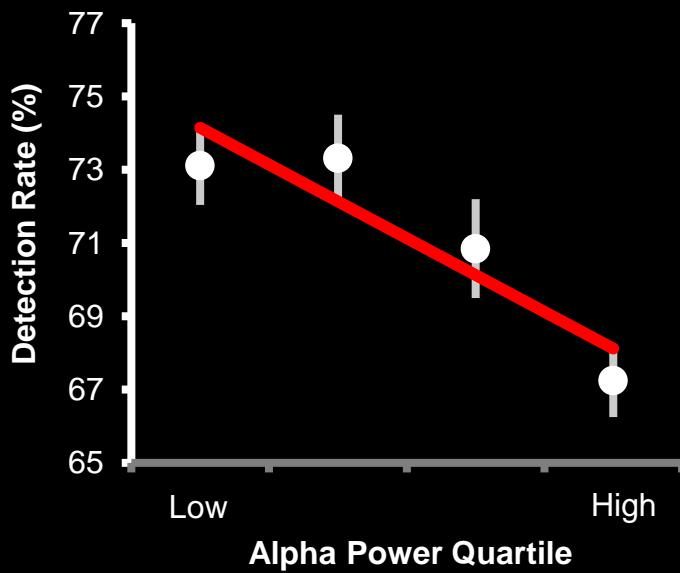
Masked priming conclusions

- Only a lone metacontrast masked stimulus produces priming
- Consistent with masked priming requiring some degree of focused attention
- Suggests that metacontrast masked prime is attended
- Metacontrast mask is not interfering with attention

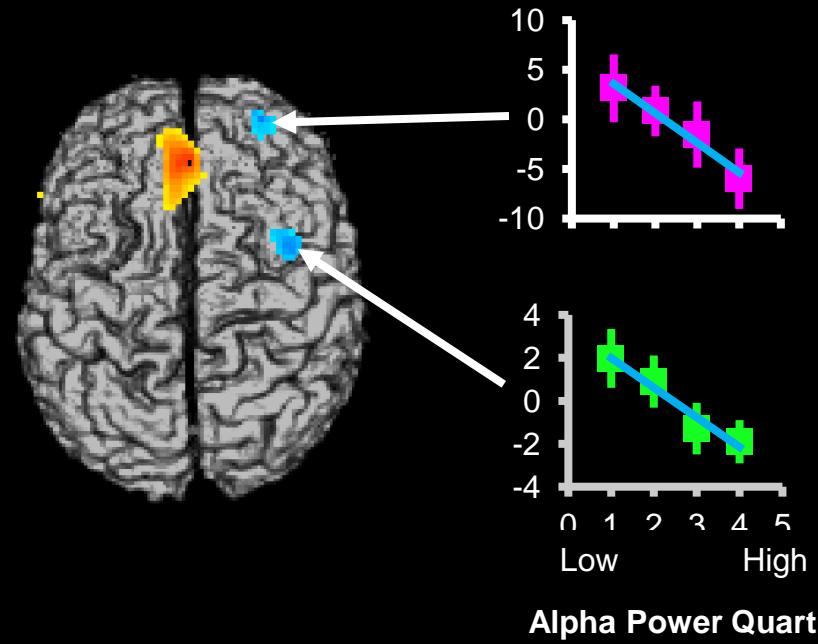
Metacontrast and Attention

- Attention modulates metacontrast masking
(Boyer & Ro, 2007)
- Pre-stimulus alpha power

Alpha power predicts detection
(Mathewson et al., 2009, 2014)



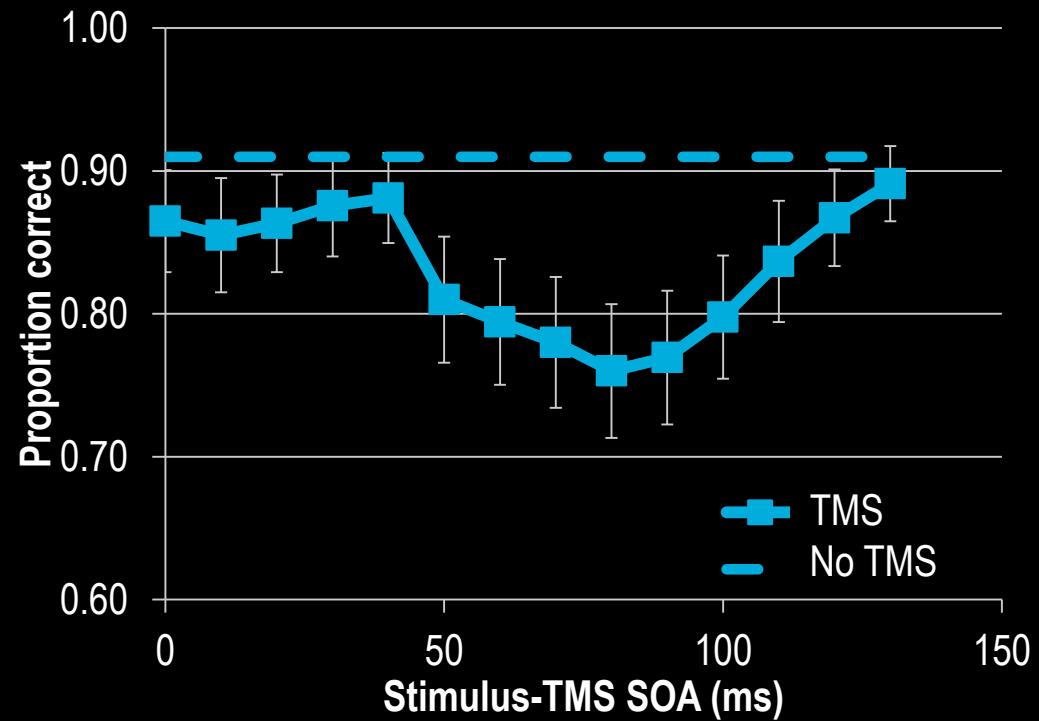
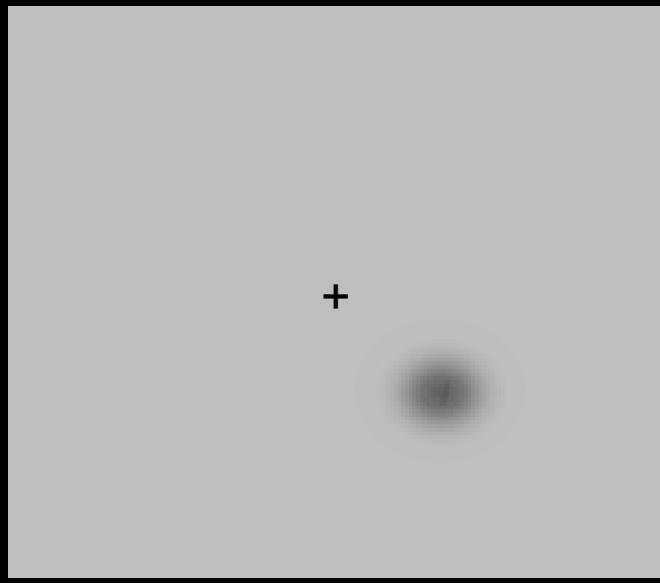
Attention network modulates alpha power
(Mathewson et al., 2014)



