Flavors of German necessity modals: experimental evidence

Summary: Modals in German and English lexicalize modal force, while their modal flavor is context-dependent. However, 'variable-flavor' modals may still be semantically restricted in terms of the flavors they are compatible with. Moreover, lexical flavor restrictions can show subtle crosslinguistic variation, even between related languages with superficially similar modal systems. This presents a challenge for language learners even at a high level of proficiency (e.g. Anthonissen & Mortelmans 2016, Howard & Leclercq 2017, Mifka-Profozic 2017). We investigate restrictions on (non-epistemic) flavors of the German necessity modals *müssen* and *sollen* by means of offline and online experimental methods, comparing the behavior of native speakers and advanced L2 speakers of German. Here we present the study design and the data obtained from native speakers. We submit that our results support Matthewson & Truckenbrodt's (2018) assessment of flavor restrictions on *müssen* and *sollen*, with interesting qualifications revealed by our empirical data.

Background: *Müssen* and *sollen* both express necessity, but they differ in their possible modal flavors. Their exact flavor restrictions are in part controversial. For instance, Kratzer (1991) holds that the flavor of *müssen* is unrestricted and the flavor of *sollen* is bouletic, while Bochnak & Csipak (2018), a.o., characterize the non-epistemic use of *sollen* as deontic. Matthewson & Truckenbrodt (2018) [henceforth M&T] propose that *müssen* and *sollen* lexically encode largely distinct modal flavors. Based on judgments from 20 native speakers, they submit that *sollen* is specified for bouletic flavor, and that deontic readings only arise via additional inferences in certain contexts. They also propose a restriction on the flavor of *müssen*: in bouletic uses of *müssen*, the speaker must be the attitude holder, i.e. *müssen* cannot express a third person's wish or preference.

Experiment: We tested modal flavor restrictions of *müssen* and *sollen*, specifically targeting M&T's generalizations that **i)** *müssen* is incompatible with bouletic readings with a third person attitude holder and **ii)** *sollen* is specified for bouletic modal flavor and compatible with third person attitude holders. In a 2×2 design, we crossed the factors *context* (levels: bouletic vs. non-bouletic) and *modal* (levels: müssen vs. sollen). As exemplified in (1) and (2), we presented participants with context descriptions designed to elicit a speaker-external bouletic interpretation (1a) or a non-bouletic (i.e. teleological/ deontic/ circumstantial) interpretation (1b), followed by a modal sentence with *sollen* (2a) or *müssen* (2b). In the first block of the experiment, participants completed a self-paced reading (SPR) task. They first saw the complete context description on the screen. After reading the context, they read the modal sentence region-by-region, with a keypress revealing each new region. Regions were defined as indicated in (2a). The second block presented an acceptability judgment task. Participants saw the same items again, this time with the context and the modal sentence presented statically on the same page. They were asked to judge how felicitous ('angemessen') the sentence is in the given context on a scale from 1 to 7.

(1) a. **Kontext:** Finn möchte, dass seine Eltern ihm beim Kauf einer Wohnung helfen, weil er selbst nicht kreditwürdig ist. Er spricht darüber mit seinem Bruder. Der weiß, dass die Eltern dem niemals zustimmen werden. Später spricht Finns Bruder darüber mit den Eltern. "Finn wants his parents to help him buy a flat, because he has bad credit. He talks about this with his brother. The [brother] knows that their parents will never agree to this. Later, Finn's brother talks to his parents about it." **[Bouletic context]**

b. **Kontext:** Finns Eltern haben das Ziel, sich endlich eine eigene Wohnung zu kaufen, aber ihre Ersparnisse reichen dafür nicht aus. Finn weiß, dass die einzige Möglichkeit ist, sich Geld von einer Bank zu leihen. Finn spricht darüber mit seinen Eltern.

"Finn's parents have the goal to finally buy their own flat, but their savings aren't sufficient. Finn knows that the only possibility is to loan money from a bank. Finn talks to his parents about this." **[Non-bouletic (teleological) context]**

(2) a. [Er sagt:] [Ihr] [sollt] [bei der Bank] [einen Kredit] [beantragen]
intro subject modal midfield.1 midfield.2 verb
"He says: You SOLL apply for a loan at the bank." **[Target sentence 'sollen']**

b. [Er sagt:] [Ihr] [müsst] [bei der Bank] [einen Kredit] [beantragen]
"He says: You MUSS apply for a loan at the bank." **[Target sentence 'müssen']**

We constructed 32 target items in 4 conditions (bouletic/*soll*, bouletic/*muss*, non-bouletic/*soll*, non-bouletic/*muss*) and distributed them over 4 lists in a Latin square design. The target items were presented in randomized order and intermixed with 16 fillers and 16 items that served as controls for the judgment task. As attention checks in the SPR task, 30 items were followed by a forced choice question targeting information from the context or the modal sentence.

Predictions: Based on M&T, we predict an interaction between the factors *context* and *modal*: In bouletic contexts, sentences with *sollen* should be rated higher and read faster than sentences with *müssen*. In non-bouletic contexts, sentences with *müssen* should be rated higher and read faster.

Results: We analyzed data from 95 German native speakers. The results of the acceptability judgment task are depicted in Fig. 1. An ordinal logistic mixed effects model fitted to the ratings revealed a significant interaction between the factors *context* and *modal* (β = -2.57, $p < .001$, 95% CI [-3.18, -1.95]): *müssen* is judged as more acceptable than *sollen* in non-bouletic contexts, but less acceptable than *sollen* in bouletic contexts. For the SPR task, Fig. 2 shows the mean residual reading times in all conditions for the 6 regions illustrated in (2a). Linear mixed models fitted to the RTs for each region revealed a significant interaction between the factors in one spill-over region after the modal (region 'midfield.2') (β = 30.67, t = 3.53, 95% CI [13.66, 47.68]): sentences with *sollen* are read faster than sentences with *müssen* in bouletic context, but more slowly in non-bouletic contexts.

