

Lateralisation of the Event-Related Brain Potential Reveals Neural Correlates of Attention, Distractor Suppression, and Visual Short-Term Memory

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**ACNS
2015**

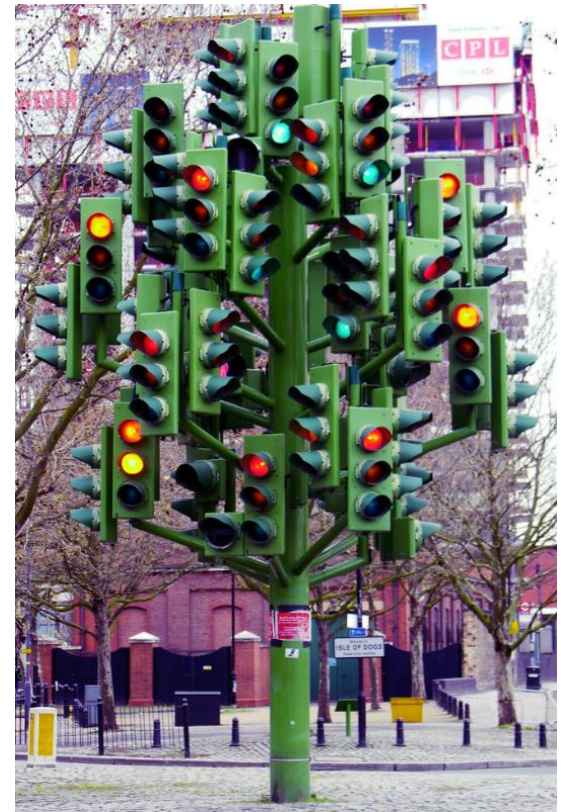
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Selective Attention

- Flexibly identify stimuli that are (possibly) task relevant
- Resist distraction
 - c.f. Engle, 2002
- Transfer/maintain relevant information to/in working memory to support behaviour
- Selection determined by stimulus factors, task goals, and individual differences



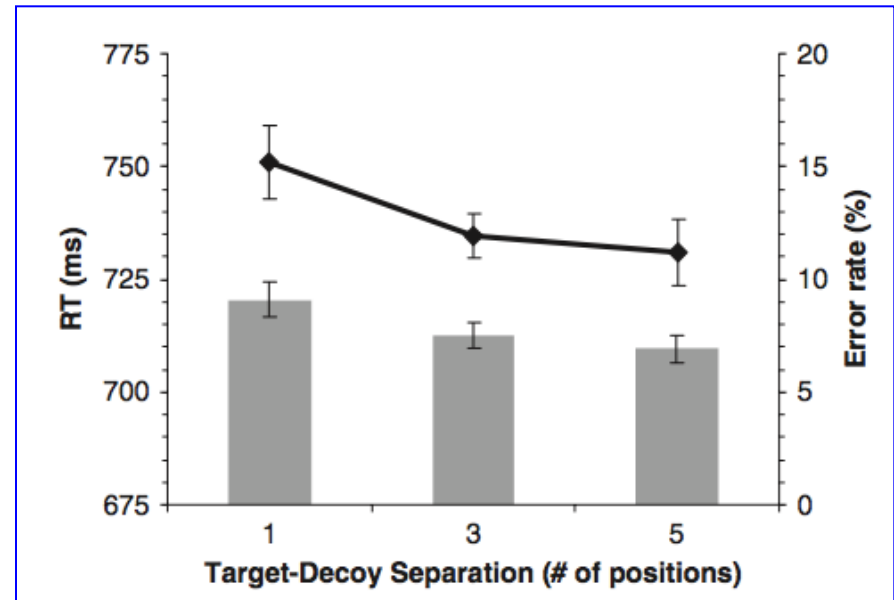
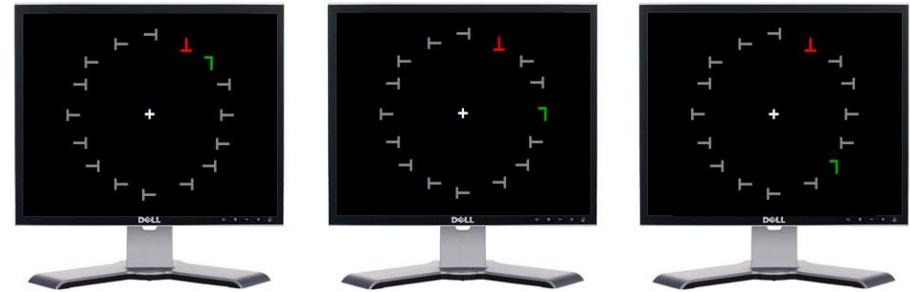
Localised Attentional Interference