Masking with Transcranial Magnetic Stimulation (TMS)

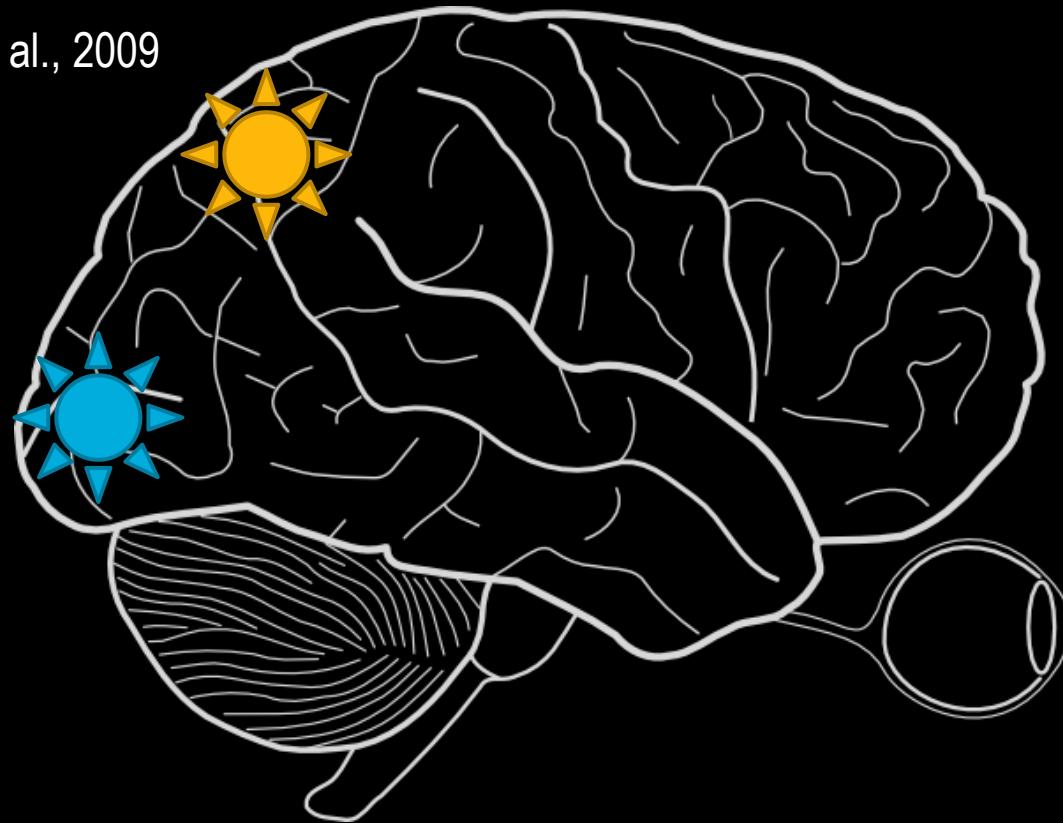


Suppressing vision with TMS

