(In-)definites, (anti-)uniqueness, and uniqueness expectations

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Abstract

Using "A" in noun phrases such as "A father of the victim" is odd, which is commonly explained by the principle *Maximize Presupposition*, requiring speakers to use the alternative with the strongest presupposition (here "The", given its uniqueness presupposition). This results in an anti-uniqueness inference for "A" (clashing with stereotypical expectations here), sometimes labelled as an 'anti-presupposition' (Percus, 2006), as it derives from reasoning over the presuppositions of alternative forms. We compare these inferences to the uniqueness inferences associated with definites, while manipulating uniqueness expectations in a picture manipulation task using visual world eye-tracking. This offers a minimal comparison of uniqueness-based inferences that are lexically encoded vs. pragmatically inferred, and furthermore tests the prediction that the accommodatability of the definite's presupposition plays a role in the derivation of anti-uniqueness inferences (Rouillard & Schwarz, 2017).

Keywords: presuppositions; visual world eye-tracking; definiteness; indefiniteness

Theoretical Background

There is a concurrent claim in the theoretical literature that definite descriptions, and presupposition triggers in general, have to be used if their presupposition (PSP) is fulfilled in the context. Since definite noun phrases come with a presupposition of uniqueness they must be used if this uniqueness presupposition is met in the context, see (1-a). The use of an indefinite noun phrase in (1-b) is infelicitous.

(1) a. The father of the victim came.
    b. #A father of the victim came.

There are various theories explaining this effect by assuming that there is lexical competition between the presuppositionally stronger definite and presuppositionally weaker indefinite governed by the principle *Maximize Presupposition* (Heim, 1991; Percus, 2006; Sauerland, 2008; Chemla, 2008). Based on pragmatic reasoning over the stronger alternative – similar to the one used for the derivation of scalar implicatures – the indefinite yields the inference that the presupposition of the definite is false ('anti-uniqueness'). (1-b), for example, has the infelicitous anti-uniqueness inference that there is not exactly one father of the victim. The resulting inferences ('anti-presuppositions') are theoretically set apart from well-studied components of meaning like presuppositions and implicatures based on their weaker epistemic status, and their projection behaviour. Recently, the strength of the epistemic status has been argued to be dependent on accommodatability of the competing presuppositional statement, which is tied to the knowledge state of speaker and hearer (Rouillard & Schwarz, 2017). There is a less prominent alternative view according to which definites and indefinite both come with their own context restrictions, i.e. that the indefinite comes with a novelty condition (Heim, 1983) or its own presupposition of anti-uniqueness (Kratzer, 2005). These make different predictions for the processing profiles associated with anti-uniqueness.

According to the first view (theory A), in which anti-uniqueness is the result of reasoning over presuppositionally stronger alternatives, the consideration of the alternative and its subsequent negation to derive the inference should require extra processing costs, based on the observation that both presuppositions and negation have been independently shown to increase the cognitive load in processing (Schwarz, 2007; Tiemann, 2014; Kirsten et al., 2014; Carpenter, Just, Keller, Eddy, & Thulborn, 1999; Reichle, Carpenter, & Just, 2000; Herbert & Kübler, 2011). As this view works with alternatives it also predicts that drawing the inference might depend on the salience and accommodability of the competitor with "the". In the example in (1) this alternative is very salient and easy to accommodate as it is common knowledge that people have one (biological) father. However, in other examples where this is not the case the inference is not as strong. (2), for example, does not seem to have any implications as to how many pathologically noisy neighbours the speaker has, at least without any further knowledge about the likelihood about it being one or more.

(2) A pathologically noisy neighbour of mine broke into the attic. (Heim, 1991)

According to the second view (theory B), definites and

indefinites should have comparable processing costs, with minimal or no differences in processing patterns as both introduce their own restrictions that are part of their lexically endoed meaning. As a result, the salience of the definite as an alternative should not play a role in deriving any anti-uniqueness inferences.

Albeit the fact that inferences resulting from *Maximize Presupposition* and the principle itself have received a lot of attention in the theoretical literature, there is almost no experimental research on the topic, with few exceptions (Amsili, 2015; Eckardt, 2014; Bade, 2016). There is, however, some experimental research on definiteness versus indefiniteness discussed in the next section.

Previous experimental work

There have been previous experimental investigations of the difference between indefinite and definite determiners. One line of research which is of importance for the present discussion is the study of so called "bridging inferences" (Haviland & Clark, 1974). They describes the inference of unique entities in certain situations where such a referent is stereo-typically unique, e.g. "the bus driver" in a situation where someone is entering the bus. These inferences are associated with different processing costs depending on how easily the referents are accessible (Haviland & Clark, 1974). (Burkhardt, 2006) in an ERP study finds similar effects for both definites and indefinites if they follow contexts that do not explicitly mention the referent.