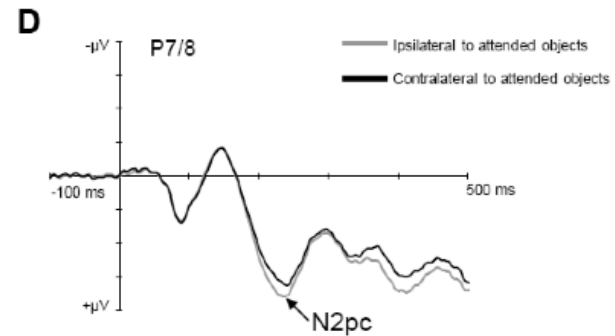
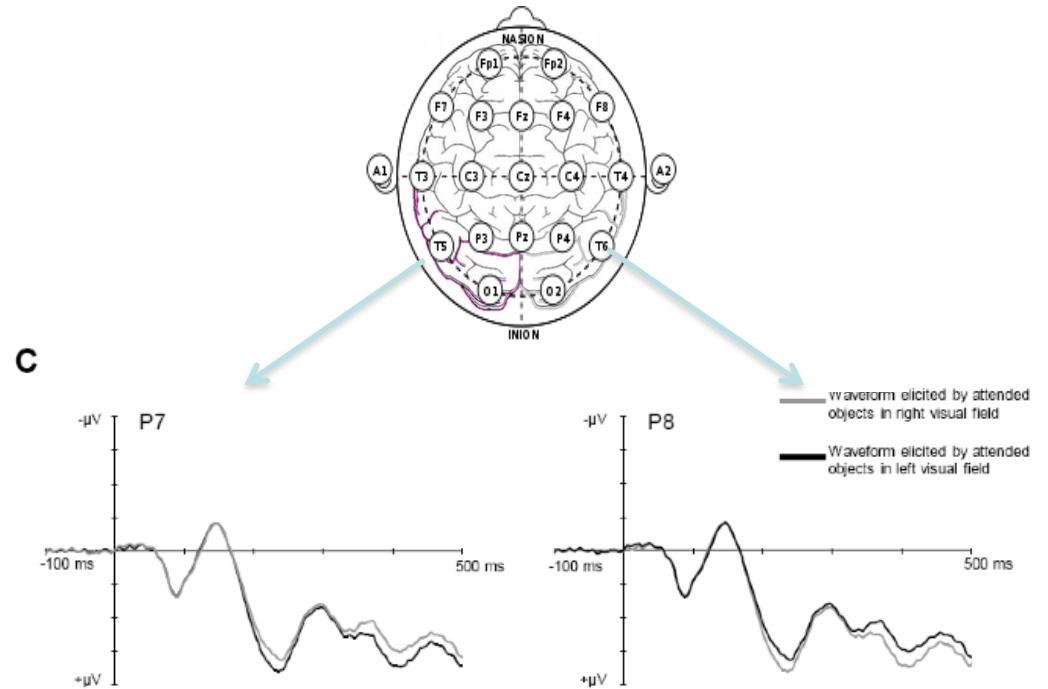
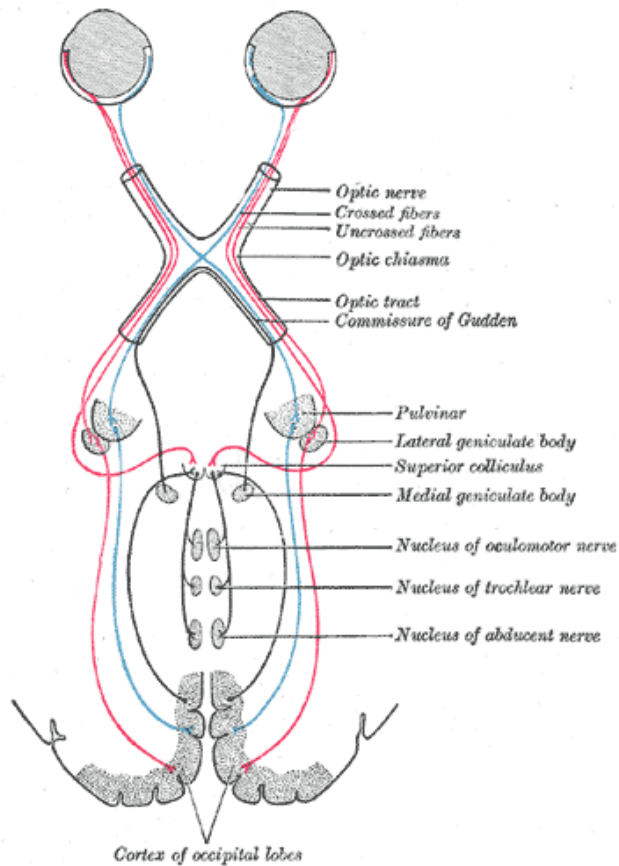
Visual-search task

- Report orientation of target (T)
- Ignore salient distractor (L)