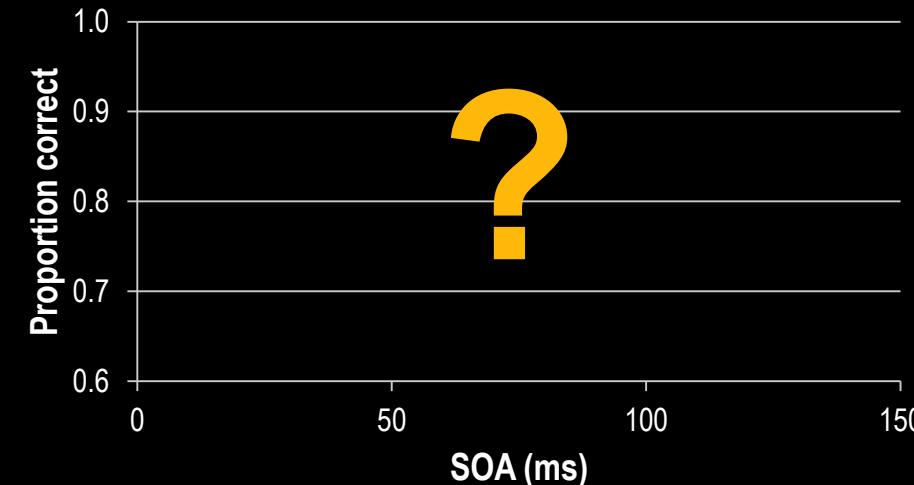
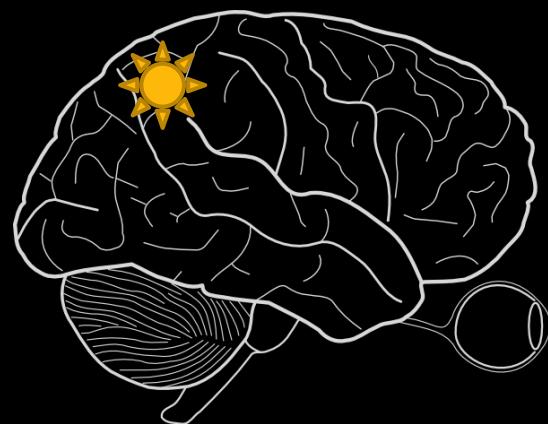
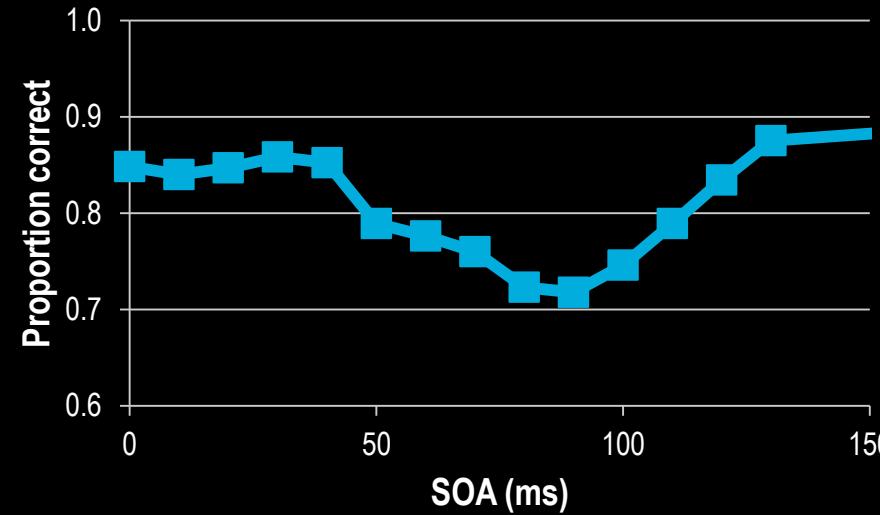
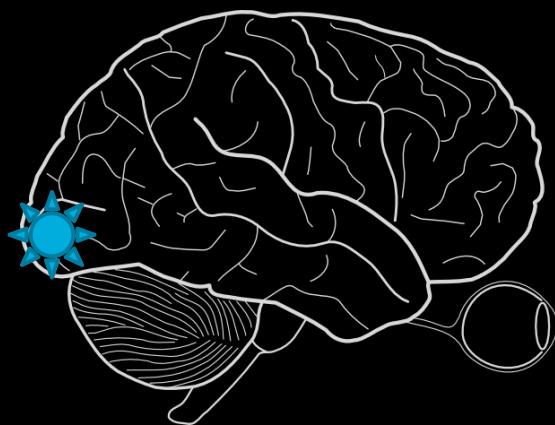


