Neural activity to viewed dynamic gaze is affected by social decision

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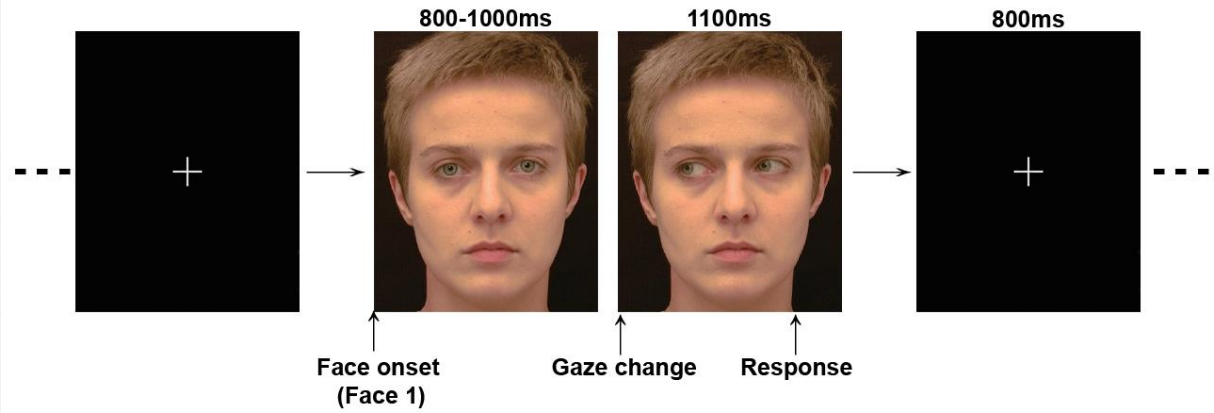
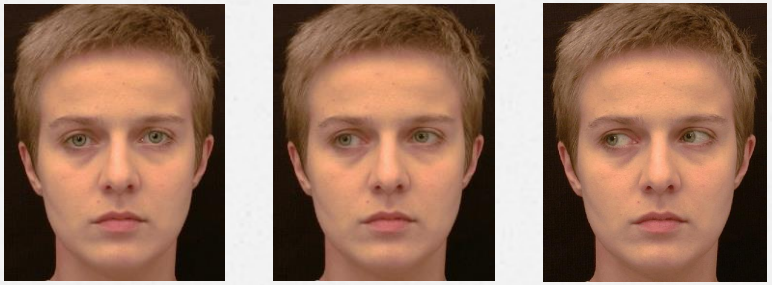
Study rationale

- the human brain has neural circuitry for processing gaze
- viewed dynamic gaze changes modulate N170: an index of changed social attention?
  - Puce et al 2000: larger N170s to viewing averted vs direct gaze [passive viewing task]
  - Conty et al 2007: larger N170s to viewing direct vs averted gaze [social decision task]
- need to reconcile differences between studies