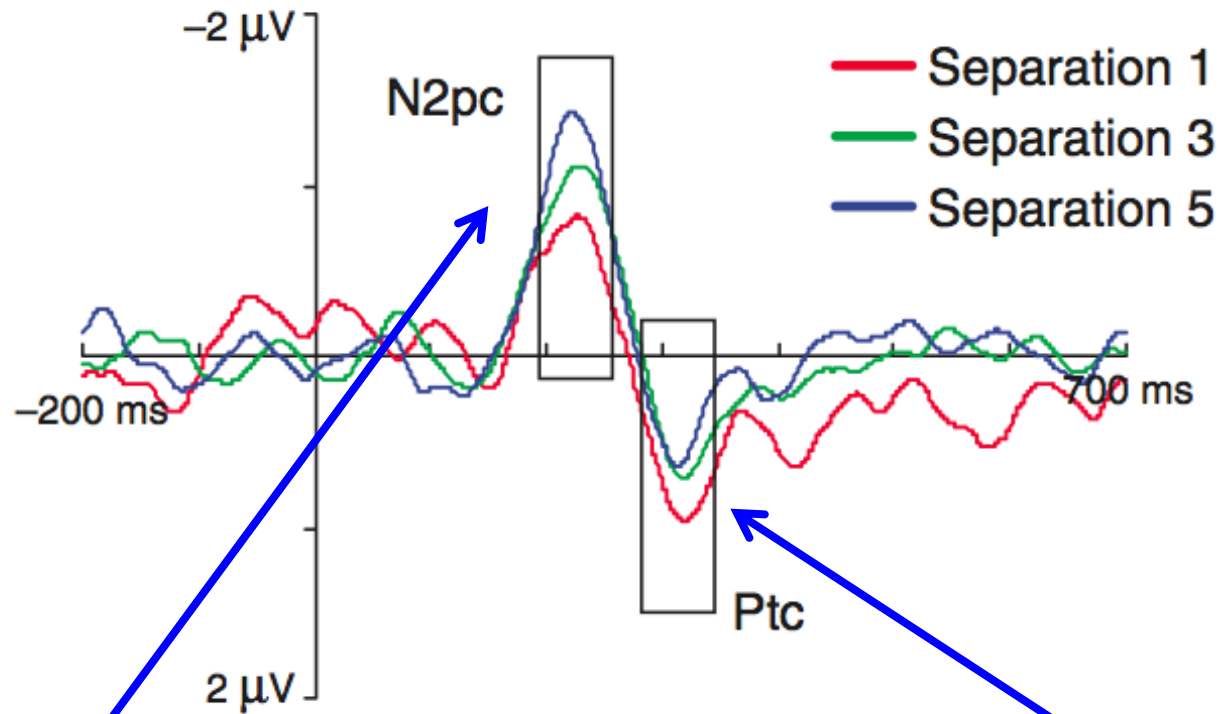
Behavioural performance depends on:

- Target-distractor separation
- Relative salience
- Foreknowledge of target colour
- Etc...





N2pc and Ptc



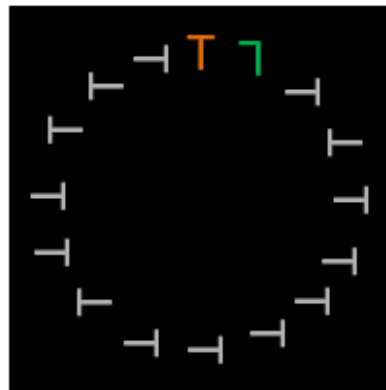
N2pc diminishes in amplitude as target and decoy get closer

Ptc increases in amplitude as target and decoy get closer

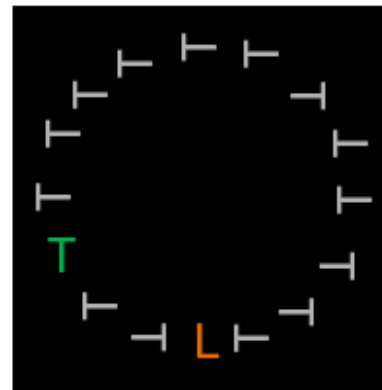
- N2pc modulated by competition for representation between target and distractor
 - Decreases in amplitude with decreasing **T-L** distance
 - Attention capture by a candidate target
 - Hilimire, Mounts, Parks, & Corballis, 2009
- Ptc modulated by competition for representation between target and distractor
 - Increases in amplitude with decreasing **T-L** distance
 - Higher amplitude for more salient distractors
 - Only observed when a salient distractor is present
 - Hilimire, Mounts, Parks, & Corballis, 2010
 - Distractor-related processing? Suppression?
 - c.f. “Pd” (Hickey, DiLollo, & McDonald, 2009; Hilimire, Hickey, & Corballis, 2012)

