Homogeneity or implicature: An experimental study of free choice

Summary: A sentence containing disjunction in the scope of a possibility modal, such as (1a), gives rise to the FREE CHOICE inference in (1b). This inference presents a well known puzzle in light of a standard treatment of modals and disjunction (Kamp 1974 and much subsequent work). To complicate things further, FREE CHOICE tends to disappear under negation: (2a) doesn't merely convey the negation of (1a), but rather the stronger DUAL PROHIBITION reading in (2b). There are two main approaches to the FREE CHOICE-DUAL PROHIBITION pattern in the literature, based on homogeneity and implicature. We present experimental findings that favor the homogeneity approach, and further discuss how the implicature approach could be developed to account for the results.

Free choice and homogeneity: The semantic approach to FREE CHOICE has recently been defended in various forms (Starr 2016, Aloni 2018, Willer 2018, Goldstein 2018, a.o.). We will focus on the account in Goldstein (2018), which is based on two main ingredients: (i) a strong meaning for sentences like (1a), which directly asserts FREE CHOICE, and (ii) a homogeneity presupposition requiring that either all alternatives are possible or none of them are. In the positive case, this presupposition is entailed by the FREE CHOICE asserted meaning. Under negation, the asserted meaning is just the negation of FREE CHOICE; the latter, in combination with the homogeneity presupposition (which projects through negation), gives rise to the desired DUAL PROHIBITION reading. In sum, combining the asserted meaning and the homogeneity presupposition captures the attested pattern (see Table 1 for a schematic illustration of the derivations in the positive and negative cases).

Free choice and implicature: The other prominent approach in the literature is the implicature approach, which also comes in different forms (Fox 2007, Klinedinst 2007, Chemla 2009, Franke 2011, Romoli & Santorio 2018, Bar-Lev 2018, a.o.). This account is based on three main ingredients: (i) a standard meaning for disjunction and possibility modals, (ii) an implicature-generating algorithm EXH,[1] and (iii) a principle regulating the distribution of EXH (independently required for implicatures more generally), which bans or strongly disprefers EXH under negation (Chierchia et al. 2012, Fox & Spector 2013, a.o.). In the positive case, the literal meaning does not entail FREE CHOICE. However, if EXH is added to the sentence, FREE CHOICE arises as an implicature. Finally, the principle in (iii) prevents EXH from appearing in the scope of negation; DUAL PROHIBITION therefore arises straightforwardly from the negation of the literal meaning of (1a) (see Table 1).

Predictions: Both approaches have been similarly successful in capturing the basic pattern described above and a variety of related data. They diverge, however, in one important prediction, which to our knowledge has been untested (though there have been similar discussions in the context of plurals, see Chemla & Križ 2015, Križ 2017, Tieu, Bill, Romoli & Crain 2018). To illustrate, consider a context like Fig. 1 (left) in which Sue is only allowed to buy the boat. In this context, the homogeneity account predicts both (1a) and (2a) to be undefined, as their presupposition is not satisfied. The implicature account, on the other hand, predicts a difference in status across the two polarities: it predicts (1a) to be literally true, but with a false implicature, while it predicts (2a) to be plainly false. To sharpen the predictions, consider the comparison with the corresponding simple disjuction case: (3a) gives rise to the exclusivity inference in (3b) (less controversially analysed as an implicature), which disappears under negation in (4a). In the context in Fig. 1 (right), in which Sue bought both the boat and the car, (3a) is true but with a false implicature, while (4a) is plainly false. We can state the predictions as follows: the IMPLICATURE approach predicts a similar pattern for the pairs in (1a)-(2a) and (3a)-(4a), reflecting a falsified implicature in the positive cases versus a falsified literal meaning in the negative ones. The HOMOGENEITY account, on the other hand, predicts a difference between the pairs (an interaction between Inference Type and Polarity), in that (1a) and (2a), unlike (3a) and (4a), are predicted to have the same status (i.e. they are both predicted to be undefined).

[1]The theories differ in how they conceive of and define EXH, how many EXH one needs, and in which position they must occur in order to generate FREE CHOICE. These differences will not be important for our purposes.

Experiment: We used a ternary judgment task (Katsos & Bishop 2011) in 'prediction' mode, in which participants had to read a puppet's guesses about what a character was allowed/not allowed to buy (free choice (FC) condition) or about what a character bought/didn't buy (disjunction (OR) condition), and then had to decide upon seeing the outcome whether the puppet should receive a small strawberry (described in the instructions as corresponding to 'totally wrong'), a large strawberry ('totally right'), or a medium-sized strawberry ('in between, not totally right but not totally wrong'). Rules (FC) and outcomes (OR) were depicted as in Fig. 1.

