

Transitioning developmental paths in modal flavors: an experimental pilot study

Background. The development of modal meanings from essentially root towards epistemic ones on the diachronic dimension has long been discussed (cf. Goossens (1982) to Nuyts et al. (2021) among many others). The slightly more detailed development is typically taken to be from dynamic to deontic and then to epistemic (and evidential) readings. The schema in (1) has been observed historically and similar observations have been made with respect to language acquisition (e.g. Cournane 2019). We start out from the following assumptions (i) developments from root to epistemic are often observed and there is no reason to question them or the basis of the path established by Bybee & Pagliuca (1985) as an overall tendency; (ii) at the same time, when looking at the details of the developments in any language a number of less perfect developments arise; e.g. early epistemic that have to be explained (cf. Traugott 1989 among others).

(1) Dynamic > Deontic > Epistemic.

Experiments. The Human Diachronic Simulation Paradigm tests a historical development path with speakers of a related language or dialect (in which certain semantic premises hold) that have yet to realize a specific change, their judgments can be used in place of speakers of the previous form of the language (Gergel et al. 2021). We build on this by testing within a single language. Our first experiment tests three different modal lexemes across three different contexts of use (dynamic, deontic, or epistemic) thereby testing theories of how the use of a given modal lexeme changes over time. We specifically capitalized on modal expressions that are empirically not considered to have the vanilla ambiguity of modal flavors assumed by semantic theory, but in fact are standardly taken to have one prevalent modal flavor in actual use. For example, each of the constructed sentences in (2)-(4) exemplify dynamic (ability/circumstances), deontic (permission/duty), and epistemic (knowledge) modality respectively in the verbal modals *be able to*, *be allowed to*, and *might*. The sentences in (2)-(4) were taken as "original" items and used to create "modified" items, where each targeted verbal modal was swapped across contexts. For example, (4) is taken as a deontic context and the dynamic modal *is able to* is put into this context yielding the sentence in (5). All modals were put into all contexts thereby testing acceptability both in contexts that correspond to the anticipated development (forwards along the evolutionary path) and in contexts that go against the anticipated development (backwards along the same path).

(2) *Because Sara's car is parked in her driveway, she is able to easily load it with luggage.*

(3) *Since Anne's truck is parked on her property, she is allowed to leave it there indefinitely.*

(4) *Given Maureen's vehicle is parked in front of her apartment, she might be home.*

(5) *Since Anne's truck is parked on her property, she is able to leave it there indefinitely.*

In summary, we have a 3x3 Latin Square design where the condition MODAL has three levels (*be_able_to*, *be_allowed_to*, and *might*) and the condition CONTEXT has three levels (dynamic, deontic, and epistemic). Our original sentences and those occurring with different modals (e.g. (3) and (5)) were split and randomized across three lists, each with 36 target and 36 filler items. To minimally emulate a contact-with-change situation (cf. Gergel, Puhl, Dampfhofer & Onea 2023 for more complex ones), participants were told some sentences come from a dialect different from theirs and their thoughts on the naturalness is the point of the study. Participants provided responses via a sliding scale (left: "completely unnatural", right "completely natural"), with underlying values from 0 to 999 not visible to the participant.

The participants' judgments of the experimental items are summarized in Figure 1. Looking at the averages alone, we see that the judgements generally follow the predictions for acceptability given the modal development path: *BE able to* is best in dynamic contexts (its current use), is degraded in deontic contexts (its next step in development), and is further degraded in epistemic uses (its subsequent step in development); *BE allowed to* is best in deontic contexts (its current use), is degraded in both dynamic and epistemic contexts (its previous and future uses according to the development path); and *might* is best in epistemic

contexts (its current use), is degraded in deontic contexts (its previous stage of use), and is further degraded in dynamic contexts (its use two stages previous to now).