Distinguishing Target-Related from Distractor-Related Processing

Lateralized Decoy - Near

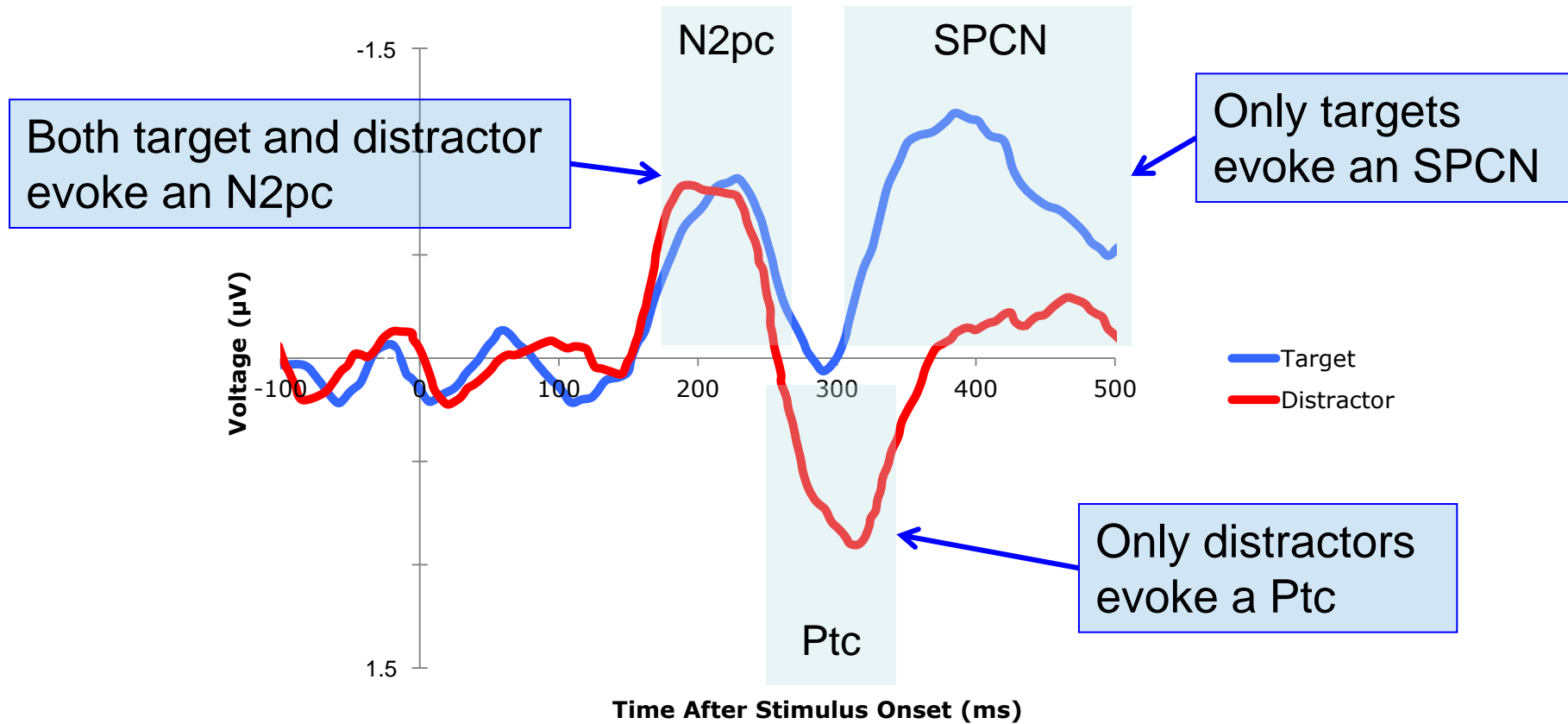


Lateralized Target - Far

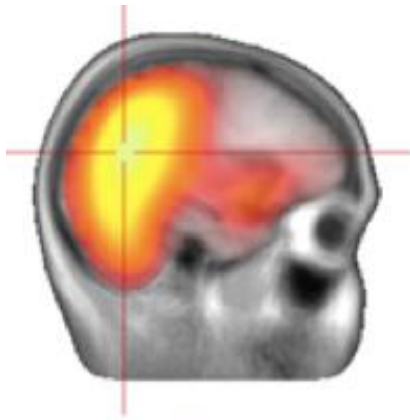


Can we further dissociate effects of target and distractor processing in N2pc and Ptc?

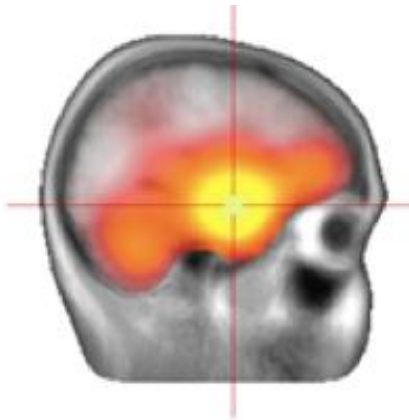
- Lateralize only one salient stimulus
 - a la Hickey, DiLollo, & McDonald, *JoCN*, 2009



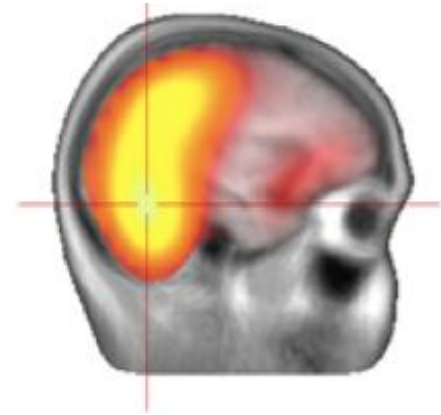
sLORETA Source Estimates



N2pc



Ptc

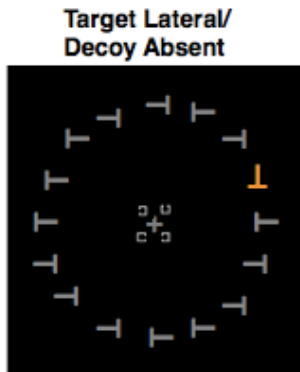


SPCN

Three Attention-Related Lateralisations

- N2pc
 - Evoked by both targets and distractors
 - (but only when task-relevant; Hilimire & Corballis, 2014)
 - Engagement of attention by a candidate target?
- Ptc
 - Evoked by distractors, not by targets
 - Distractor suppression?
- SPCN
 - Evoked by targets, not by distractors
 - Visual working memory?

