What is seen as impossible depends on what question we ask

In the last few decades there has been a fruitful interdisciplinary exchange connecting linguistic research on 'modal language' (Hacquard, 2010; Phillips & Kratzer, 2024) with psychological inquiry into 'possibility representations' (Leahy & Carey, 2020; Phillips & Cushman, 2017). This exchange traced the developmental trajectory from pre-linguistic logical primitives (Cesana-Arlotti et al., 2022) to the acquisition of specific modal vocabularies (Cournane, 2021; Ozturk & Papafragou, 2015; Papafragou, 1998). A central tension in this literature concerns the differentiation of flavors. Strikingly, when forced to decide whether events are "possible" or "impossible" under time constraints, adults categorize immoral, improbable, or irrational events all as "impossible" (Phillips & Cushman, 2017); children do the same, even without time pressure (Shtulman & Carey, 2007). This has been argued to reflect a "default modal representation" that conflates all modal violations with physical impossibility to efficiently constrain the search space for decision-making. However, this hypothesis is at odds with real-time language processing, which requires distinguishing flavors to interpret sentences with different flavors like "You *can* steal it, but you are not *allowed* to": a contradiction if 'can' and 'allowed' conflate. **We propose** to resolve this tension by attributing flavor conflation to pragmatic *competence* as opposed to a cognitive *incompetence* driven by default flavor. Drawing on the "Question Under Discussion" (QUD) framework (Roberts, 2012), we argue that under time pressure, participants construct ad-hoc categories based on alternatives raised by a salient question.

In the QUD framework, conversation is organized around a hierarchy of questions, which each conversational move aims to resolve. Broad QUDs define overarching conversational goals, and narrow QUDs guide the interpretation of individual utterances as steps toward addressing those broader goals. In a two-alternative forced choice task, a label like "impossible" is interpreted not only based on its semantics, but based on what question – and thus alternatives ('contrast class') – it evokes. When being asked whether certain actions are possible or impossible, it is reasonable to assume a broad QUD about whether something is a valid candidate for action. Since immoral and irrational acts are both non-viable with respect to this broad QUD, they are pragmatically grouped with "Impossible" events as non-candidates. We test this hypothesis by making the explicit question not about the *presence*, but the *source* of a violation (e.g. "is it immoral or impossible?"), in turn shifting the broad QUD to a 'why'-question. If a 'default modal representation' drives the flavor confusion, such manipulations should not make a difference and participants should still struggle to appropriately categorize relevant flavors. On the other hand, if conflation was driven by pragmatic regrouping to resolve the QUD, it should disappear under a different QUD. We report three experiments (N=60) that support this pragmatic hypothesis.

Experiment 1: Replication. Experiment 1 (N=20) served as our baseline, replicating the design of Phillips & Cushman (2017) using original materials but recreating the stimuli in PCIbex. Participants judged 120 events organized around 6 vignettes as either "Possible" or "Impossible" under strict time pressure (<1500ms). For each vignette they had to make 24 speeded judgements along 5 Event Types (*Impossible, Immoral, Irrational, Improbable, and Possible).*

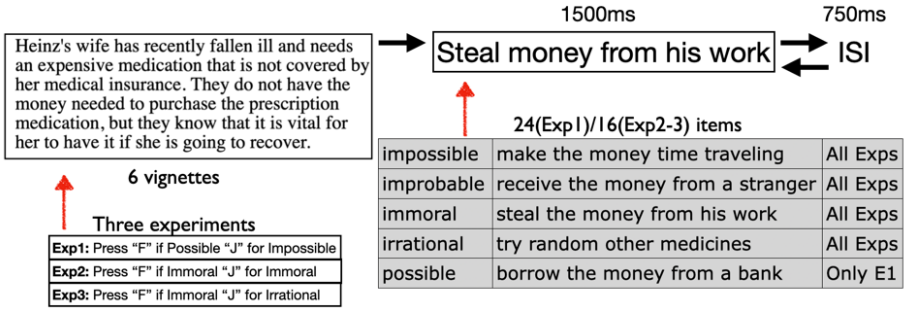

Figure 1) ***Design****. The three experiments (differed in task) used 6 vignettes, each with 24(Exp1)/16 (Exp2-3) different items for divided by the different event types.*

Results: We replicated the characteristic finding of the default representation account, where participants were unable to tell apart certain possible events

from *impossibility*. A Generalized Linear Mixed Model (GLMM) revealed a significant main effect of Event Type ($\chi^2(4) = 539.81$, $p < .001$). Participants were significantly more likely to categorize *immoral* and *irrational* events as "Impossible" compared to *possible* events (OR = 13.6 and 17 respectively, $p < .001$) and even compared to *improbable* events (OR = 1.97 and 2.47 respectively, $p < .001$).