Participants: 114 adults recruited through Amazon Mechanical Turk were randomly assigned to the FC or OR condition; 3 were excluded for not reporting English as a native language, leaving 111 participants for analysis (56 FC, 55 OR). Participants were paid \$.75 USD for the 5-minute study.

Materials: In the FC condition, the critical positive and negative target sentences (e.g., (1a)-(2a)) were presented in contexts like Fig. 2 (left), in which only one of the disjuncts was 'allowed' (e.g., Sue was only allowed to buy the boat). In the OR condition, the positive and negative disjunctive statements (e.g., (3a)-(4a)) were presented in contexts like Fig. 2 (right), which falsified the exclusivity inference (e.g., Sue bought both the boat and the car). Participants received 2 training items, followed by 8 targets (4 positive, 4 negative) and 8 controls (2 true and 2 false positive controls, 2 true and 2 false negative ones). Every picture/context contained three objects, to avoid any infelicity associated with using disjunction in a context with only two objects (cf. Skordos et al. 2018).

Results: As can be seen in Fig. 1, participants primarily gave the intermediate reward in response to both positive and negative FC targets, while they gave an asymmetric pattern of responses to the positive and negative OR targets. We fitted a mixed effects cumulative link model to responses to the targets with Inference Type, Polarity, and their interaction as fixed effects, and random by-participant slopes for Polarity. Model comparisons revealed a marginal effect of Inference Type ($\chi^2(1) = 3.2, p = .07$), a significant effect of Polarity ($\chi^2(1) = 102, p < .001$), and a significant interaction between Inference Type and Polarity ($\chi^2(1) = 88, p < .001$), with participants showing a greater difference between polarities for OR than for FC.

Discussion: The difference between free choice and disjunction, and in particular the observed interaction, are challenging for the IMPLICATURE account, which predicts a similar pattern for both sentence types across polarities. On the other hand, the results are straightforwardly in line with the HOMOGENEITY account, which predicts (1a) and (2a) to be equally undefined in the given context.

One direction that could address the challenge for the IMPLICATURE account is to reconsider the principle regulating the distribution of EXH. In fact, a recent proposal has argued independently that the standard formulation based on logical strength should be replaced by a constraint based on a notion of 'connectedness'. Roughly, the principle makes a parse strongly dispreferred if it doesn't give rise to a connected meaning (Enguehard & Chemla 2018). Formal details aside, what is relevant here is that this proposal differs from the standard one precisely in that it predicts EXH not to be banned in the scope of negation with FREE CHOICE, while still predicting the standard asymmetry between positive and negative in the case of simple disjunction.[2] This proposal is therefore a promising direction for making the implicature approach compatible with our results (possibly in combination with considerations of scalar diversity, cf. van Tiel et al. 2016).

Conclusion: Our results are in line with previous findings in the literature of crucial differences between FREE CHOICE and implicatures, e.g., in their processing and acquisition profiles (Chemla & Bott 2014, Tieu, Romoli, Zhou & Crain 2016). One possible approach is to abandon the implicature account altogether. Alternatively, one could take these results as informative about, e.g., the nature of the alternatives involved in the respective inferences or about the principle regulating the distribution of EXH. Regardless of the theoretical choice pursued, the relative status of the positive versus negative sentences provides an important window into theories of free choice and implicature.

[2]This is the case only if an anti-conjunctive inference is not derived (see Enguehard & Chemla 2018).

(1) a. Sue is allowed to buy the boat or the car.
b. $\rightsquigarrow$ *Sue is allowed to buy the boat and Sue is allowed to buy the car* FREE CHOICE

(2) a. Sue is not allowed to buy the boat or the car.
b. $\rightsquigarrow$ *Sue is not allowed to buy either one* DUAL PROHIBITION

(3) a. Sue bought the boat or the car.
b. $\rightsquigarrow$ *Sue didn't buy both the boat and the car* EXCLUSIVITY IMPLICATURE

(4) a. Sue didn't buy the boat or the car.
b. $\rightsquigarrow$ *Sue didn't buy either one* NEGATED LITERAL MEANING