Attentional Template



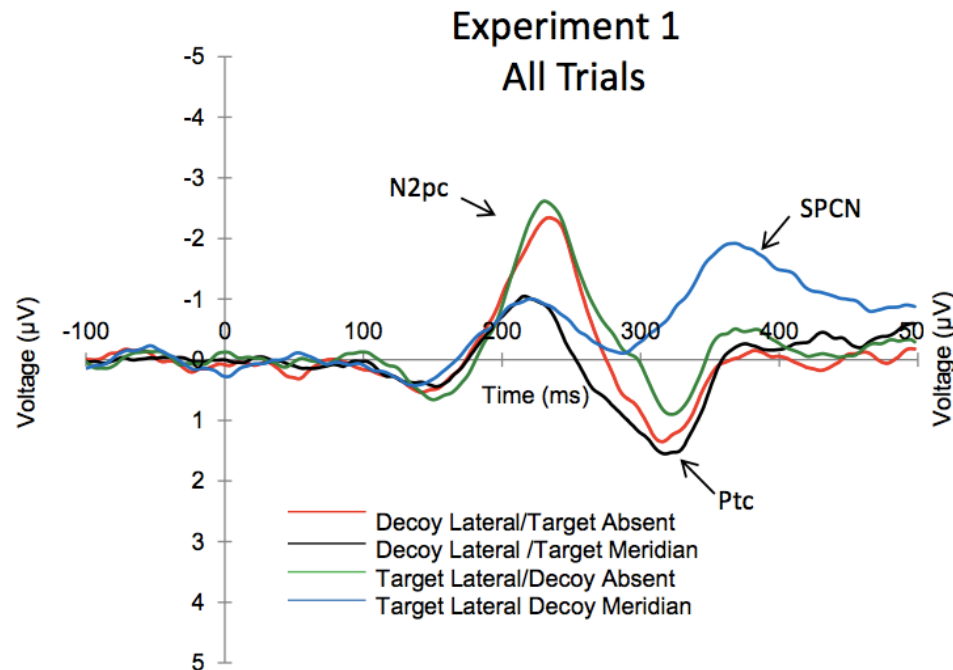
Experiment 1

- Target colour unknown

Experiment 2

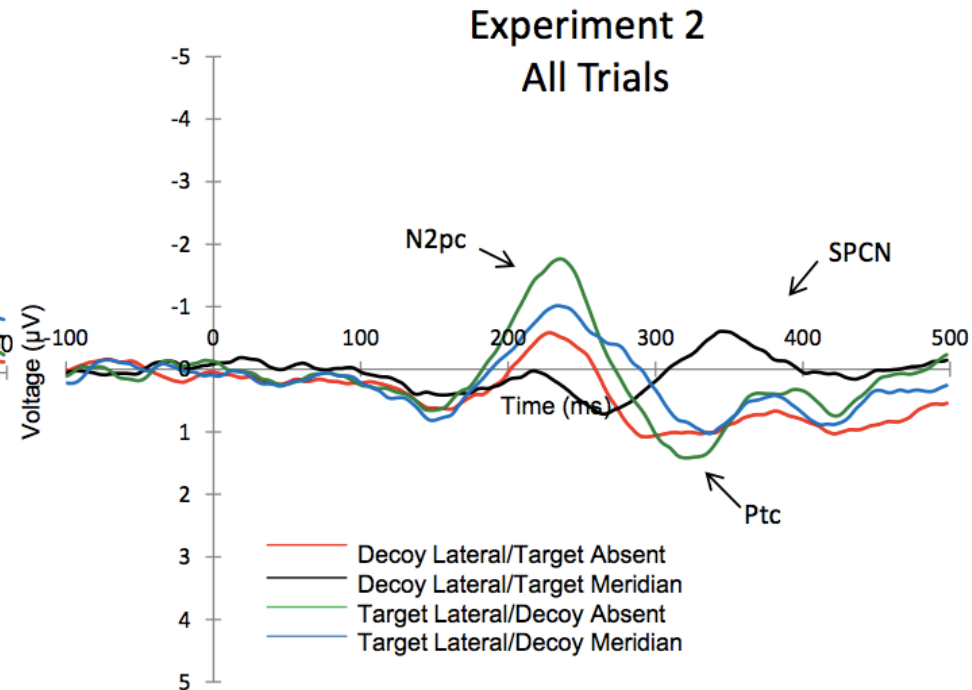
- Target colour known in advance
- Does knowledge of target colour influence attention capture by salient distractors?

Colour Varies



- N2pc attenuated by presence of distractors
 - Competition
- SPCN only evoked by target when salient distractor present

Colour Known



- Decoy N2pc greatly attenuated
- Ptc evoked by singleton targets
 - Disengagement?
- SPCN greatly reduced or eliminated