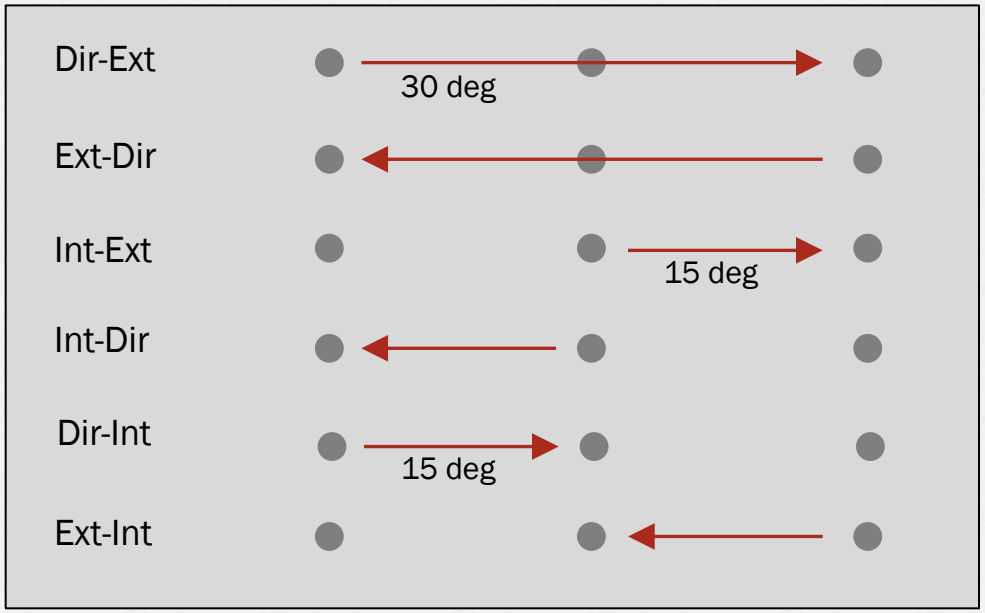
METHOD

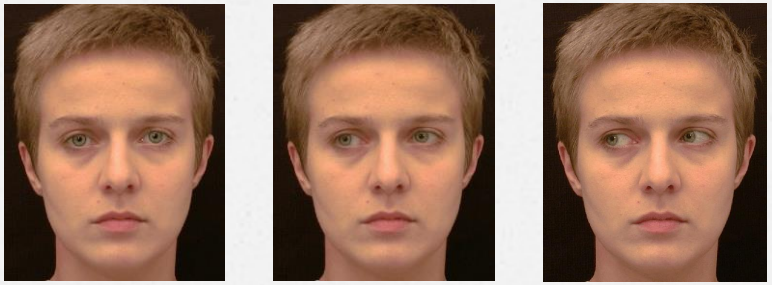
- 22 subjects (26.2 yrs ± 3.4 yrs; 11 female)
- EEG: continuous 256 channel recording
  - 500 Hz sampling rate; 0.1-200 Hz bandpass; Cz reference
- stimulus subset from Conty et al 2007
- identical trial structure to Conty et al 2007



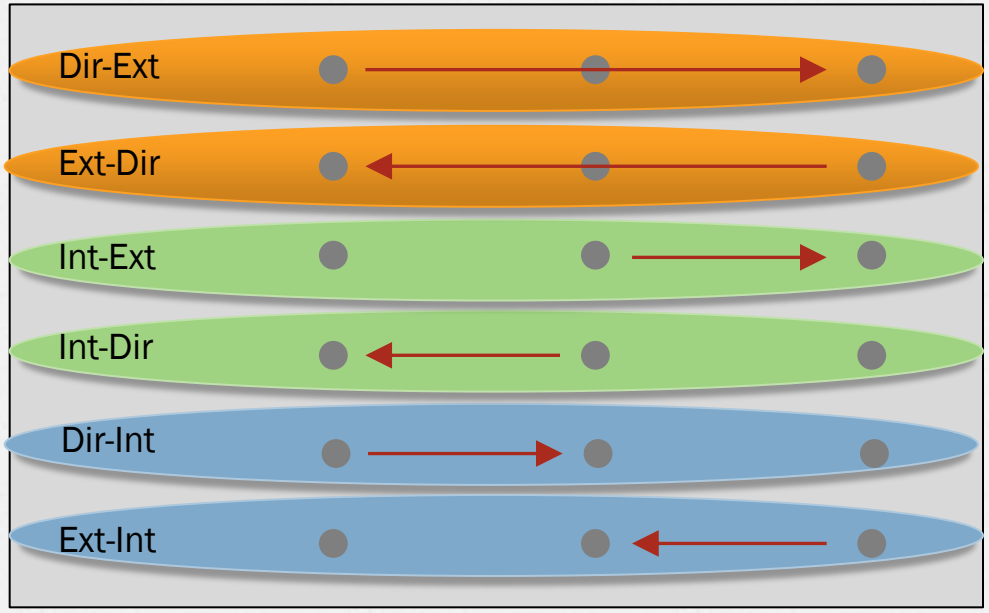


Direct Intermediate Extreme





Direct Intermediate Extreme



Puce et al 2000

Conty et al 2007

New conditions

Two tasks

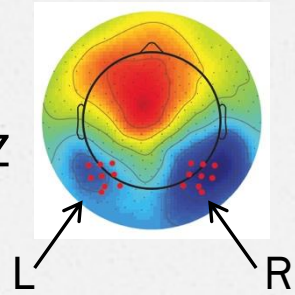
- two tasks with counter-balanced order; identical stimuli; record response times & accuracy