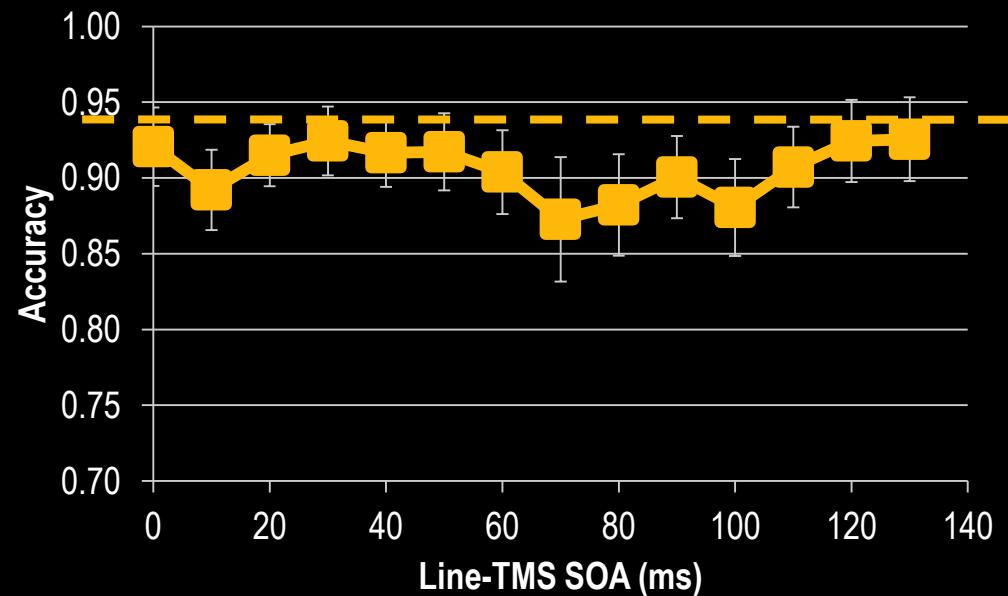
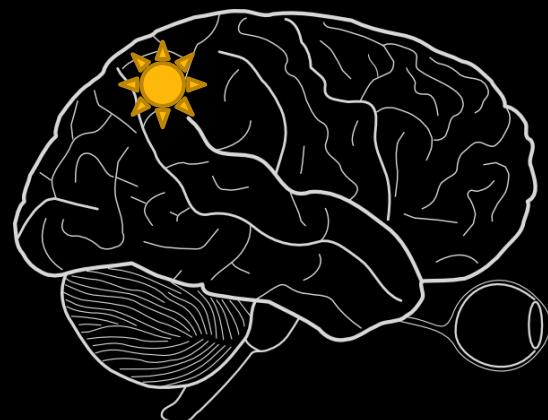
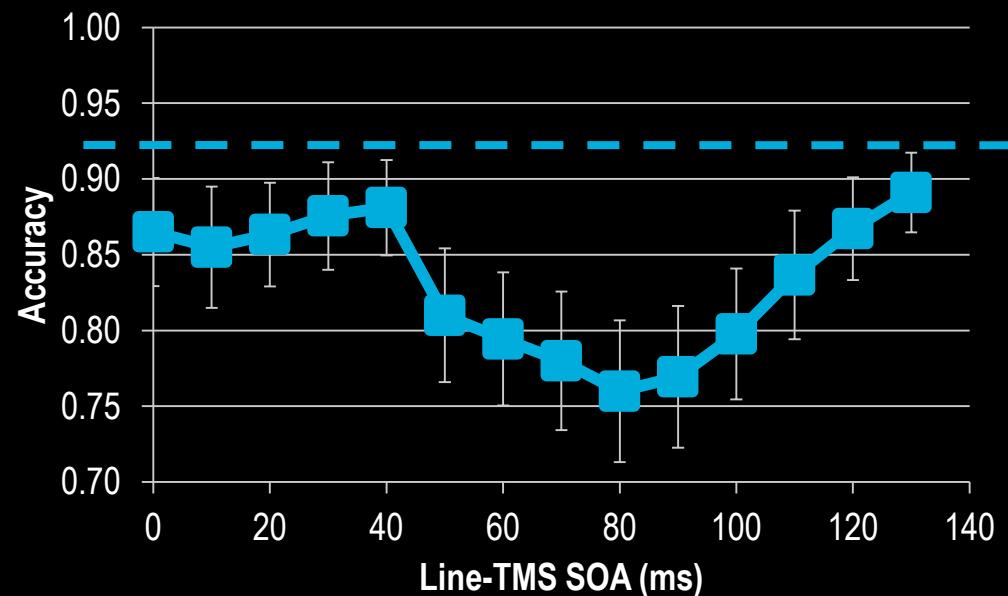
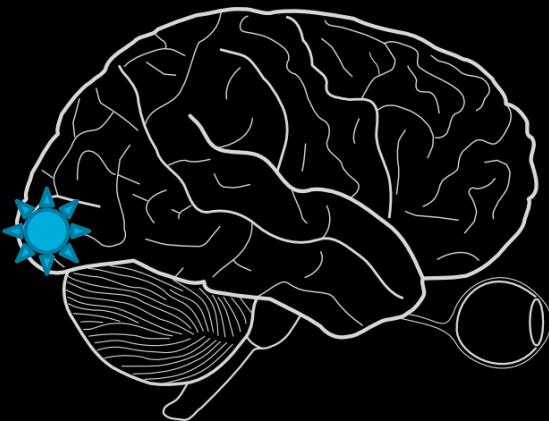
Occipital and parietal phosphenes