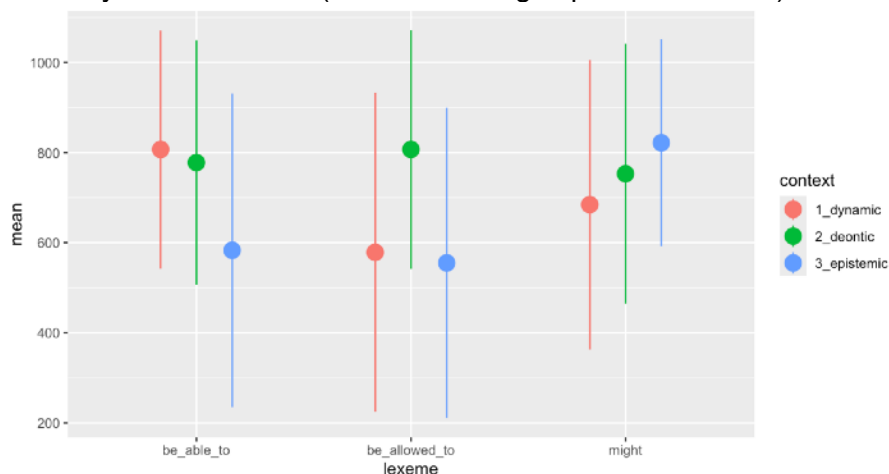


Figure 1: Mean (point) acceptability ratings with SD (range) for Experiment 1.

We modeled the results with a linear mixed-effects model (6).

(6) `lmer(Response ~ modifier*context + (1|Participant)+(1|item),REML=FALSE)`

Starting with the development of BE *able to*, the difference between *be_able_to*:dynamic and *be_able_to*:deontic was not found to be significant (SE=43.69, $p=0.56163$). BE *able to* is unacceptable in epistemic contexts as this combination caused a significant degradation in acceptability (SE=43.74, $p<0.001$). BE *allowed to* is firmly in its place as a deontic modal, because judgments of this modal in dynamic and epistemic contexts are significantly worse. Lastly, the difference between the distance from the intercept to *might*:dynamic versus that to *might*:deontic is relatively small and not significant (SE=61.82, $p=0.1418$). The difference between the distance from the intercept to *might*:dynamic and that to *might*:epistemic is significant (SE = 61.84, $p < 6.85e-08$). In other words, the acceptability of *might* in deontic contexts is relatively similar to that of *might* in epistemic contexts, but different from that of *might* in dynamic contexts. The results generally fit with the historical data but present an interesting question regarding deontic-to-epistemic development; why is it so marked here?

To test whether adverbials may facilitate the use of deontic modals in epistemic contexts, we used a 2x2 Latin-square design with the factors FLAVOR and MODIFICATION with the respective levels DEONTIC, EPISTEMIC and ADVERBIAL, NONE. For example, a DEONTIC:ADVERBIAL stimulus would look like (3) but with *possibly* modifying BE *allowed to*. The rest of the experiment followed the same design and analysis of results as before. Unsurprisingly, we see a significant difference ($p<0.01$) between DEONTIC:ADVERBIAL and EPISTEMIC:ADVERBIAL. Second, there is a difference between DEONTIC:ADVERBIAL and DEONTIC:NONE ($p<0.001$), which we attribute to sentence complexity. Third there is a significant difference between DEONTIC:ADVERBIAL and EPISTEMIC:NONE ($p<0.05$) on top of the aforementioned differences, which suggests there is an interaction between modal flavor and modification when it comes to the acceptability of BE *allowed to*. To test whether this perceived interaction effect is significant, we conducted an ANOVA between the linear model including interaction and one without, finding a significant difference ($p<0.05$).

Conclusion. We have shown that the methodology of conducting experiments to replicate diachronic changes can be fruitfully applied to modals. The findings support the experimental replication of diachronic tendencies while highlighting both constraints on semantic change and the potential role of bridging elements. Moreover, these experimental paradigms can illuminate mechanisms underlying language change and propose integrating syntactic factors and contextual triggers in future research.