- non-social task
  - *"Does the gaze shift to the left or right?"*

- social task
  - *"Does the gaze shift toward me or away from me?"*

EEG data processing

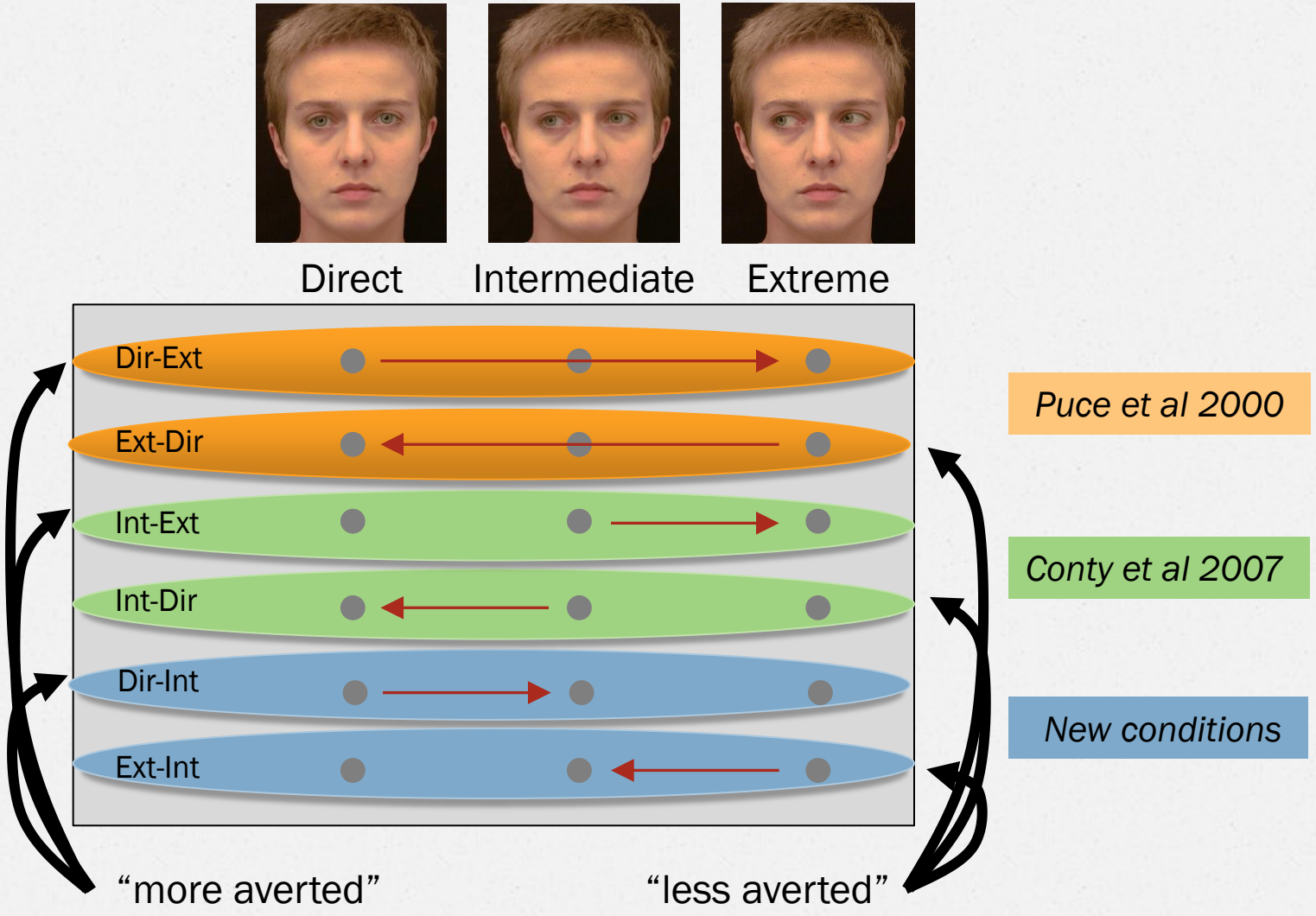
- EEG data epochs of 1600 ms for correct trials
- bad channel & artifact rejection
  - ICA removal of eye blinks, pulse artifact, gross muscle activity
- interpolate bad EEG channels
- re-reference: average reference [nose]
- baseline correction, digital filter of 40 Hz
- two 9 electrode clusters
- peak picker for N170 in individual subjects



Statistical analysis

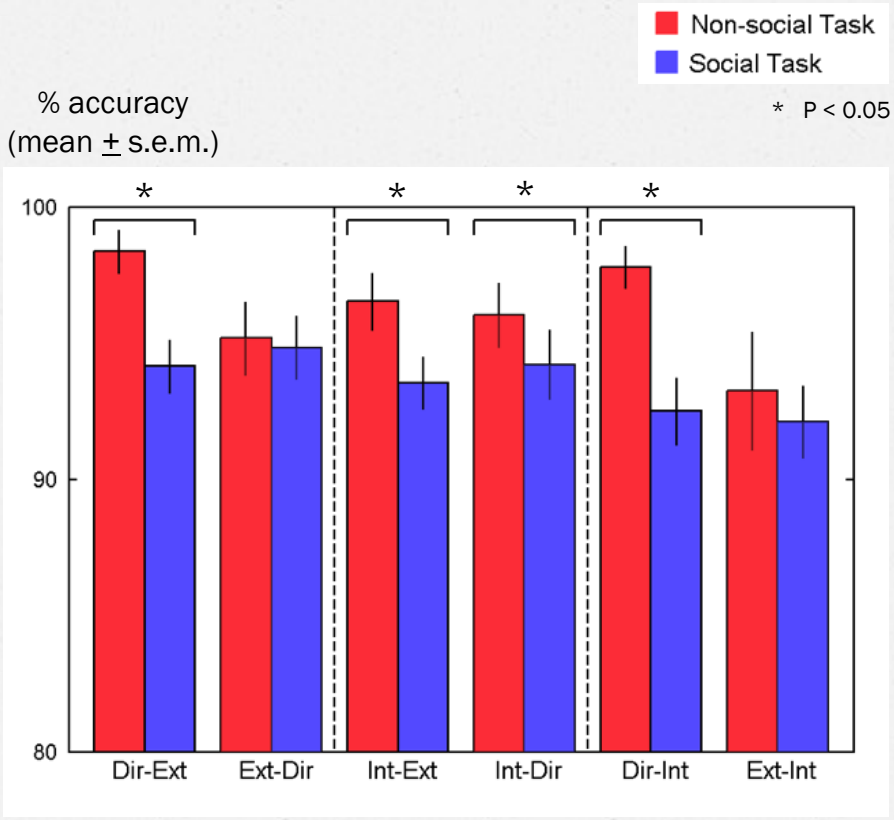
- Behavior: accuracy & response time
  - ANOVA: task X condition X gender
- N170 ERP: amplitude & latency
  - ANOVA: task X condition X gender X hemisphere
- other ERPs (P100, P250 etc.) also analyzed
- also perform whole-head ANOVA [task X condition]

