Temporal Implications and Conjunctive Sentences

Conjunctions and temporal order:
She got married and finished her PhD. ...
She first got married and then finished her PhD.

Grice:
Maxim of Manner: Be orderly.
Semantics: \( p \land q \iff q \land p \)
Pragmatics: \( p \land q \iff p \text{ and then } q \) (temporal implication)

Alternative accounts:
Partee (1984): a past-tense event description establishes a reference time interval that is picked up by the next past tense.
Kamp and Reyle (1993): not a purely pragmatic phenomenon, since the temporal succession is also present for cases of unrelated event reports.
Carston (2002): the events reported by conjunctions create a single complex unit, unlike when they are reported in juxtaposed clauses.

In the narrative account (Kehler, 2000, 2004): “and” is a connective that maintains the narrative coherence and thus implicates “and then”.

Script knowledge vs. event order
She washed her hair and did it. vs. She played an ace and a king.

Relevance: Is the order relevant in the context? For instance: Was it important (for the game) what was played first? Is the temporal implication inferred if the only relevant information conveyed concerns what has been accomplished?

Question 1: Is there any “default” expectation for the events to be reported in the chronological order, especially in the case of unrelated events (that in principle could happen in any order)?

Question 2: Does contextual relevance of the order play any role in deriving/processing of temporal implications?

Hypothesis 1 N400 effect for the order violation: lexical prediction/retrieval processes are modulated by the encoded temporal structure and the processor “expects” the linguistic input to match it.

(Pragmatic enrichment of the sentence meaning by the temporal implication?)

Hypothesis 2 P600 (and no N400) effect for the order violation: meaning-related predictive processes are not modulated by the temporal order but the combinational process of building-up the representation of sentence meaning is more effortful.

(Temporal implication is a phenomenon at the level of discourse structure?)

Experiment 1: Order-relevant memory game

Goals:
- Test the processing of temporal violations in sentences that report two consecutive (contingent) game events.
- Compare scenarios where the order is/is not relevant from the perspective of the game win.

Paradigm:
Card game resembling a memory game: A (virtual) player flips two out of five cards, one after another. Participants assign points to the player and read sentences describing game events.

Game Rules:
There are two categories of cards: animal and non-animal cards.
- If the player flips two cards from the same category, then she gets 1 point.
- If she flips two cards from different categories, the points depend on the cards’ order. If she first flips an animal card and then a non-animal card, she gets 2 points; if she flips first a non-animal and then an animal card, she gets 0 points.

After the cards are opened, the participant is asked to assign the points.

Next: a sentence is presented, e.g. Julia hat eine Katze und eine Blume umgedreht (Julia has flipped a cat and a flower).

In the correct-order condition, sentences describe the events in the order in which they happened; in the reversed-order condition, the events are described in the reversed order.

Design: Category (Mixed/Same) × Order (Correct/Reversed)

Word (animal/non-animal): cross-balanced over conditions (not a factor in the design)

Filler trials are introduced, in which the sentence mentions cards that have not been flipped. A question is asked for 25% of all trials whether the sentence mentioned any cards that have not been flipped. The role of this secondary task and filler trials is to make sure that the subjects actually read the sentences.

Results:
P600 effect for the violation of the temporal order!
450-650 ms: \( F(1, 27) = 18.651, p < .001, \eta^2 = .409 \)

N400 effect for the order violation.
300-400 ms: \( F(1, 27) = 5.02, p = .033, \eta^2 = .157 \)

Experiment 2: Order-irrelevant memory game

In Experiment 1: Order was relevant in the Mixed Category condition, but not in the Same Category, but it was also in a way relevant for the whole game!

New rules:
Now the order of cards does not matter, only whether they match or mismatch.

- (Version 1, N=20)
  - Flipping cards from the same category gives 1 point.
  - Flipping cards from the mixed categories gives 0 points.

- (Version 2, N=20)
  - Flipping cards from the same category gives 0 points.
  - Flipping cards from the mixed categories gives 1 point.

Conclusions:
Order violation triggers structural/combinatorial reanalysis processes (P600 effect). The lexical-level predictive processes (reflected in N400) are modulated by temporal order only if the order is contextually relevant.

Results:
P600 effect for the order violation!
450-650 ms: \( F(1, 38) = 13.036, p = .001, \eta^2 = .255 \)

No modulation of the N400 by order. No main effect of version.