Dispositional affect and the P600

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INTRODUCTION

Do we see neural correlates of dispositional affect in language processing?

Recently, we have begun to conceive of cognition as "hot" vs. "cold"

- That is, cognition is no longer viewed as independent of mood and affective states (cf Gasper & Clore, 2002)

What about neurocognition of language, e.g., Event-Related Potentials (ERPs), specifically P600?

- Chwilla and colleagues (2010, 2013) examined whether participants with induced happy vs. sad mood differed in neural responses, via **P600** effects, to sentences exhibiting semantic reversals and errors in agreement
- They showed happy participants had larger P600 effects, where sad participants had attenuated effects.
- Relatedly, recently in our lab we showed that Positive Affect scores modulated P300 effects in dual-task ERP language study. (Selvanayagam, Witte, Schmidt & Dwivedi, 2019)
- Here, we investigate if, and if so, how, Positive Affect modulates the P600 effect, an ERP component associated with structural integration (Osterhout & Holcomb, 1992, Kaan et al., 2000; Dwivedi et al., 2006). Specifically, we use stimuli from Osterhout & Holcomb's seminal 1992 study, examining structures that exhibit garden path anomaly.

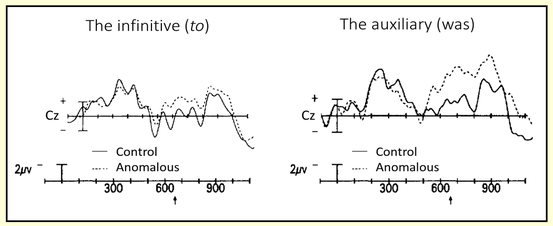


Figure 1. P600 effects found in the syntactically anomalous sentences of Osterhout and Holcomb (1992)

PRESENT INVESTIGATION

- Investigate dispositional affect, which reflects stability across time of individuals to view their world with approach-oriented positive affect, using PANAS (Positive and Negative Affect Schedule, Watson et al., 1988).
- Given previous findings, we expect that individuals higher in Positive Affect would show larger P600 effects in response to stimuli.
- We use stimuli (exhibiting garden path effects and ungrammaticality) from Osterhout & Holcomb (1992) in order to elicit P600 responses (see Table 1).

METHODS

Participants

- 25 (22 female) right-handed monolingual speakers of English from Brock University age 18-27 (*M* = 20, *SE* = 0.45) with no self-reported neurological or language related impairments
- **PA** range 15-40 (*M* = 30.20, *SE* = 1.20); **NA** range 14-32 (*M* = 20.3, *SE* = 0.89) as assessed by PANAS (Watson et al., 1988)
- **Handedness** range 2-24 (*M* = 19.52, *SE* = 0.98) as assessed by handedness inventory, indicating all are indeed right-handed (Briggs & Nebes, 1975)

Procedure

- RSVP with 600ms SOA (200ms ISI)
- Variable ITI (500 - 1000ms)

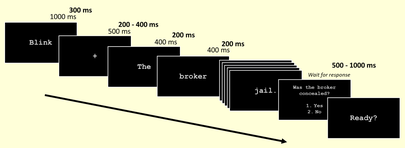


Figure 2. Sample trial.

METHODS

Materials

Table 1. Experimental paradigm with sample stimuli (including questions) Critical words ***bold***.

Length	Verb type	Example sentence
Short	Plan-type (*Intransitive*)	The broker planned ***to*** conceal the transaction.
		Q: Did the broker plan something? **1) Yes** 2) No
	Persuade-type (*Transitive*)	The broker persuaded ****to*** conceal the transaction.
		Q: Did the broker persuade someone? 1) Yes **2) No**
Long	Plan-type (*Intransitive*)	The broker planned ***to*** conceal the transaction ****was*** sent to jail.
		Q: Was the broker concealed? 1) Yes **2) No**
	Persuade-type (*Transitive*)	The broker persuaded ****to*** conceal the transaction ***was*** sent to jail.
		Q: Was the broker persuaded? **1) Yes** 2) No

- 2x2 design: Sentence Length (short vs long) and Verb type (*Plan/ Intrans* vs. *Persuade/ Transitive*)
- Four counterbalanced, pseudo-randomized lists were constructed consisting of 120 target and 210 filler sentences
- All critical items featured comprehension questions, as well as ~60% of fillers.

ERP analysis

- EEG recorded from a 64 channel ActiveTwo BioSemi system at a sampling rate of 512 Hz
- Epochs rereferenced offline to linked mastoids, bandpass filtered from 0.1 to 100 Hz and time-locked to word onset (-200 to 1200 ms) were computed in EMSE 5.5.1 (Cortech Solutions, 2013)

RESULTS

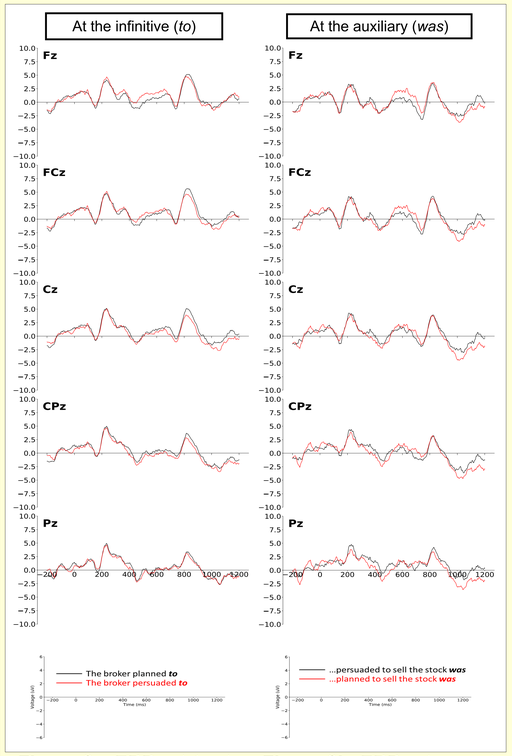


Figure 3a. ERPs at ***to*** at midlines.