RESULTS


Direct
Intermediate
Extreme
Dir-Ext
Ext-Dir
Int-Ext
Int-Dir
Dir-Int
Ext-Int
"more averted"
"less averted"
Puce et al 2000
Conty et al 2007
New conditions

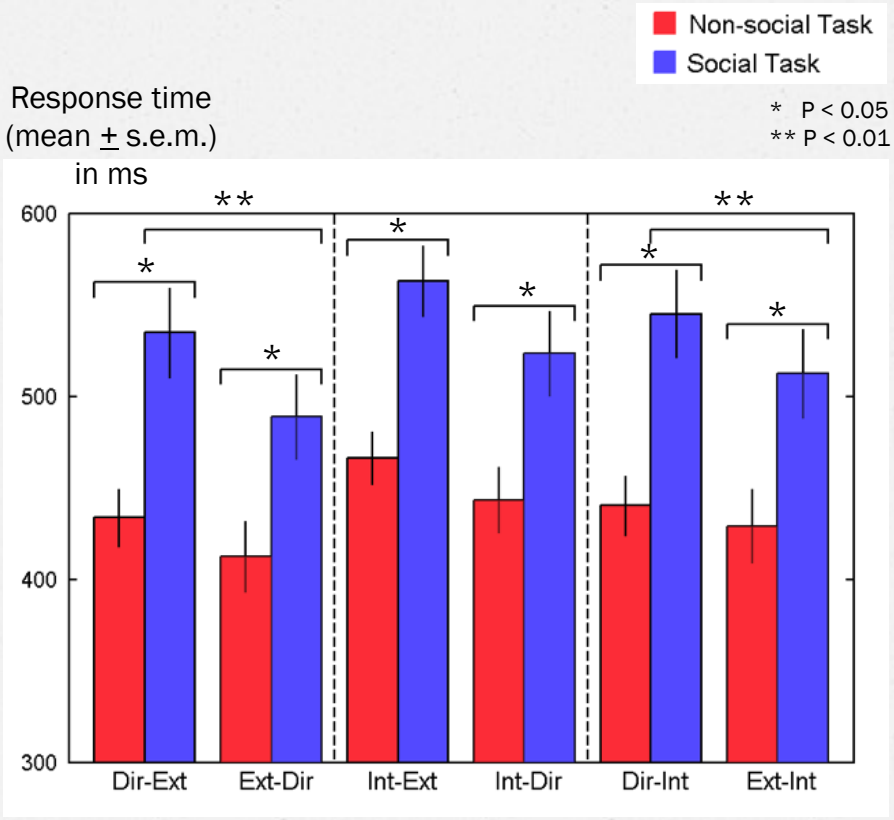
Behavior: Accuracy

- main effects
  - task ($p < 0.025$): more accurate for non-social task
  - condition ($p < 0.025$): more accurate for less averted gaze
- interaction
  - task x condition ($p < 0.005$): more accurate for non-social task & less averted gaze

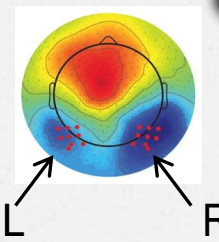


Behavior: Response Time

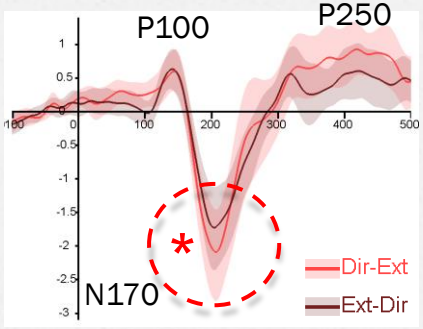
- main effects
  - task ($p < 0.001$): faster for non-social task
  - condition ($p < 0.001$): faster for less averted gaze
- interaction
  - task x condition ($p < 0.05$): faster for non-social task with less averted gaze