Many studies on the definite have found additional processing costs if the context does not furnish an appropriate (unique) referent (Tiemann et al., 2011; Kirsten et al., 2014; Tiemann, 2014). Additional processing costs have also been found for the indefinite, which has been attributed to it introducing a new discourse referent (Kirsten et al., 2014; Schumacher, 2009).

A set of studies which is of special interest for our discussion tested the use of definites versus indefinites for stereo-typically unique items in context in which they are typically unique (e.g. stove in a kitchen) or not (e.g. stove in an appliance store) (Clifton, 2013). Clifton found that interactions between contexts and determiner in reading times only emerged if the experiment involved a secondary arithmetic task, which is argued to lead to deeper processing resulting in participants forming a more complete situation model. This model required the accommodation of a unique referent in the mismatching condition of the definite, and the introduction of a new referent in the mismatching condition of the indefinite.

Experiment

The aim of the experiment was to test whether the potential theoretical distinction between (anti-uniqueness-) anti-presuppositions on the one hand, and (uniqueness-)

presuppositions on the other hand is supported by processing measures. Additionally, we wanted to test the prediction of theory A that lexical alternatives, as well as the epistemic state of the speaker with regard to the truth of the inference, play a role in the derivation of anti-uniqueness inferences.

Design and Material

For that purpose, we created sentence materials that either contained the definite or indefinite determiner (first factor DETERMINER with two levels, +/-DEF) and combined them with either stereo-typically unique or non-unique nouns (second factor STEREO-TYPICALITY with levels +/-TYPICALLY UNIQUE, see an example in all 4 sentence conditions below.

(3)   Someone spilled orange juice on. . .
   a.   a television   +TYPICALLY UNIQUE, -DEF
   b.   the television +TYPICALLY UNIQUE, +DEF
   c.   a pillow   -TYPICALLY UNIQUE, -DEF
   d.   the pillow   -TYPICALLY UNIQUE, +DEF
   . . . in the living room.

A given sentence was paired with two pictures providing settings where the referenced object was either typically unique or not, i.e. the sentences in (3-a) and (3-b) were paired with the two pictures in figures 3 and 4, and the sentences in (3-c) and (3-d) were paired with the two pictures in figures 1 and 2. As part of our task (described in more detail below) participants had to decide which of the two pictures the sentence was about, with the (anti-)uniqueness information conveyed by the respective determiners being key for the picture choice.

Figure 1: -TYPICALLY UNIQUE (*A/The pillow), target for unique Def (pic 1)*

Figure 2: -TYPICALLY UNIQUE (*A/The pillow), target for non-unique Indef (pic 2)*

Figure 3: +TYPICALLY UNIQUE (*A/The TV), target for unique Def (pic 1)*

Figure 4: +TYPICALLY UNIQUE (*A/The TV), target for non-unique Indef (pic 2)*

We created 24 sets of experimental stimuli, for counterbalanced presentation to participants of 6 items per experimental conditions. In addition, there were 24 filler items with the temporal connectives "before" and "after" (e.g. "Peter spilled coffee after doing the dishes") and 12 fillers with the quantifier "several" (e.g. "Peter spilled coffee on several chairs in the dining room").

Norming study

To determine what objects people considered to be stereo-typically unique in a given scenario, our first step was a norming study with 60 native speakers of English. They were asked to rate the typicality of uniqueness by being asked "How typical do you think it is that there is exactly one TV in a standard living room?". We tested 48 different objects in the norming study. For the 24 critical items used in the study we took the 24 objects with the highest average rating and paired them with objects that received a very low average rating.

Main experimental task

We tested 77 native speakers of American English recruited through the SONA system of the University of Pennsylvania. They received course credit for their participation. Participants engaged in a simple game. In the main comprehension part of the experiment, they heard recordings of descriptions (containing indefinite or definite articles) of spills that happened in different rooms. They then had to try to best match the description they heard by dragging a splash representing a spilled beverage to one of two room settings, which differed in whether they contained one or two of the mentioned type of object (e.g., television or pillow). After going through a practice phase with 4 trials they went on to the 24 experimental trials (plus fillers). See Figure 5 for a screen shot of a sample trial (in a control condition, which sometimes depicted two different types of room settings).

Figure 5: Screen shot of a comprehension trial.

Picture choices, response times and eye-movements were tracked during the comprehension phase. Partici-pants also went through a brief constrained production phase (9 trials), where they had to drag words to construct a sentence of the form above to describe a provided picture. This was intended to engage them with the task more by seeing both sides of the game, and to highlight the alternative choices between determiners in relation to the number of relevant objects in the picture. The determiner choices they were given were "A", "The" and "Several". The pictures were created so that each of these determiner would be chosen 3 times (given the theoretical assumptions, e.g. with the definite used for unique items and the indefinite for non-unique ones). There were two practice trials for the production task. A screen shot of a production trial is given in Figure 6 below. Production and comprehension block order was counterbalanced across participants.