Discussion and outlook: Both our online and our offline measures yielded significant interactions in line with the predictions derived from M&T, but there are some interesting differences. In the acceptability judgments, the interaction is driven by a difference in the ratings of sentences with *müssen* across contexts. This supports M&T's generalization that *müssen* is less compatible with speaker-external bouletic readings than with other modal flavors. However, judgments for sentences with *sollen* do not differ across contexts, they were judged as equally acceptable with bouletic and non-bouletic flavor. Conversely, the interaction in the SPR task is driven by significantly longer RTs for sentences with *sollen* in non-bouletic than in bouletic contexts, with no significant difference between sentences with *müssen*. M&T propose that *sollen*, while semantically bouletic, can receive deontic interpretations via additional inferences. It seems plausible that these additional inferences can license interpretations compatible with non-bouletic context descriptions (as reflected in the acceptability judgments) and also impose additional processing cost (as reflected in the reading times). Although the differences between non-epistemic modal flavors are notoriously subtle, our experiment has revealed that the bouletic/non-bouletic distinction is reflected in the German native speakers' behaviors as they interpret *müssen* and *sollen*, as predicted by the theoretical literature. We are currently collecting parallel data from advanced L2 speakers of German, which will shed light on the question to what extent these subtle differences are acquired in L2 learning and reflected in sentence processing.

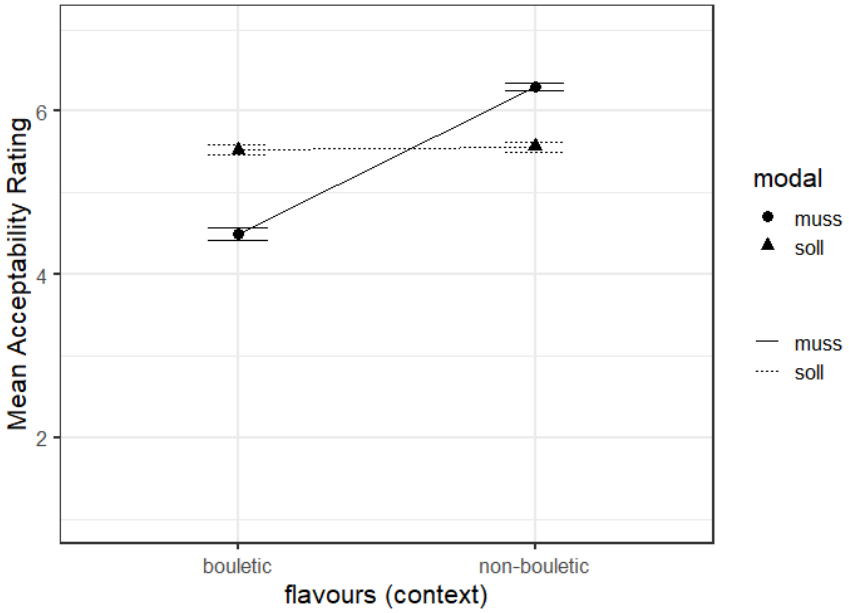

Figure 1: Acceptability judgments across conditions

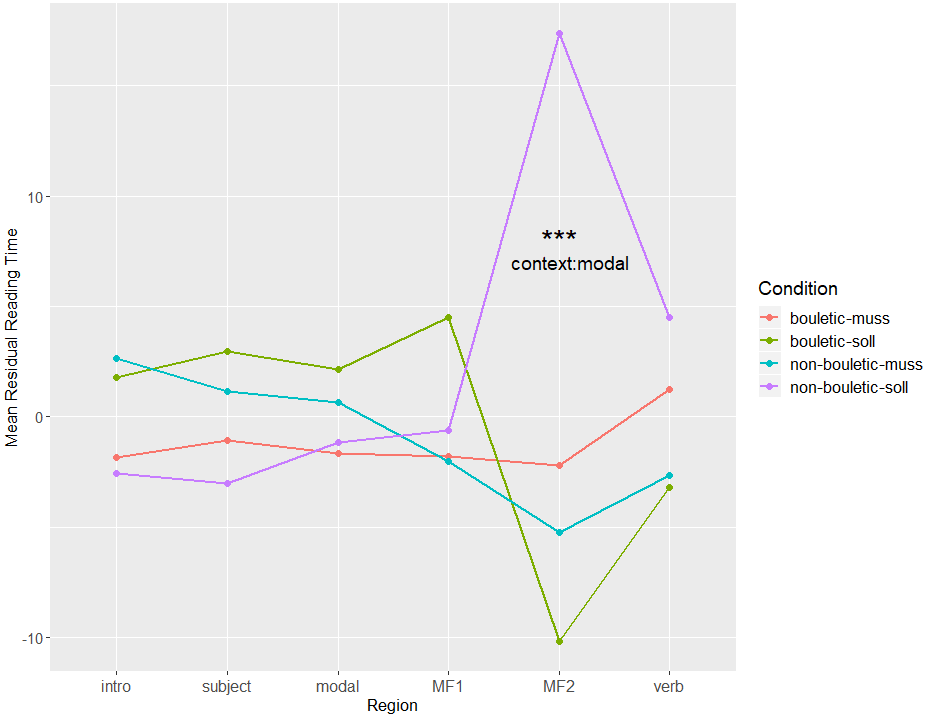

Figure 2: Mean residual reading times across regions and conditions

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