	ASSERTED MEANING	PRESUPPOSED MEANING	RESULT
POSITIVE	$\Diamond(a \vee c) = \Diamond a \wedge \Diamond c$	$\Diamond a \leftrightarrow \Diamond c$	$\Diamond a \wedge \Diamond c$
NEGATIVE	$\neg \Diamond (a \vee c) = \neg(\Diamond a \wedge \Diamond c)$	$\Diamond a \leftrightarrow \Diamond c$	$\neg \Diamond a \wedge \neg \Diamond c$

	LITERAL MEANING	IMPLICATURE	RESULT
POSITIVE	$\Diamond(a \vee c) = \Diamond a \vee \Diamond c$	$\text{EXH}(\Diamond(a \vee c)) = \Diamond a \wedge \Diamond c$	$\Diamond a \wedge \Diamond c$
NEGATIVE	$\neg \Diamond (a \vee c) = \neg \Diamond a \wedge \neg \Diamond c$	$^*\neg(\text{EXH}(\Diamond(a \vee c))) = \neg(\Diamond a \wedge \Diamond c)$	$\neg \Diamond a \wedge \neg \Diamond c$

Table 1: Derivation of the FREE CHOICE-DUAL PROHIBITION pattern under the HOMOGENEITY (upper table) and the IMPLICATURE account (lower table).

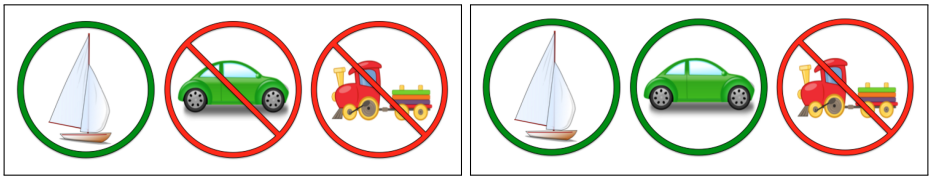

Figure 1: Example visual stimuli: the left image was paired with the positive and negative FC targets in (1a)-(2a); the right image was paired with the positive and negative OR targets in (3a)-(4a).

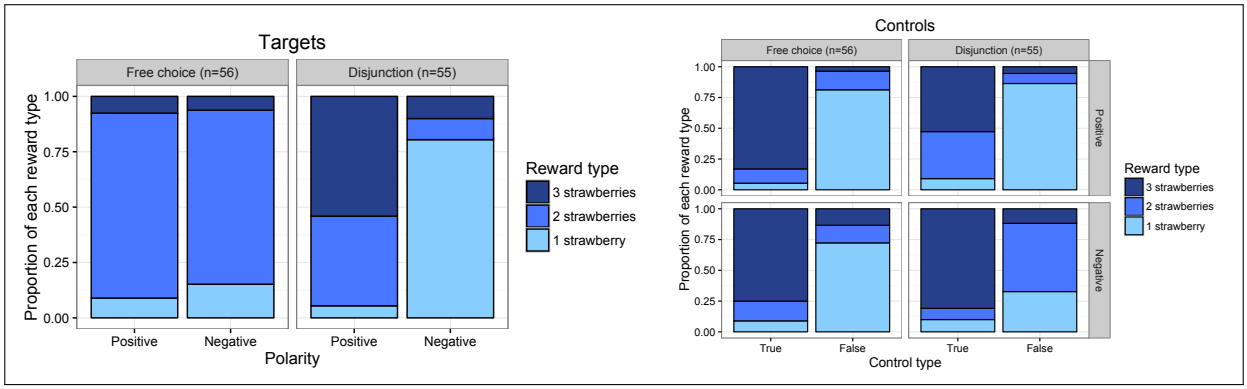

Figure 2: Proportion of reward types in response to targets and controls in FC and OR conditions.

Selected References

Bar-Lev, M. 2018. *Free choice, homogeneity and innocent inclusion*. • Chemla, E. & Bott, L. 2014. Processing inferences at the semantics/pragmatics frontier: disjunctions and free choice. • Enguehard, I. & Chemla, E. 2018. Connectedness as constraints on exhaustification. • Fox, D. 2007. Free choice and the theory of scalar implicatures. • Goldstein, S. 2018. Free choice and homogeneity. • Katsos, N. & Bishop, D. 2011. Pragmatic tolerance: Implications for the acquisition of informativeness and implicature. • Skordos, D., Feiman, R., Bale, A. & Barner, D. 2018. Do children interpret 'or' conjunctively?