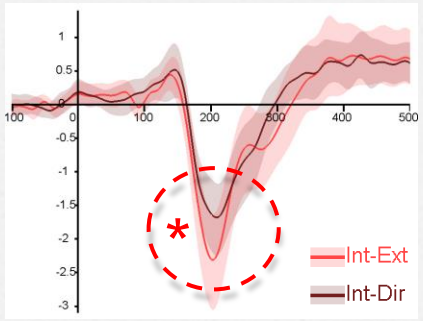
N170 ERPs: R hemisphere



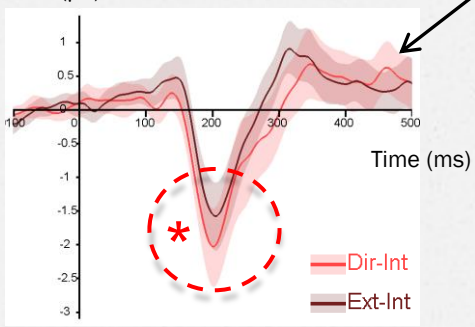
Non-social task



Puce et al 2000

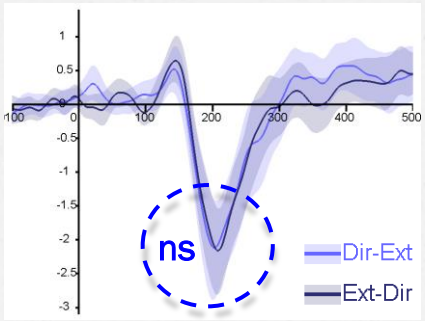


Conty et al 2007

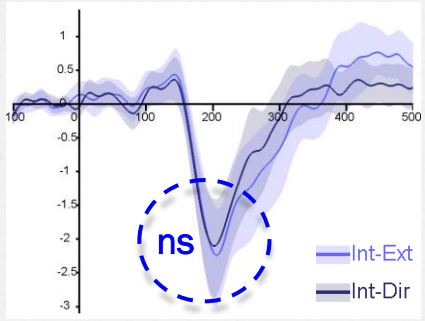


New conditions

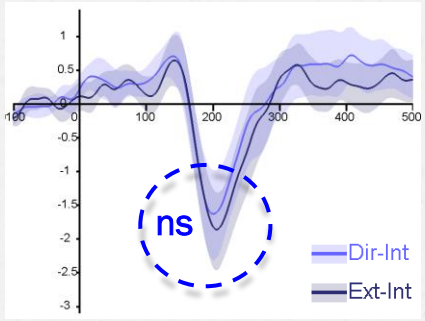
Social task



Puce et al 2000

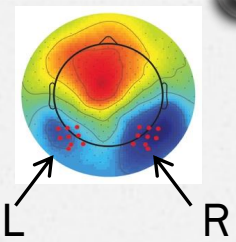


Conty et al 2007

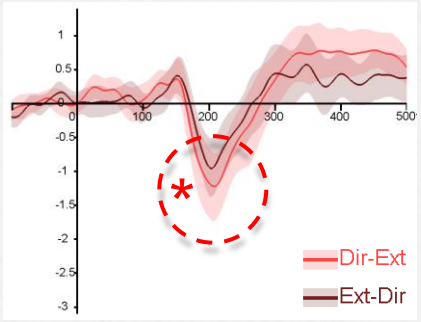


New conditions

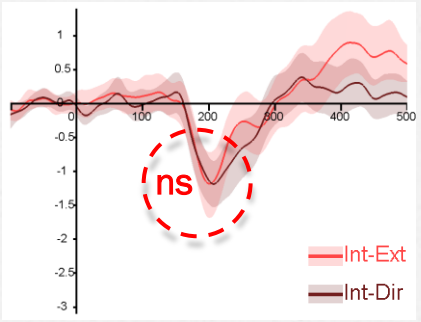
N170 ERPs: L hemisphere



