# Testing whether the social N400 effect indexes integration- or inhibition-processes

Previous title: Social Context Inhibits What Has Been Semantically Primed: An Event-Related Potential Study

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## Experiment 1: Introduction

- The **social N400 effect** is an enhancement of the small amplitude of the N400 ERP that is evoked by semantically primed words. This enhancement occurs when participants know that a person next to them did *not* receive the semantic priming information. (ADD REF numbers).
- Prior social N400 studies interpret this enhancement as an increase in the **difficulty to integrate** semantic information in the social context of an uninformed person who cannot integrate this information due to the lack of priming.

- On the contrary, the **N400 inhibition hypothesis** stipulates that this enhancement indexes **inhibition** of what was primed so that the participant can also have a theory of what is in the mind of the confederate.
- According to this inhibition hypothesis, the social N400 effect should not occur in the case of indeterminacy, that is, when the system cannot determine what has to be inhibited, such as when both of the following conditions are met:
  1. the task does not constrain semantic processing, e.g., a simple memorization task
  2. this task is performed in an unknown social context, like in the presence of a stranger and when participants have no way to know for sure what information/stimulus this stranger is receiving.

- This prediction can be made not only for the N400, but also for the N300 elicited by pictures, which has been shown to index the inhibition of actions that are systematically activated by certain stimuli (e.g., faces, tools, etc.)(ADD REF numbers)

- In contrast, according to the integration hypothesis, indeterminacy should increase integration difficulty and boost N400 amplitudes.

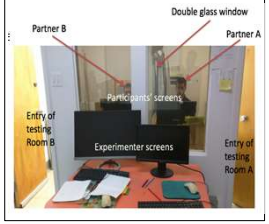
## Experiment 1: Methods

- 30 **Alone participants** (controls)
- 36 Participants in presence of their **friends**
- 29 Participants in presence of a **stranger**

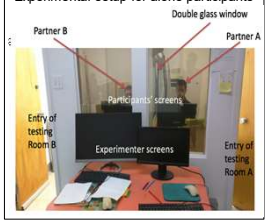
**Stimuli:**
- 280 images (70 in each of the 4 blocks with a short break) from the International Affective Picture System (IAPS)[4] for the friends and strangers; and 400 for the alone
- *Partners had no way of seeing what was presented on their partner's half of the screen.* (The curtain remained closed during EEG recording. Participants were not allowed to talk to each other).
- **For pairs:** At every trial, on each half of the screen, one image was presented. These two images occurred simultaneously. They were randomly either identical or different.
- **For alones (controls):** They viewed a sequence of IAPS images by themselves.

**Task**: try to memorize the images.

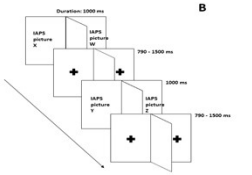
Experimental setup for pairs (friends and strangers groups)




Experimental setup for alone participants




Stimulus presentation sequence




**EEG recordings & signal processing**
- Impedance < 5 kΩ.,
- EEG Amplification: 10,000 times.
- High- and low-pass filter half-amplitude cut-offs: .01 & 100 Hz
- 60-Hz electronic notch filter.
- Channels of trials with amplifier saturations or analog-to-digital clippings removed off-line by automatic rejection criteria:
- if clipping > 100 ms duration or if amplitude out of the ±100 µV range.

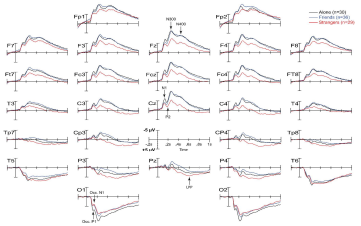
## Acknowledgment

## Experiment 1: Results

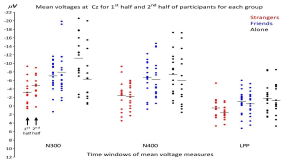
**Measures**
- ERP mean voltages within the time-windows of the N300 (200-350 ms), of the N400 (350-550 ms) and of the LPP (650-900)

**Analyses**
- Repeated measures ANOVAs for each time-window, using social context (group) as a between-subjects factor.
- post-hoc (independent sample t-test) at Pz between alone and friends to find the source of interaction between group and electrodes at sagittal subset.

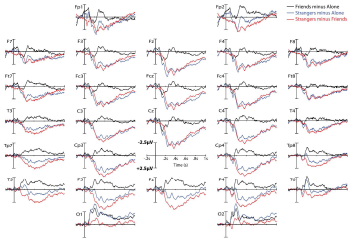
Grand average of ERPs elicited by the IAPS images for controls (alone) and participants with friends and strangers



Scatter plot showing the mean voltages of the three groups at Cz within the three time windows




Subtractions of the grand averages (GAs) of controls (alones) from GAs of participants with friends and strangers