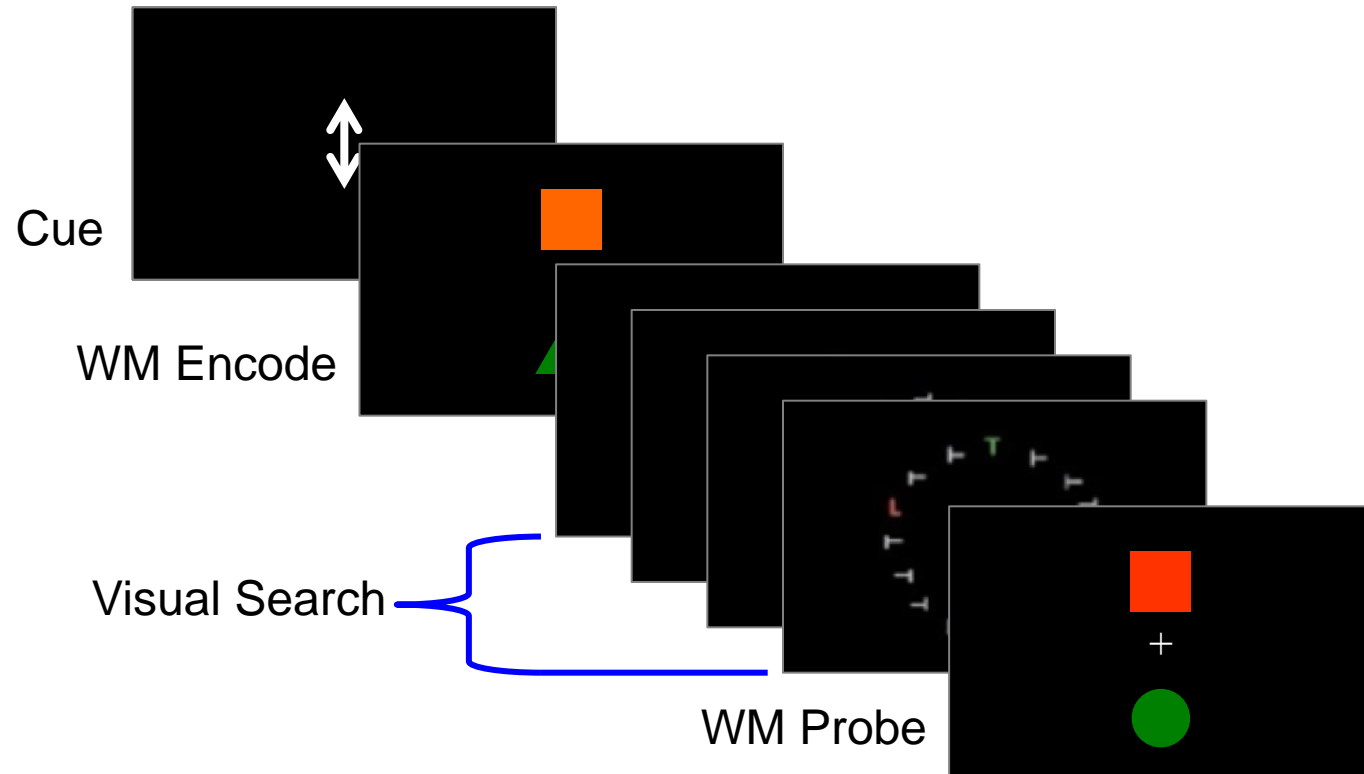
Summary

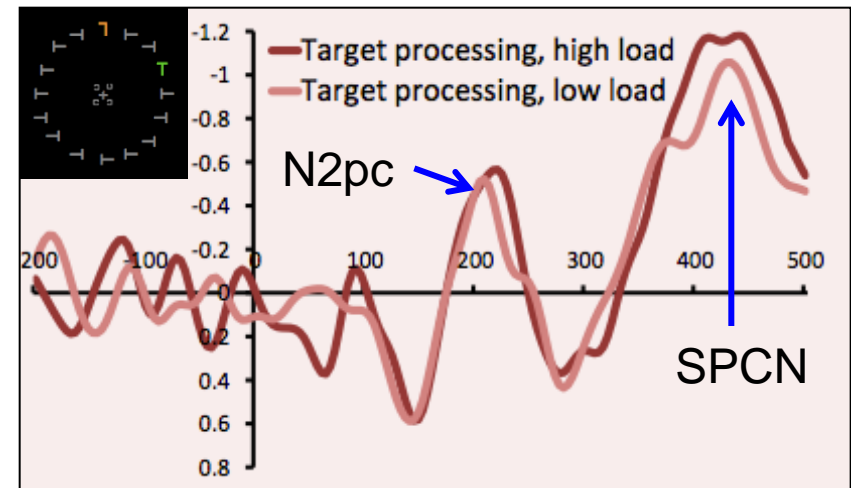
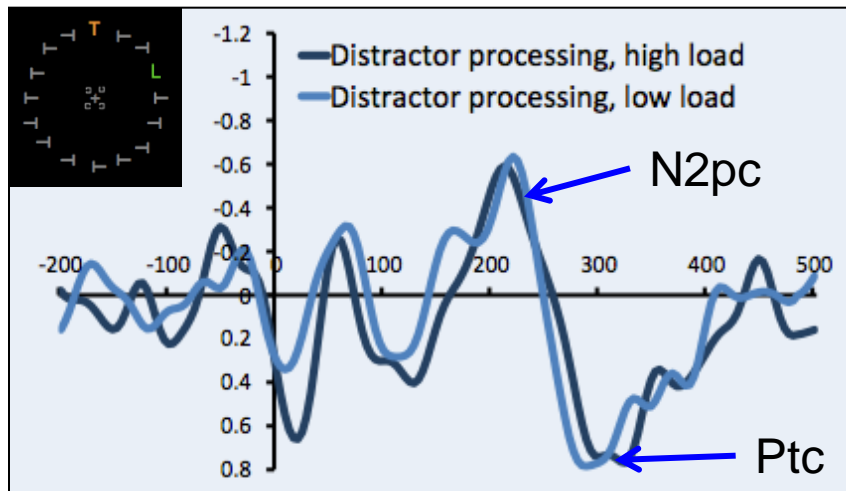
A priori knowledge of target colour:

- greatly reduces N2pc evoked by distractors
 - Ignore irrelevant information
- reduces Ptc evoked by distractors
 - but singleton targets evoke Ptc
 - active termination of search?
 - c.f. Sawaki, Geng, & Luck, 2012.
- greatly reduces or eliminates SPCN
 - WM storage only necessary under conditions of competition?
 - c.f. Woodman, Luck, & Schall, 2007.