Non-social task



Puce et al 2000



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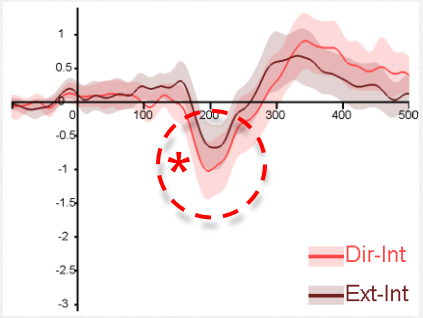
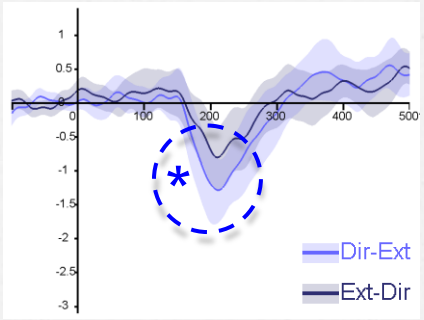
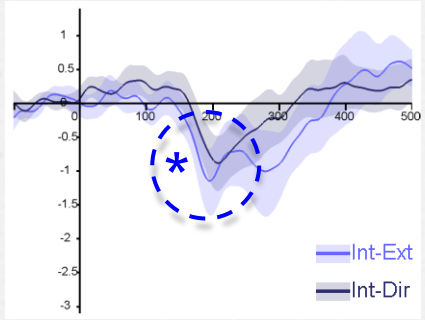


New conditions

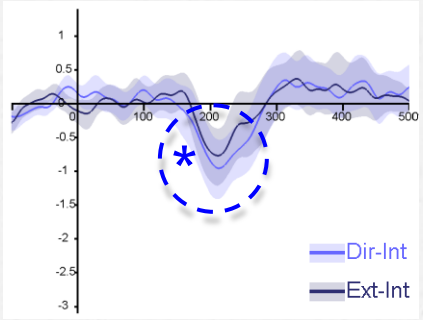
Social task



Puce et al 2000



Conty et al 2007



New conditions

N170 Amplitude

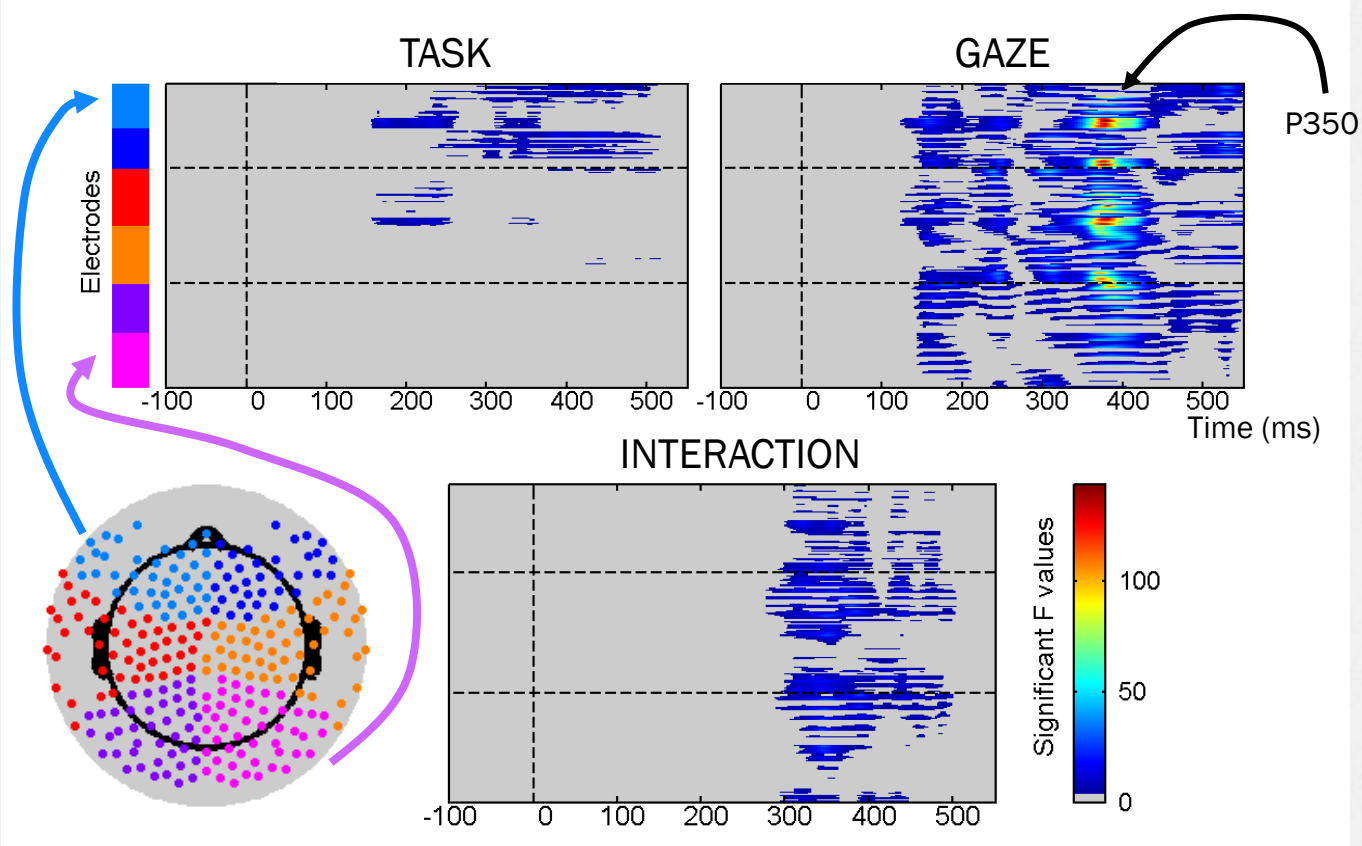
- main effects
  - hemisphere ($p < 0.005$): R > L
  - condition ($p < 0.001$): more averted > less averted

