The Meaning and Processing of Conditionals – German *'wenn'* (if) vs. '*nur wenn'* (only if)

Mathias Barthel & Mingya Liu (Humboldt University Berlin, Germany)

This paper focuses on the semantics, pragmatics and processing of the lexically related German conditional connectives (CCs) *'wenn'* (if) and *'nur wenn'* (only if). In logic, *if* is treated as a binary truth-functional CC of material implication (p → q). However, the interpretation of conditionals in natural language is subject to semantic and/or pragmatic modulation [1-3]. The modulating role of CCs for a conditional's interpretation hitherto remains unclear.

Logically, modus ponens (MP) should be valid for all conditional sentences, irrespective of their CC (If p → q.; p. // q.). Based on the semantics of *'only'* proposed in [4], '*nur-wenn'* sentences should also entail the affirmation of the consequent inference (AC) (Only if p → q; q. // p.), making *'nur wenn*' a promising candidate for a natural language bi-conditional CC. The bi-conditional status of *'nur wenn'* is doubted by [5], however. In a series of three experiments (E1-3), we contrasted the meaning and interpretation processes of the respective CCs.

In E1 (N_{subj} = 24, N_{items} = 108), participants read short scenarios including a conditional (If p, q.) with *'wenn'* or *'nur wenn'* and a second sentence containing the confirmed or negated antecedent proposition (p / not-p). Participants completed a final sentence fragment by either affirming or negating the consequent proposition (q / not-q; see (1)). After confirmed antecedents, <1% of completions in '*wenn*' but 11% in '*nur wenn*' contained a negated consequent. After negated antecedents, however, 15% of completions in *'wenn'* but <1% in '*nur wenn'* contained a negated consequent, suggesting that neither of the CCs was treated as bi-conditional, with AC being questionable for '*wenn*' and MP being questionable for '*nur wenn*'.

In E2 (N_{subj} = 48, N_{items} = 48, $N_{fillers}$ = 48), participants were presented with a conditional sentence containing '*wenn'* or '*nur wenn'* and a second sentence containing either the confirmed or the negated antecedent proposition. In a final sentence, participants were asked to rate the truth of the consequent on a 5-point Likert scale (see (2)). A Bayesian ordinal mixed model with CC and antecedent plus their interaction revealed the bi-conditional interpretation to be most prominent overall, with mean ratings for both CCs above 4.6 after confirmed antecedents and below 1.6 after negated antecedents. However, after confirmed antecedents, acceptance rates were decisively lower for *'nur wenn'* than for *'wenn'* (BF_{10} = 499), suggesting that in *'nur wenn'*, less p-cases have been interpreted to be q-cases than in *'wenn'*. After negated antecedents, on the other hand, ratings for *'wenn'* were decisively higher than for *'nur wenn'* (BF_{10} > 2000), suggesting that in *'wenn',* less not-p-cases have been interpreted to be not-q-cases than in *'nur wenn'* (Fig. 1). Analyses of rating latencies support these results, with faster decisions for *'wenn'* after confirmed than after negated antecedents and for *'nur wenn'* after negated than after confirmed antecedents (Fig. 2). These results again cast doubt on the strict bi-conditionality of *'nur wenn'* (or *'wenn'*, as expected).

To compare the CCs' online interpretation, participants in E3 (N_{subj} = 24, N_{items} = 108, $N_{fillers}$ = 24) did a self-paced reading task on scenarios containing a conditional sentence with either *'wenn'* or *'nur wenn'* and a follow-up sentence which, in critical trials, always contained the negated antecedent. A final sentence contained either the confirmed or the negated consequent (see (3)). A Bayesian mixed effects regression model (Fig. 3) with CC and consequent plus their interaction revealed that reading times for the positive quantifier in the final sentence (indicating the confirmed consequent) were statistically equivalent between CCs, but the negative quantifier was read decisively faster in *'nur wenn'* than in *'wenn'*, suggesting that the meaning 'not-p → not-q' is activated more strongly by '*nur wenn* p, q' than by '*wenn* p, q' conditionals.

In conclusion, neither *'wenn'* nor *'nur wenn'* are interpreted as strictly bi-conditional connectives. While for *'wenn',* all p-cases are interpreted to be q-cases, only some not-p-cases are not-q-cases. For *'nur wenn'*, on the other hand, all not-p-cases are interpreted to be not-q-cases and only some p-cases are q-cases. This finding contradicts common conceptions of the meaning of *only if* and calls for adequate formal analyses of the meaning contributions of CCs.

(1) S1: Kristian las die Zeitung und dachte sich: (K. read the newspaper and thought:)
S2: **Wenn/Nur wenn** die Artikel interessant sind, schneide ich einen aus. (If/Only if the articles are interesting, I'll cut one out.)
S3: Wie sich zeigte, waren die Artikel **(nicht)** interessant. (As it turned out, the articles were (not) interesting.)
S4: Von denen schnitt er … . (Of these he cut … .)