Working Memory

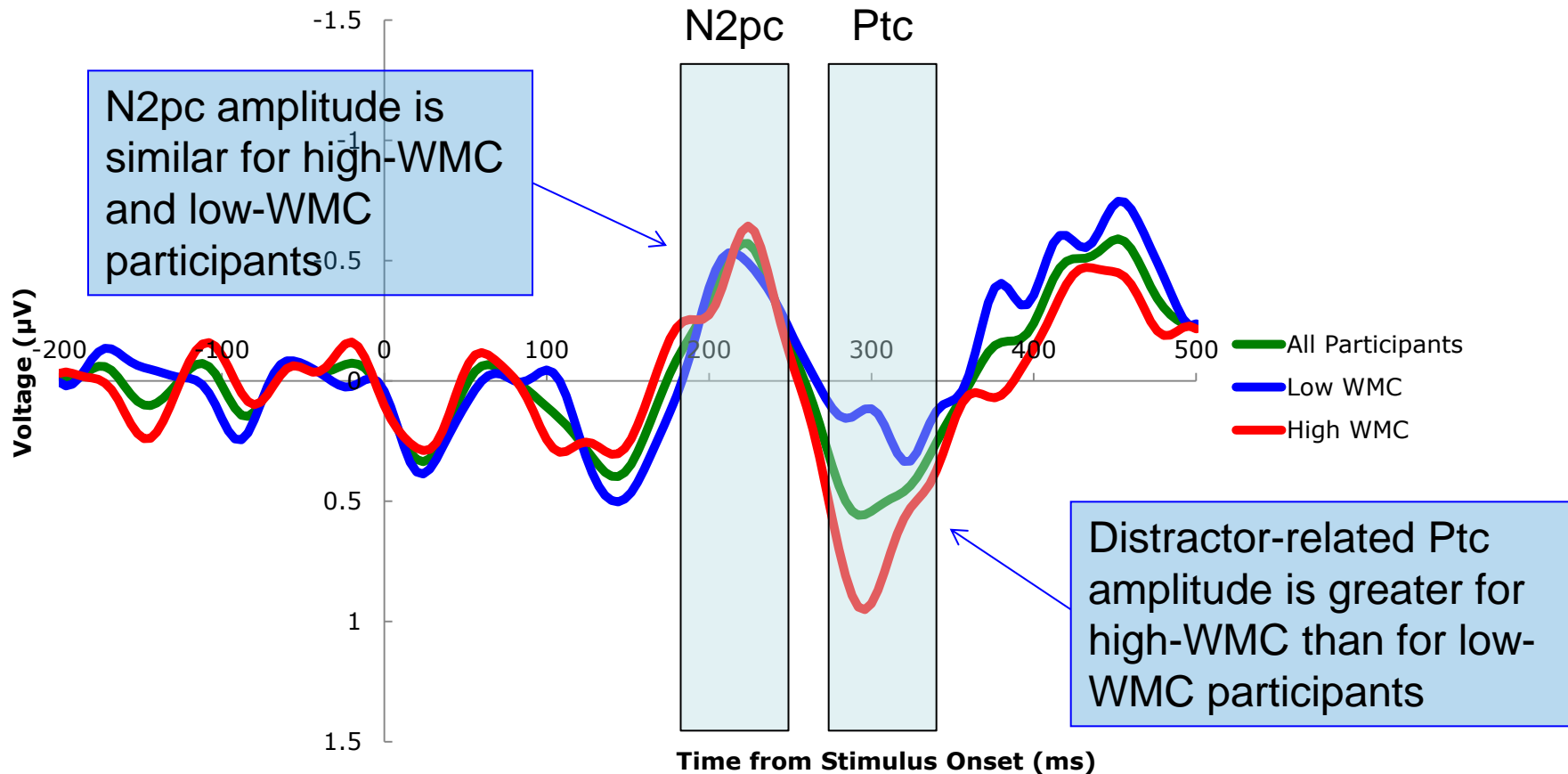
- Executive attention theory of WMC
 - e.g., Kane & Engle, 2002; Engle & Kane, 2004
- Common resource for working memory and visual search
 - Anderson, Vogel, & Awh, 2012
- WM capacity may be critical in overcoming distraction
 - Engle, 2002; Vogel & Awh, 2008
- Do working-memory load or capacity influence lateralised components?
 - Ptc? SPCN?