Figure 3b. ERPs at ***was*** at midlines.

Behavioural Results

Sentence Type	Comprehension Accuracy
Filler Accuracy	95%
Plan (Short length)	98%
Persuade (short length)	76%
Plan (long length)	87%
Persuade (long length)	77%

Table 2: Response accuracy to comprehension questions following filler and critical trials

ERPs at critical words

At *to*: P600 effects (in 500-700 ms time window) were computed for each Verb type collapsed across length. No effect of VerbType was observed (*F* < *1).* A significant VerbType x Electrode interaction was observed ($F(4,76) = 3.7$, $p = .02$, $\eta_p^2 = .166$); however, this simply indicated that **within** *persuade *to* condition, ERPs were more positive at frontal vs. posterior midline sites.

At *was: No main effect of VerbType was observed in 500-700 ms time window (*F* < 2); however a (significant VerbType x Electrode interaction ($F(4,76) = 2.9$, $p = .04$, $\eta_p^2 = .13$) did reveal a P600 effect at frontal midline sites.

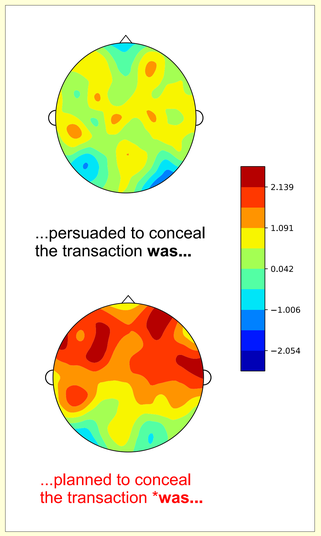
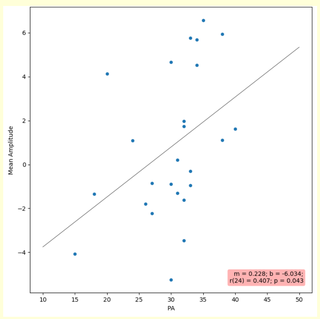


Figure 4. Topographic maps for the P600 effect at '***was***' at 500-700ms.

RESULTS



Correlations with PA

Figure 5. Scatterplot of PA vs. P600 effect at *was*

Given the strength of the P600 effect at frontal sites (Fz, FCz, Cz) for ***was***, we conducted a correlation at this region for PA vs. P600 effect, where P600 amplitude at Persuade-type verbs was subtracted from Plan-type verbs.

A positive correlation with PA was found, $r(24) = .407$, $p = .043$.

(No correlation was found for Negative Affect, $r(24) = .025$, $p = .905$)

DISCUSSION

(1) Unlike Osterhout & Holcomb (1992), we did not find P600 effects at ***to*** however, this effect was found downstream at ***was***, albeit with frontal distribution.

(2) Positive correlation was found with Positive Affect scores and P600 effect.

How do we interpret our (slightly) different P600 effects (ie using Osterhout & Holcomb stimuli)?

- Differences in task in our study vs. Osterhout & Holcomb (1992), i.e., we did not have ppts perform grammatical acceptability judgment, instead had them answer comprehension accuracy questions.
- Ppts might be less sensitive (online) to ungrammaticality at ***to*** since they are reading for comprehension vs. attending to ungrammaticality.
- Sensitivity to grammaticality at ****to*** is indeed observed *after* sentences are read, via lower comprehension accuracy scores at ~75% (see Table 2).
- Next, frontal distribution of P600 effect at ***was*** would square well with the hypothesis that ppts are reading for comprehension, given that frontal P600 effects are associated with 'revision' (Kaan et al., 2000; Kaan & Swaab, 2003; Dwivedi et al., 2006).
- ***Given the P600 effects found in this experiment, how do we interpret the correlation with Positive Affect?***
- More positive participants are more engaged/motivated with meaning and interpretation. Therefore, they would be more sensitive to error in meaning, and more willing to revise sentence to achieve plausibility (Gibson et al., 2013; Dwivedi et al., 2018; Dwivedi et al., 2006).

CONCLUSION

Do we see neural correlates of dispositional affect and language process? YES!

- Individuals higher in positive affect produced larger P600 effects (see also Dwivedi & Selvanayagam, 2019; Selvanayagam et al., 2019).
- In addition, our changes re: task resulted in a frontal P600 effect at ***was***. This effect and its modulation by Positive Affect supports characterization of the P600 effect as one of structural revision.

Future directions

- *Increase the sample size of the current experiment from 25 to 48 participants*
- *Task effect*
  - Repeat experiment without comprehension questions to investigate the role of task effects on the P600 component
- *Mood induction*
  - Once the N is increased and we have an understanding of the effect of dispositional affect, the next step is to further explore this relationship by inducing mood in participants.

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***Acknowledgements*:** This work was partially supported by INNOVATION.CA, Social Sciences and Humanities Research Council of Canada, Conseil de recherches en sciences humaines du Canada, Canada and by Brock University awarded to V. Dwivedi.