

Propositional truth-value and the comprehension of 'impossible' counterfactual worlds: Evidence from event-related potentials

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Introduction: Two event-related potential (ERP) experiments addressed the role of propositional truth-value in comprehension of (Spanish) sentences about biologically or physically impossible counterfactual worlds. Counterfactuals are thought to require keeping in mind what is true and what is false [1], and pre-stored real-world knowledge may therefore intrude upon and delay counterfactual comprehension, as is predicted by some accounts of discourse comprehension [2], and has been observed with ERP and eye-tracking measures [3-4]. Impact of truth-value may thus be delayed in counterfactuals, as also claimed for negated and quantified sentences (see also [5]; but see [6]). The current hypothesis involved N400 ERP amplitude, which indexes early semantic processing costs and is sensitive to subtle variations in discourse-semantic fit [7]. If real-world knowledge briefly disrupts counterfactual comprehension, critical words in counterfactual true statements (Spanish equivalent of 'water' in "If dogs had gills, Dobermans would breathe under water without problems") should evoke larger N400s than in real-world true statements ("Because fish have gills, tunas breathe under water without problems"), while smaller than N400s to words that render both sentence types false ('poison'). In contrast, if incoming words are mapped onto counterfactual context without delay, false sentences should elicit similarly increased N400s compared to true sentences, whether counterfactual or real-world. Experiment 2 examined the contribution of the counterfactual premise.

Methods: In Experiment 1, EEG was collected (27 electrodes) while twenty native Spanish speakers read 96 Spanish sentences (design: 2(counterfactual, real-world) x 2(true,false)) word-by-word that were matched for critical word expectancy and truth-value, mixed with 120 fillers. In Experiment 2, twenty new participants read the consequences without premise ("Dobermans would/Tunas breathe under water/poison without problems"), and 120 fillers. Pre-testing confirmed that without premise, counterfactual 'true' sentences ("Dobermans would breathe under water") were rated similarly as false sentences.

Results: In Experiment 1, false sentences elicited larger N400s than true sentences ($F(1,18) = 82.2, p < .001$; based on average voltage across all electrodes per condition between 350-400 ms after word onset), for counterfactual and real-world sentences alike, there was no interaction between truth-value and sentence type ($F(1,18) = .66, n.s.$). In Experiment 2, there was an interaction between truth-value and sentence type ($F(1,15) = 7.3, p < .05$): real-world false sentences elicited larger N400s than real-world true sentences ($F(1,15) = 2.7, p = .001$), whereas counterfactual true/false sentences elicited similarly enlarged N400s ($F(1,15) = .54, n.s.$). Between-experiment analyses revealed that ERP patterns differed between experiments at anterior electrodes ($F(1,32) = 4.2, p = .049$) and at crossline electrodes (T7/8, C3/4, Cz; $F(1,32) = 3.5, p = .07$).

Conclusions: The indistinguishable N400 effects of counterfactual and real-world truth-value in Experiment 1 argue against disruptions by real-world knowledge during counterfactual comprehension, and suggest that incoming words are mapped onto counterfactual context without delay. Experiment 2 confirmed the contribution of the counterfactual premise, and, together with N400s in counterfactual false sentences (Experiment 1), suggests that the observed patterns in counterfactual sentences are not due to modal verbs. Propositional truth-value can rapidly impact ongoing semantic processing, be the proposition factual or counterfactual.

References

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