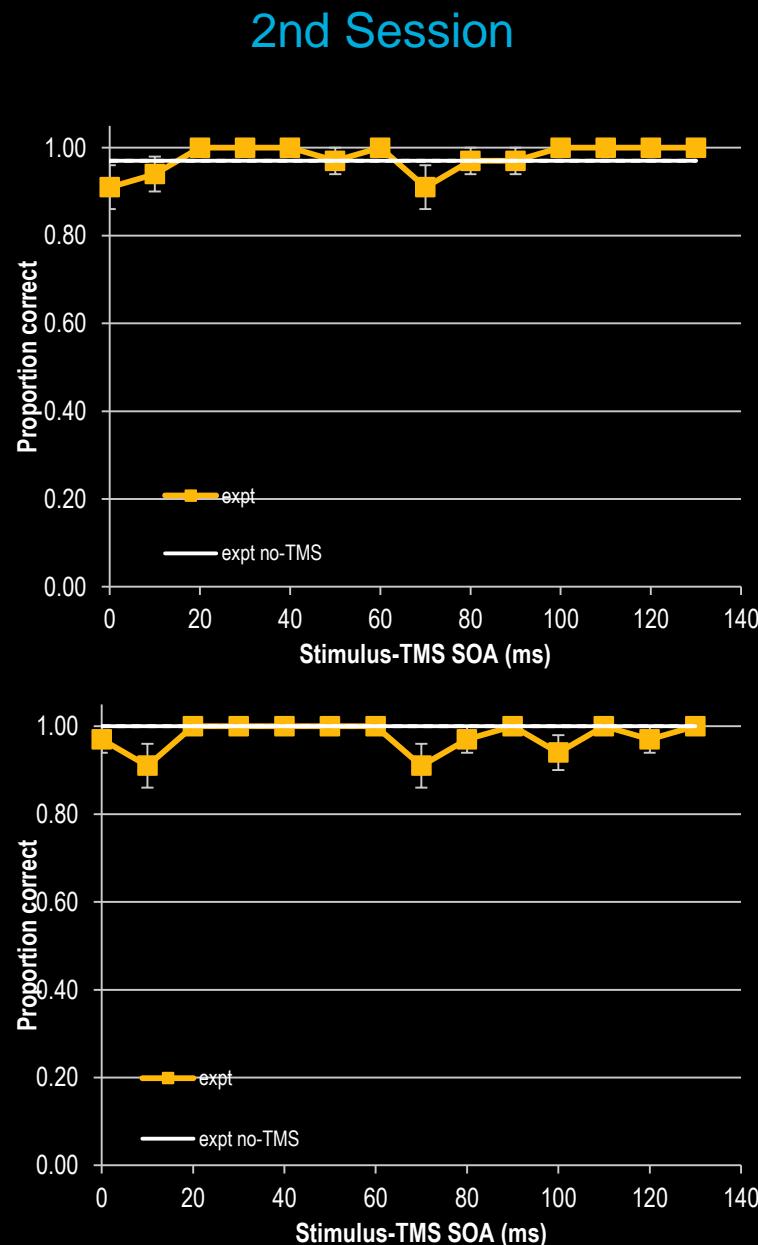
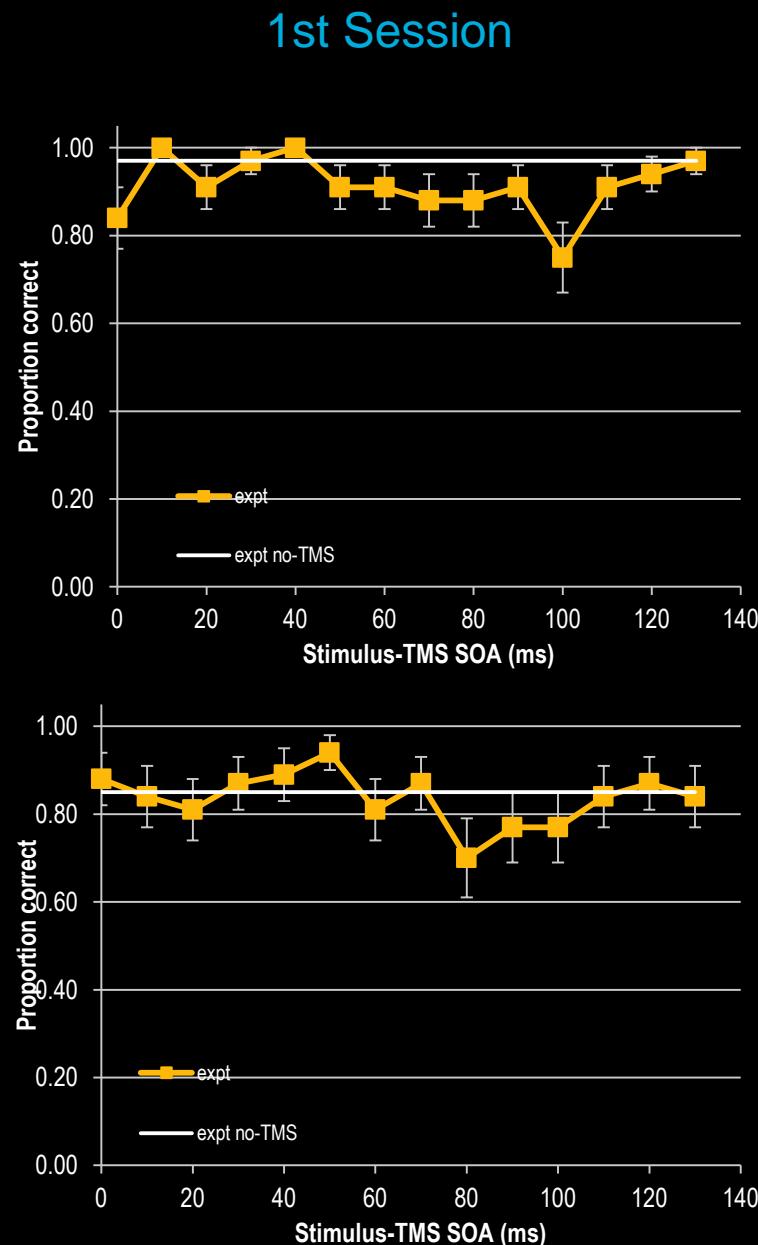
Marzi et al., 2009



Occipital vs. Parietal TMS masking







TMS suppression summary

- With the occipital and parietal TMS protocol matched
- Significant suppression for occipital TMS
- No significant suppression for parietal TMS

Overall Summary

- Neither the metacontrast masking nor parietal-TMS implicate attention or parietal cortex in the feedback crucial to visual awareness

Thank You



Evelina Tapia,
University of Illinois



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University of Illinois



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University of Illinois



Kyle Mathewson,
University of Alberta



Silvia Savazzi,
University of Verona



Alejandro Lleras,
University of Illinois



Chiara Mazzi,
University of Verona

Funding: National Eye Institute and NIMH, NIH

Event Related Optical Signal: Parietal TMS induces activity in extrastriate cortex