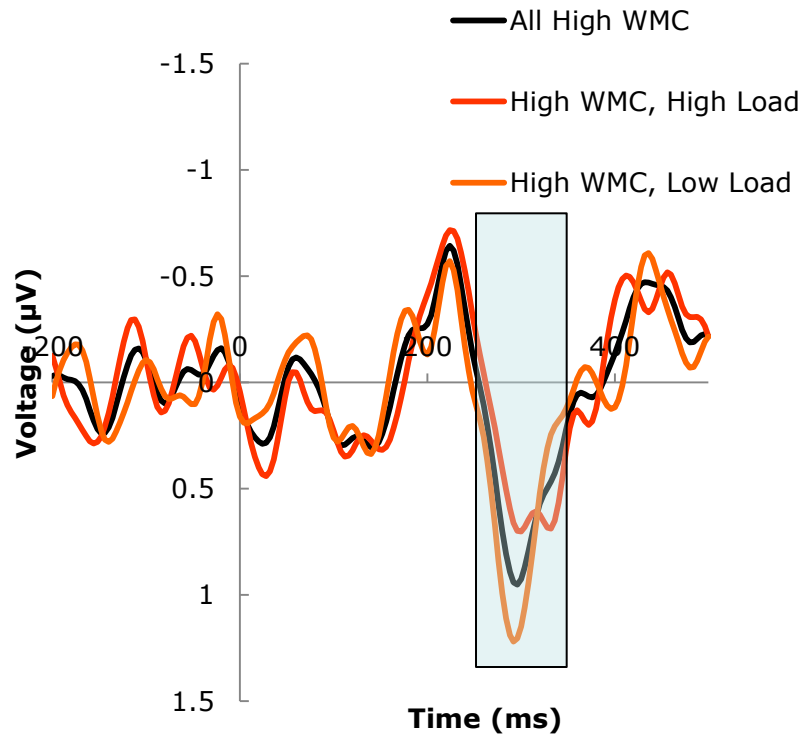
No overall effect of WM load on attention-related lateralisations

Working Memory Capacity: Distractor Processing

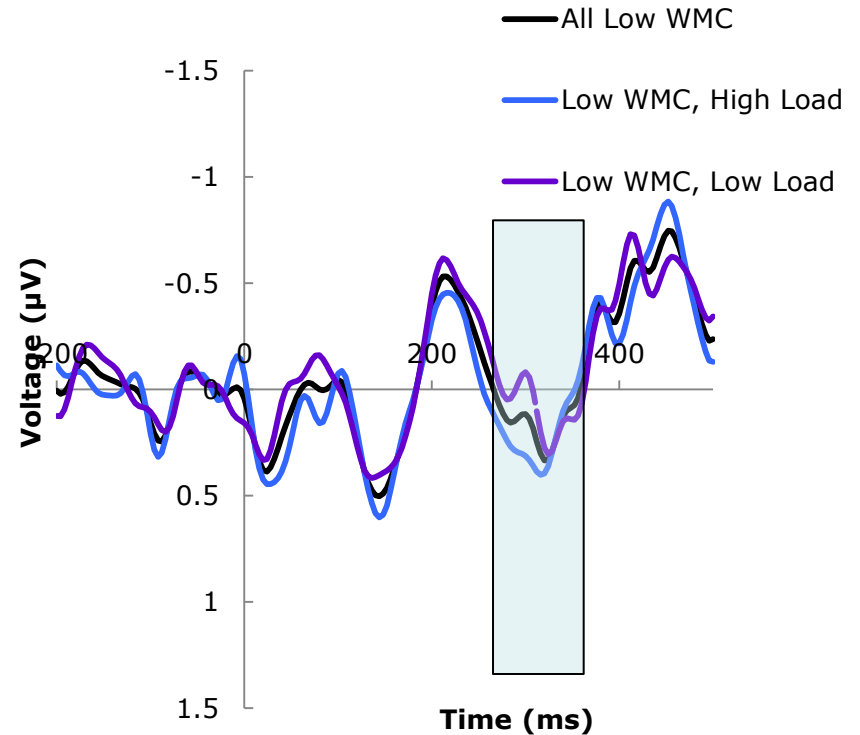


Distractor Processing

High WMC



Low WMC



Summary

- No influence of working-memory load or WMC on target-related lateralisations
- Distractor-related Ptc is greater in amplitude for high-WMC participants
- This effect interacts with working-memory load
 - Low WMC: No influence of load on Ptc
 - High WMC: Ptc is greater amplitude for low-load than for high-load trials
- No clear relationship between load, WMC, and SPCN
 - Is SPCN really about working memory?

Conclusions

- Attention-related ERP lateralisations reveal a series of distinct processes in visual search
 - N2pc: Identification of potential targets
 - Ptc: Distractor suppression/disengagement
 - SPCN: Stimulus enhancement?
- These processes are influenced by attentional template/foreknowledge of target properties
- Working memory capacity and load interact to influence distractor-related processing

Thanks to...

Matthew Hilimire, PhD

- College of William and Mary

Jeff Mounts, PhD

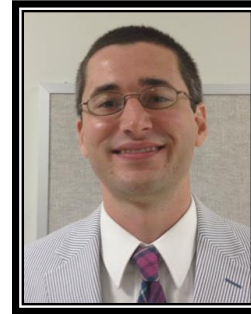
- SUNY Geneseo

Nate Parks, PhD

- University of Arkansas

Dion Henare, MSc

- University of Auckland



Hilimire



Mounts



Parks



Henare

... and numerous unindicted co-conspirators