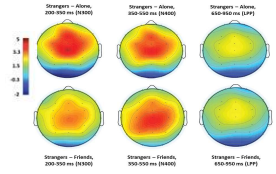
ANOVA results for Alones vs Strangers

| Mean voltages within time windows | Set of Electrodes | Main effect of social contexts (groups) df | F | P | $\eta_p^2$ | Interactions of social contexts with electrodes df | F | P | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|
| N300 (200-350 ms) | Sagittal | 1,57 | 11.4 | $1 \times 10^{-3}$ | 0.17 | 3,171 | 11 | $21 \times 10^{-5}$ | 0.16 |
| | Parasagittal | 1,57 | 7.34 | $9 \times 10^{-3}$ | 0.11 | 6,342 | 9.9 | $41 \times 10^{-6}$ | 0.15 |
| | Lateral | 1,57 | 8.68 | $5 \times 10^{-3}$ | 0.13 | - | - | - | - |
| N400 (350-550 ms) | Sagittal | 1,57 | 12.36 | $1 \times 10^{-3}$ | 0.17 | 3,171 | 5.75 | $9 \times 10^{-3}$ | 0.09 |
| | Parasagittal | 1,57 | 10.48 | $2 \times 10^{-3}$ | 0.16 | 6,342 | 6.75 | $3 \times 10^{-2}$ | 0.11 |
| | Lateral | 1,57 | 10.69 | $2 \times 10^{-3}$ | 0.16 | - | - | - | - |
| LPP (650-950 ms) | Sagittal | 1,57 | 10.84 | $2 \times 10^{-3}$ | 0.16 | 3,171 | 4.64 | $21 \times 10^{-3}$ | 0.08 |
| | Parasagittal | 1,57 | 4.17 | $46 \times 10^{-3}$ | 0.06 | 6,342 | 4.68 | $13 \times 10^{-3}$ | 0.08 |
| | Lateral | 1,57 | 3.88 | $54 \times 10^{-3}$ | 0.06 | - | - | - | - |

ANOVA results for Friends vs Strangers

| Mean voltages within time windows | Set of Electrodes | Main effect of social contexts (groups) df | F | P | $\eta_p^2$ | Interactions of social contexts with electrodes df | F | P | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|
| N300 (200-350 ms) | Sagittal | 1,63 | 13.74 | $44 \times 10^{-4}$ | 0.18 | - | - | - | - |
| | Parasagittal | 1,63 | 12.02 | $1 \times 10^{-3}$ | 0.16 | 6,378 | 4.61 | $19 \times 10^{-3}$ | 0.06 |
| | Lateral | 1,63 | 12.45 | $1 \times 10^{-3}$ | 0.16 | - | - | - | - |
| N400 (350-550 ms) | Sagittal | 1,63 | 20.34 | $29 \times 10^{-4}$ | 0.24 | - | - | - | - |
| | Parasagittal | 1,63 | 17.29 | $99 \times 10^{-4}$ | 0.21 | 6,378 | 3.94 | $33 \times 10^{-3}$ | 0.06 |
| | Lateral | 1,63 | 15.61 | $19 \times 10^{-3}$ | 0.19 | - | - | - | - |
| LPP (650-950 ms) | Sagittal | 1,63 | 8.34 | $5 \times 10^{-3}$ | 0.12 | - | - | - | - |
| | Parasagittal | 1,63 | 3.82 | $55 \times 10^{-3}$ | 0.06 | - | - | - | - |
| | Lateral | - | - | - | - | - | - | - | - |

Spline Interpolated maps of the mean voltage of ERP subtractions



ANOVA results for Alones vs. Friends

| Mean voltages within time windows | SoE | Main effect of social contexts (groups) df | F | P | $\eta_p^2$ | Interactions of social contexts with electrodes df | F | P | $\eta_p^2$ |
|---|---|---|---|---|---|---|---|---|---|
| N300 (200-350 ms) | - | - | - | - | - | - | - | - | - |
| N400 (350-550 ms) | Sagittal | - | - | - | - | 3,192 | 3.783 | $42 \times 10^{-3}$ | 0.06 |
| LPP (650-950 ms) | - | - | - | - | - | - | - | - | - |

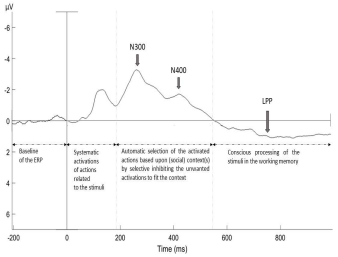
Post-hoc: independent sample t-test for Alones vs. Friends N400

t(64)=1.78 and p=0.038

## Experiment 1: Conclusions

1. predicted, with a stranger, amplitudes of N400s and N300s were largely smaller than those of participants who were alone. In contrast, relative to these alone participants, the amplitudes were unchanged by the presence of a friend, and thus when the social context was better known to participants and when what had to be inhibited to fit this context could be determined.

2. Thus, our inhibition hypothesis is met.



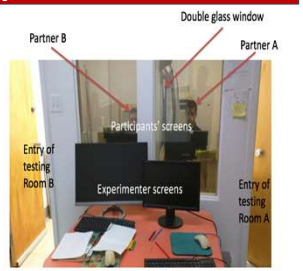

## Experiment 2: Introduction

ANOVA results for Friends vs Strangers

## Experiment 2: Methods

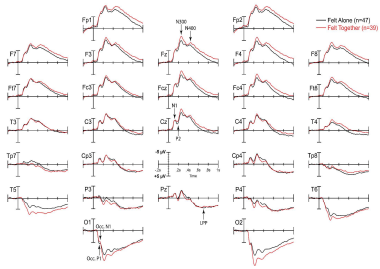
**Participants**
- Pairs of closely related individuals (n=86)

**Procedure:**
- Same as in Experiment 1.
- inslructions: maintain the feeling of the presence of their partner.
- :Debriefing, "did you feel together" or not during most of the stimulus sequence, and then were split into two subgroups.




## Experiment 2: Results

Figure . Grand averages of the ERPs elicited by IAPS images in the Experiment 2 in Felt-alone vs Felt-together groups



## Experiment 2: Conclusion

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## References

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2. Bouten, S., Pantecouteau, H., & Debruille, J. B. (2014). Looking for effects of qualia on event-related brain potentials of close others in search for a cause of the similarity of qualia assumed across individuals. *F1000Research*, 3.
3. Haffar, M.; Pantecouteau, H.; Bouten, S..; Debruille, J.B. Effects of Stimulus Processing on Event-Related Brain Potentials of Close Others. Preprints 2018, 2018060084 (doi: 10.20944/preprints201806.0084.v1).
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