Parietal TMS - Control TMS

0 ms

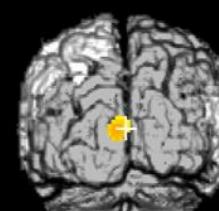
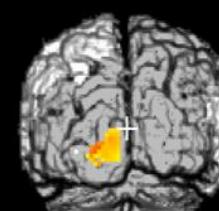
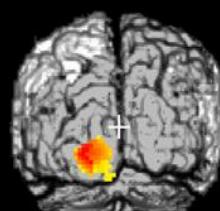
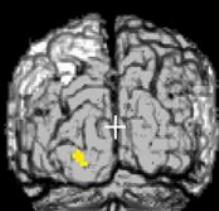
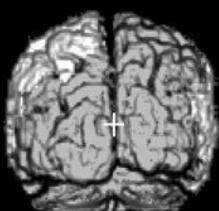
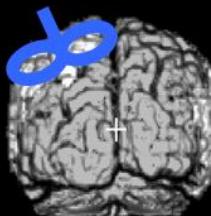
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16

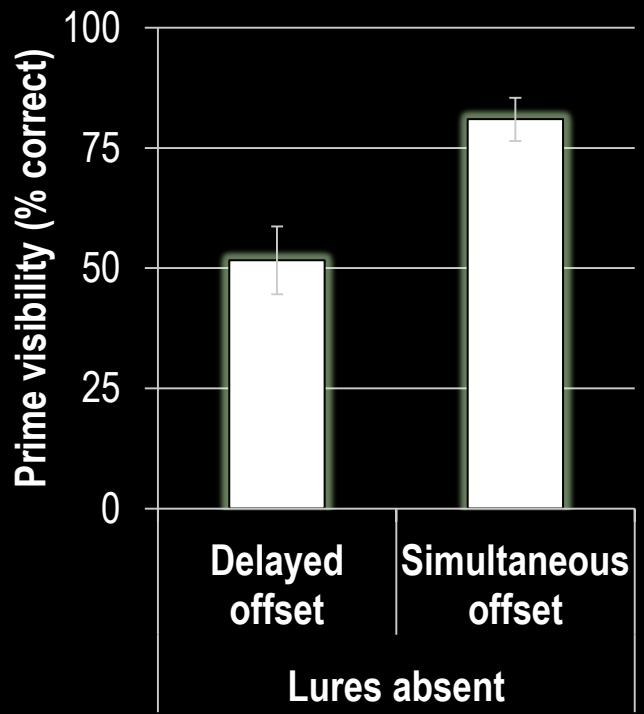
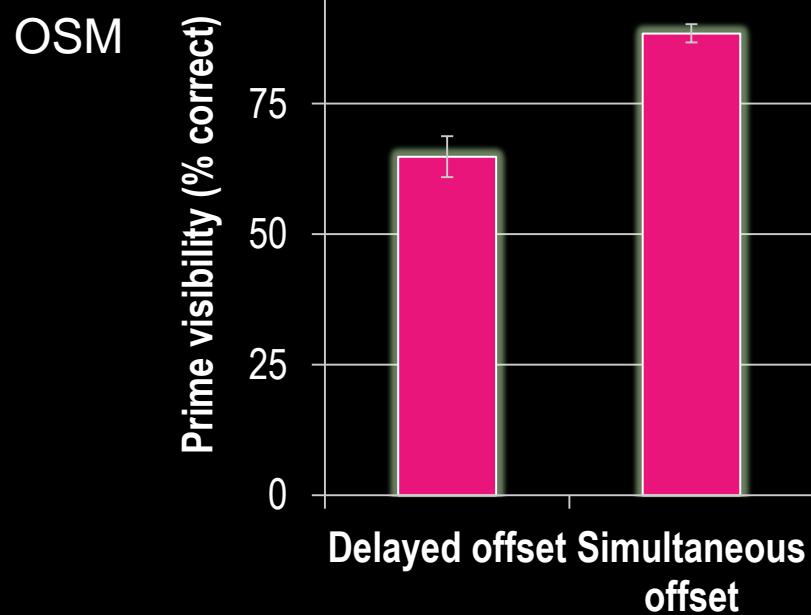
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32