(2) S1: **Wenn/Nur wenn** heute gutes Wetter ist, geht Kai Eis essen. (If/Only if the weather is good, Kai will go have ice cream.)
S2: Heute ist **(kein)** gutes Wetter. (The weather is (not) good today.)
S3: Geht Kai Eis essen? (Is Kai going to have ice cream?)

(3) S1: Kristian las die Zeitung und dachte sich: (K. read the newspaper and thought:)
S2: **Wenn/Nur wenn** die Artikel interessant sind, schneide ich einen aus. (If/Only if the articles are interesting, I will cut one out.)
S3: Wie sich zeigte, waren die Artikel **nicht** interessant. (As it turned out, the articles were not interesting.)
S4: Von denen schnitt er **einen / keinen** aus und las weiter. (Of these he cut one / none out and continued to read.)

Figure 1. Rating results in E2.

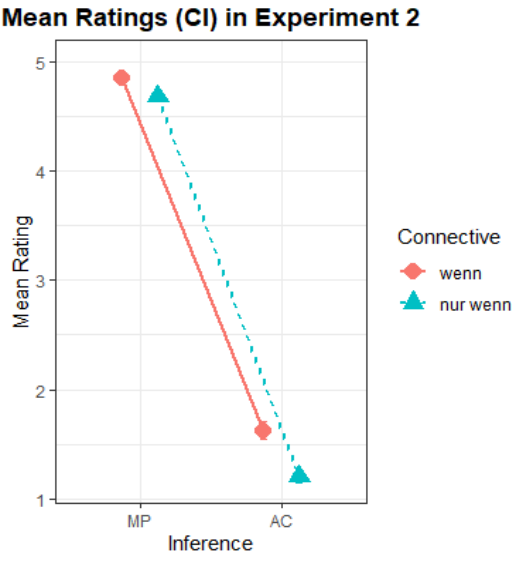


Figure 2. Rating latencies in E2.

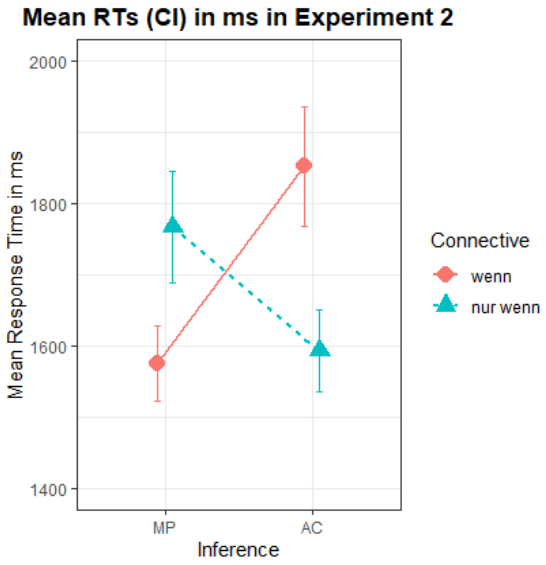
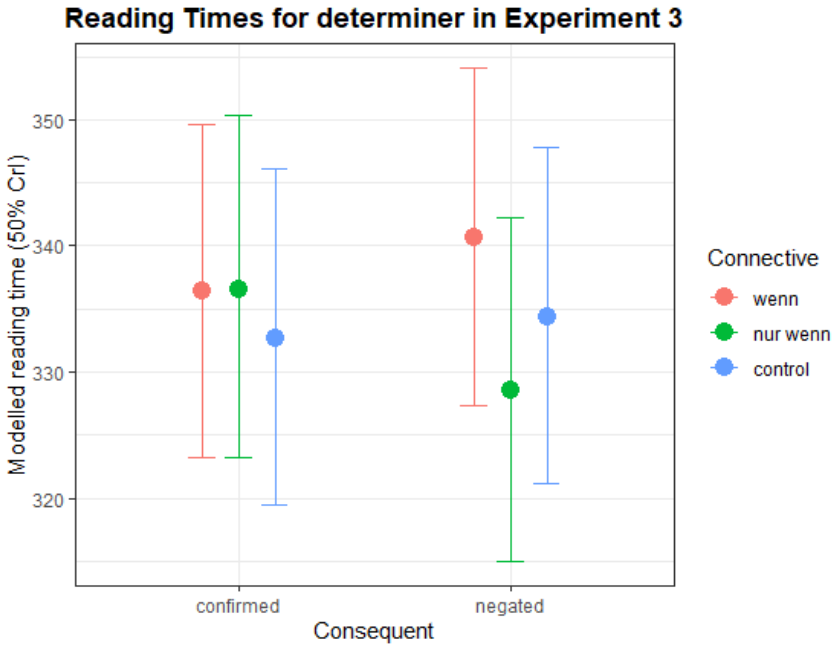


Figure 3. Reading times for critical word in E3.



References:
[1] Evans & Over (2004). If.
[2] Johnson-Laird & Byrne (2002). Conditionals: A theory of meaning, pragmatics, and inference.
[3] von Fintel (2011). Conditionals.
[4] Horn (2002). Assertoric inertia and NPI-licensing.
[5] Herburger (2015). Only if: If only we understood it.