Figure 6: Screen shot of a production trial.

Predictions

Given the theoretical assumptions spelled out above we coded the pictures with two objects matching the description in the relevant noun phrase to be the target picture for the indefinite (pic 2), see again Figure 2 and 4 above. For the definite, we assumed the picture depicting exactly one object of the kind referred to in the sentence to be the target (pic 1), see Figure 1 and 3. Drawing the anti-uniqueness inference which is the basis for the target choice of the indefinite was predicted to be influenced by whether the referenced object is typically unique in the given setting by theory A. This theory predicts target choices to be higher for the indefinite in the non-typically unique condition than in the typically unique condition, whereas the definite should not be affected by this factor. As a result, we expected there to be an interaction between DETERMINER and STEREO-TYPICALITY for picture choices. Moreover, based on theory A, anti-uniqueness anti-presuppositions are expected (or at least likely) to show a different pattern in eye-movements than the uniqueness presuppositions evoked by the definite. Again, since drawing the infer-

ence for the indefinite should be facilitated by the object being typically unique, we predict an interaction between DET and STEREO-TYPICALITY for measures reflecting looks to target, as well as a main effect of both factors. No such differences or interactions are predicted by theory B, according to which determiners should be more or less equally affected by stereo-typicality. According to theory A, but not B, the data should also be influenced depending on whether there was exposure to the alternative. Thus order effects of the tasks should be relevant for the processing associated with the indefinite following theory A but not B.
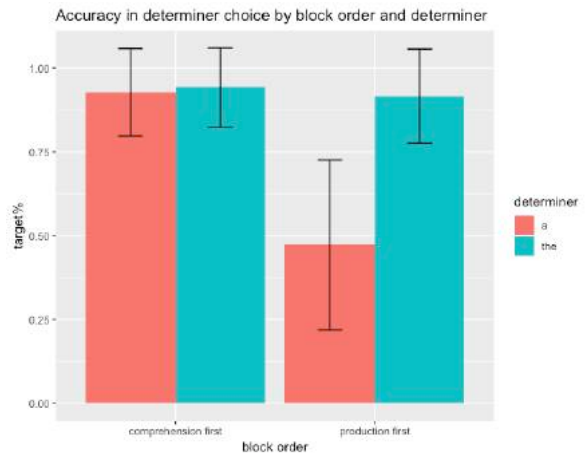
Analysis

Responses were analyzed using logistic mixed effect models as implemented in the glmer function in R (Bates, 2005). Reaction times and fixations on target were log transformed for analysis and analyzed using linear mixed effect models and the lmer function in R (R Core Team, 2017). Participant, condition and item were treated as random factors in both model types, and random effect slopes were included as model convergence allowed.

Results

Responses The anti-uniqueness inference of indefinites is less readily available, and less robust than the uniqueness inference of definites in our data, in line with previous results. This is witnessed by (i) low production 'accuracy' for indefinites when the production block came first, see Figure 7: in the condition where the displayed picture included multiple objects matching the noun phrase description, participants only chose an indefinite about half of the time in their sentences. There is a significant main effect of block order (p<.01) with more target choices for production when it followed the comprehension block and also a significant interaction between DETERMINER and BLOCK ORDER (p<.01) with accuracy of choice being less affected by block order if the target determiner was definite than when it was indefinite.

The weak status of the indefinite is also reflected in (ii) target choice rates in the comprehension task. Overall, there was a main effect of BLOCK ORDER, present at all levels, with overall more target choices when production came first (and comprehension second). Crucially for the present point, there is a bigger susceptibility of the indefinite to plausibility effects biasing against multiple instances of stereo-typically unique objects, especially in the initial comprehension block. This is reflected in an interaction between typical uniqueness and determiner in the 'comprehension first' block (p< .01), driven by more frequent target choices for Def in +typically unique condition (parallel simple effect also present for 'production first'), see Figure 8.

**Figure 7:** Target determiner choices for production task by block order
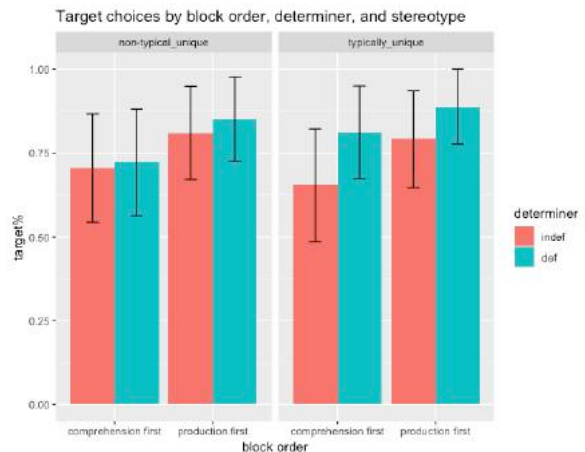
Figure 8: Target selections for comprehension task by block order and stereo-typical uniqueness

Eye movements For the analysis of the eye movements we considered time windows of 200ms between 100ms and 2300ms after noun phrase onset (which is roughly 4 seconds into the trial and the point where, on average, participants picked up the splash to place it on the picture). We looked at the fixations on the respective target for definite (pic 1) and indefinite (pic 2) relative to its competitor. The main dependent measure that we report on below is Target Advantage score, calculated by subtracting the proportion of fixations to the competitor from the proportion of fixations to the target.