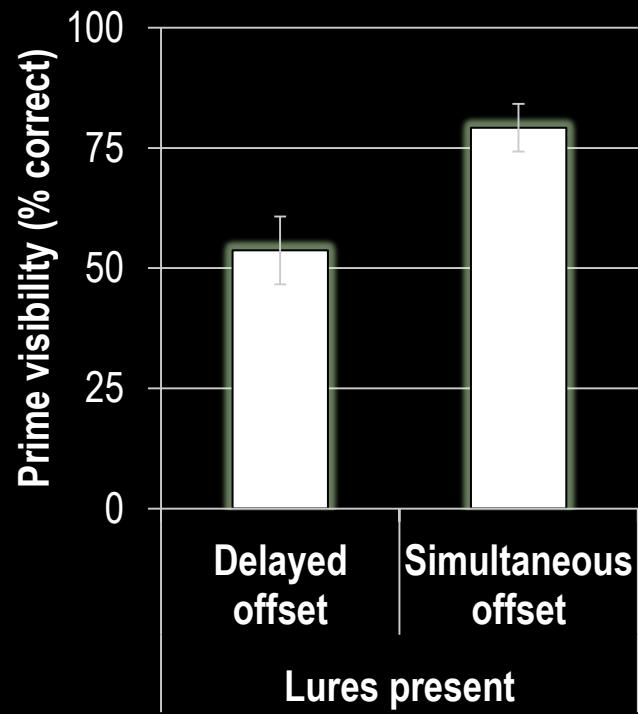
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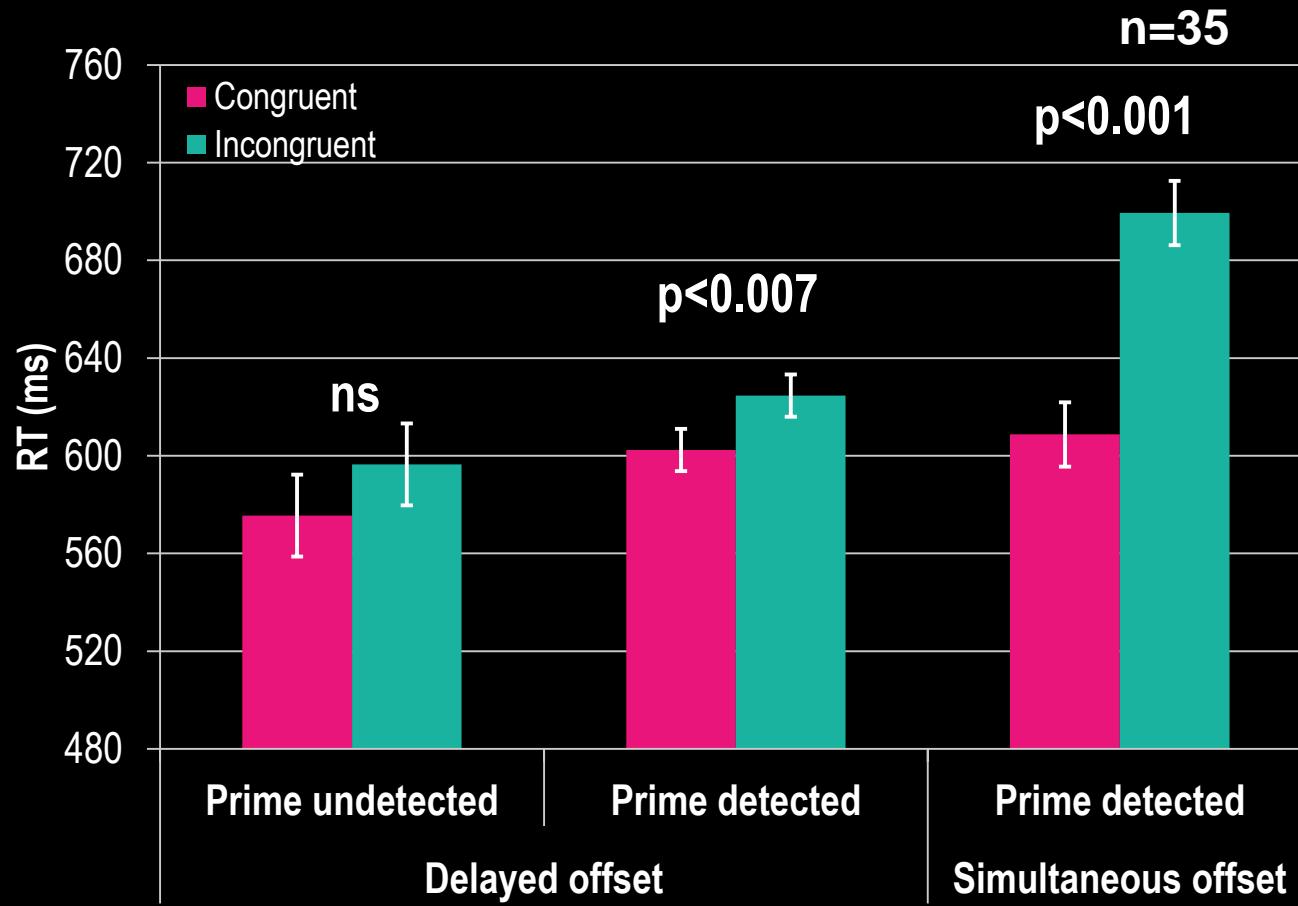
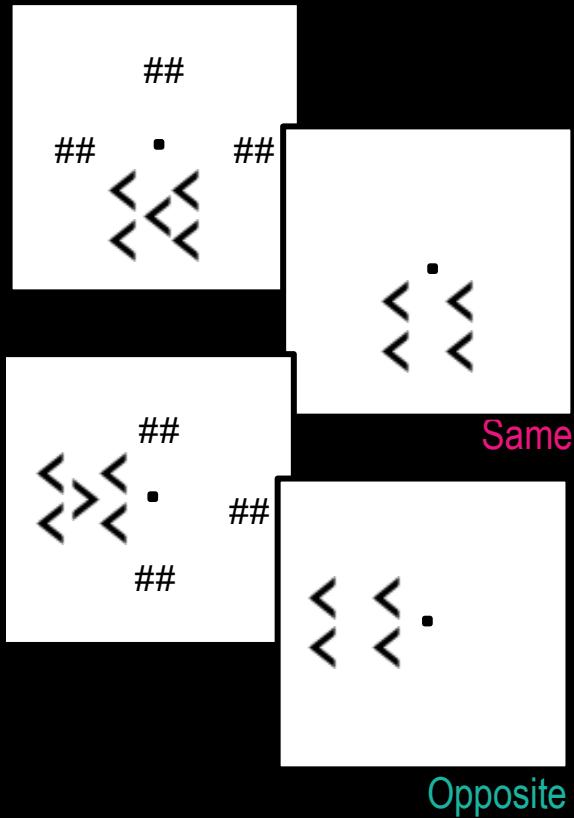
Parks, Mazzi, Tapia, Savazzi, Fabiani, Gratton, & Beck, *in prep*