Experiment 2: Immoral vs. Impossible. In Experiment 2 (N=20), we changed the task such that participants had to decide whether events were "Immoral" or "Impossible." If the confusion in Experiment 1 is due to a cognitive default, it should persist. However, if it was driven by pragmatic partitioning of the space of the provided answers than the "Immoral" label should now attract the *immoral* events, forcing a redefinition of the "Impossible" category without them. **Results:** A significant Event Type × Study interaction ($\chi^2(3) = 153.16$, $p < .001$) supported the QUD hypothesis. In this context, the flavor conflation for *immoral* events largely vanished. Participants were significantly less likely to categorize *immoral* events as "Impossible" in E2 compared to E1 (OR = 0.19, $p < .001$). Other event types were also affected. Most strikingly, *improbable* events, were not mapped onto the "Immoral" label but categorized as "Impossible" significantly more often than in E1 (OR = 3.57 for Improbable, $p < .001$). This makes intuitive sense, as these actions are clearly not immoral, and can be considered as 'practically' impossible

Experiment 3: Irrational vs. Impossible To explore whether QUD changes are specific to morality, Experiment 3 (N=20) changed the response options to "Irrational" vs. "Impossible." "Irrational" is a special category, as *immoral* and *improbable* can also be thought of as subtypes of *irrational* actions. If E2 was driven by a change in the inferred QUD, E3 should help reframe all non-impossible categories as falling under "Irrational". **Results:** Consistent with this, we found a significant interaction of experiment and event type (($\chi^2(6) = 201.81$, $p < .001$). In this context, *irrational*, *immoral* and *improbable* events were all categorized differently from *impossible* events (all OR-s > 15, all $p < .001$), revealing a strong competence for telling apart different deviations.

General Discussion Across three experiments, we found that 'flavor conflation' phenomena is highly unstable. The likelihood of any not-impossible event being judged "Impossible" depended entirely on the alternative options provided by the experiment. These findings support a QUD-based explanation over the Default Representation hypothesis. Critically, even under severe time pressure, humans can successfully separate norm violations or irrationality from physical impossibility. These findings also imply that even in their speeded judgements humans engage in pragmatic partitioning of the space of possible answers. Every response label was used as a flexible category whose interpretation depends on its pair. Thus, what appeared to be a cognitive limit in previous research might be a hallmark of flexible, context-sensitive reasoning.

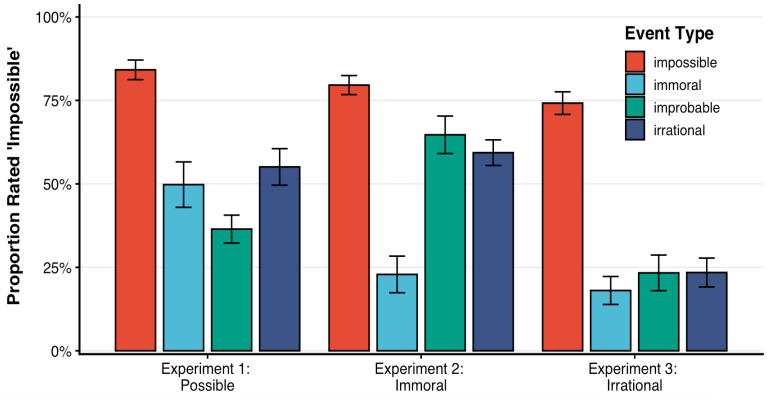

Figure 2) Proportion of categorizing events as "impossible". Error bars represent SE. Main findings: immoral events (light blue) were rated as impossible significantly less frequently when "Immoral" was an explicit alternative (Exp 1vs2). When "Irrational" was a possible response (Exp 3) it served as a catch all for all non-impossible, deviant events.

Refs: Cesana-Arlotti, N., Varga, B., & Téglás, E. (2022). The pupillometry of the possible: an investigation of infants' representation of alternative possibilities. *Philosophical Transactions of the Royal Society B* * Cournane, A. (2021). Revisiting the epistemic gap: It's not the thought that counts. *Language Acquisition.* * Hacquard, V. (2010). Modality. *Language* * Leahy, B. P., & Carey, S. E. (2020). The acquisition of modal concepts. *Trends in Cognitive Sciences* * Ozturk, O., & Papafragou, A. (2015). The acquisition of epistemic modality: From semantic meaning to pragmatic interpretation. *Language learning and development* * Papafragou, A. (1998). The acquisition of modality: Implications for theories of semantic representation. Mind & Language * Phillips, J., & Cushman, F. (2017). Morality constrains the default representation of what is possible. *Proceedings of the National Academy of Sciences* * Phillips, J., & Kratzer, A. (2024). Decomposing modal thought. Psychological Review * Roberts, C. (2012). Information structure: Towards an integrated formal theory of pragmatics. *Semantics and pragmatics.* * Shtulman, A., & Carey, S. (2007). Improbable or impossible? How children reason about the possibility of extraordinary events. *Child development*