- interaction effects:
  - task X condition X hemisphere ($p < 0.005$): larger for non-social task, more extreme aversions in R hem
  - task X gender ($p < 0.05$): male > female in non-social task

N170 Latency

- main effect of hemisphere ($p < 0.05$)
  - R < L [213 vs 222 ms]
- no other main or interaction effects noted

Whole-head ANOVA



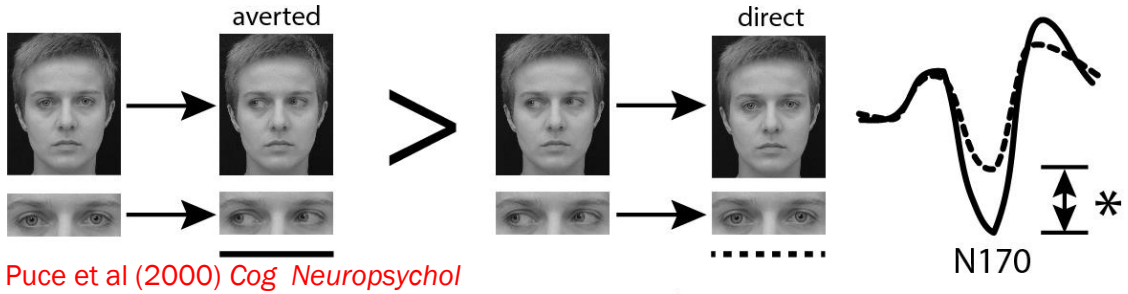
Data take-home messages

- N170 does not index changes in another's social attention per se
  - more extreme gaze aversions elicit larger N170s [non-social judgments, R hem, males]
- replicate Puce et al 2000 [non-social task]
- do not replicate Conty et al 2007 [social task]
  - original expt altered head & gaze directions
  - known head & gaze direction interactions [Itier et al., 2007]

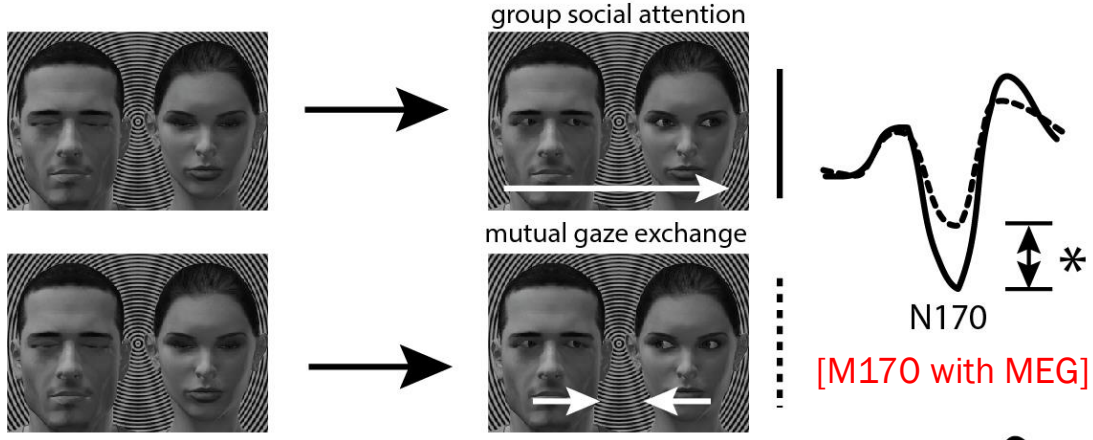
Question

- Does the human brain have different modes of social information processing?
  - e.g. passive vs active?

passive mode

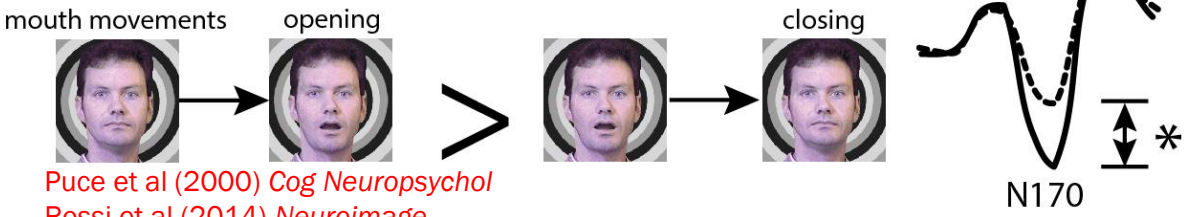


Puce et al (2000) *Cog Neuropsychol*



[M170 with MEG]