Metacontrast



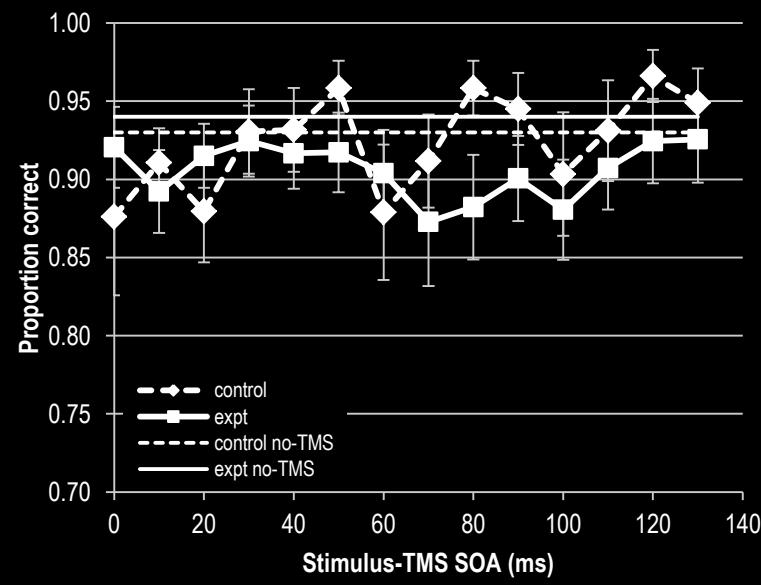
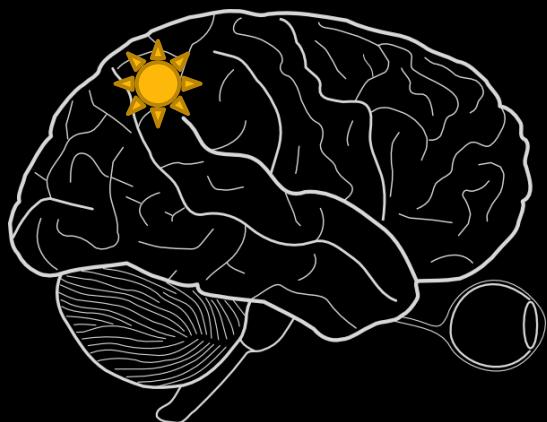
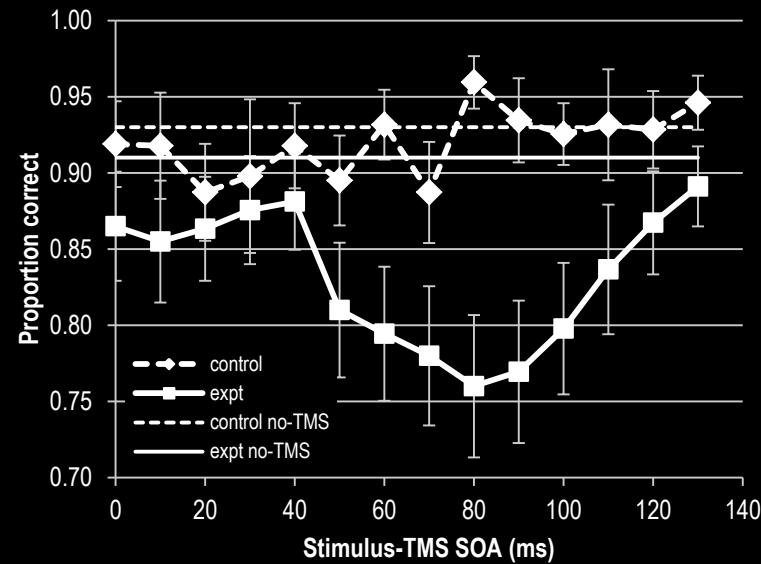
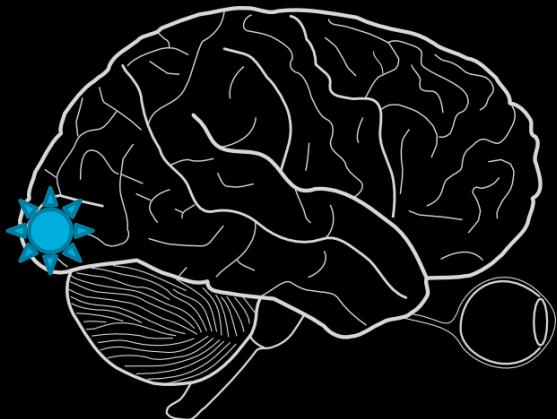
Priming in OSM



Masked priming

- Metacontrast masked stimulus can still prime (e.g. Breitmeyer et al., 2004, 2005; Enns & Oriet, 2007; Kentridge et al., 2008; Klotz & Neumann, 1999; Tapia et al., 2010, 2011, 2013; Vorberg et al., 2003)

	Masked priming w/ unseen (avg # trials)	Masked priming w/ seen (avg # trials)	Priming w/ seen (avg # trials)	Target accuracy: Masked (present/absent) vs. simultaneous	d' masked vs. simult (2 tail against zero)	c (bias) masked vs. simult (2 tail against zero)	Sample size
Metacontrast	YES (44)	YES (33)	YES (58)	0.43/0.87 vs. 0.83	1.55 vs. 3.04	1.16 vs. 0.26	35
Metacontrast with foils	NO (51)	NO (23)	YES (59)	0.31/0.84 vs. 0.83	0.6 vs. 2.6	1.03 vs. 0.11	35
OSM	NO (26)	YES (48)	YES (65)	0.65/0.9 vs. 0.9	2.2 vs. 3.16	0.53 vs. 0.13	35



Tapia, Mazzi, Savazzi & Beck, 2014