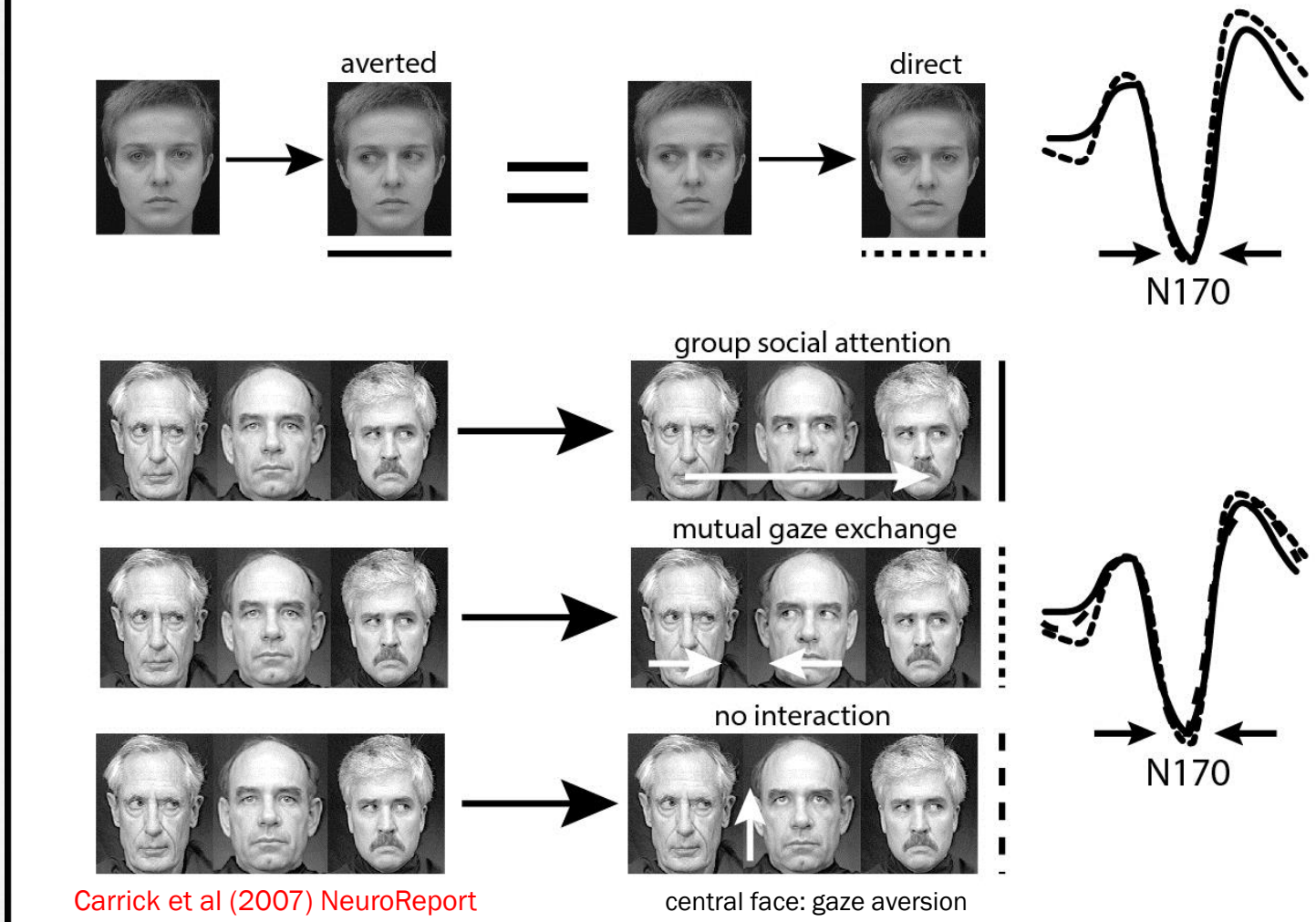
Ulloa et al (2014) *Soc Cog Affect Neurosci*



Puce et al (2000) *Cog Neuropsychol*

Rossi et al (2014) *Neuroimage*

active mode


increased sensory gain?
averted
direct
N170
group social attention
mutual gaze exchange
no interaction
N170
Carrick et al (2007) NeuroReport
central face: gaze aversion

Acknowledgments

NIH National Institute of Neurological Disorders and Stroke
Reducing the burden of neurological disease...

Eleanor Cox Riggs