In the first time window (100-300ms after noun phrase onset) we find a main effect of definiteness, with a higher target advantage for the indefinite. This effect is likely due to the target for the indefinite (pic 2) being the overall more unusual picture in the typically unique condition (e.g. with 2 TVs). This is also in line with the observa-

tion that in the typically unique cases, there is a significantly higher target advantage for the indefinite ($p<.01$) even before the noun phrase onset, see both graphs in Figure 9 and 10.
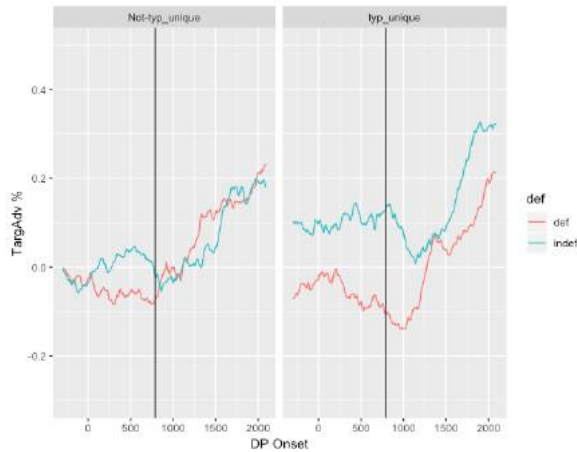

Figure 9: Target advantage by determiner and stereo-typicality for all trials (Black line indicates mean noun phrase-offset/PP-onset.)
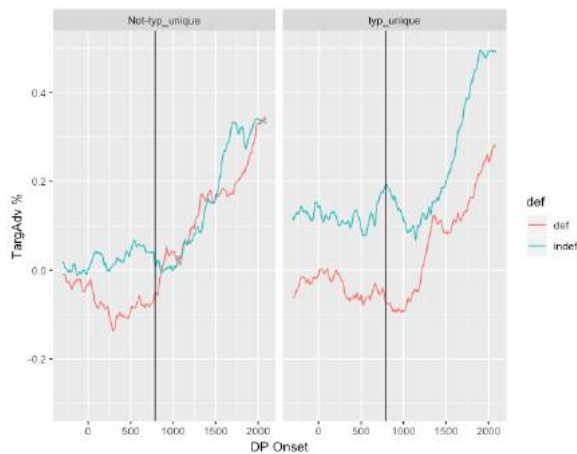
Figure 10: Target advantage by determiner and stereo-typicality for accurate trials (Black line indicates mean noun phrase-offset/PP-onset.)

Given this indication that pic 2, i.e. the target for the indefinite, has an advantage due to inherent properties of the picture, we also looked at the influence of both factors on the looks to pic 1 and pic 2, respectively, see figure 11. We find that in the early time window there is an interaction for looks to pic 1 between both factors: there are more looks to pic 1 for the definite if the item is typically unique and fewer looks to pic 1 for the indefinite if the target is non-typically unique. There are, however no main effects of the two factors. This together suggests

that in the first time window the looks to the two pictures are guided by both determiner and stereo-typicality, and not oddness of the pic 2 picture alone.
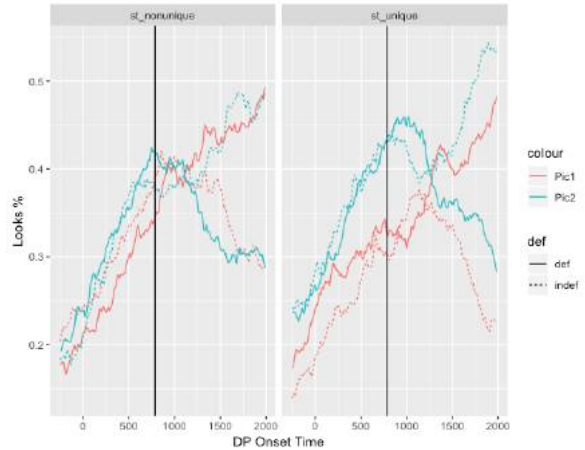
Figure 11: Looks to pic 1 and pic 2 by determiner and stereo-typical uniqueness, all trials)

In the time windows 300-500 and 500-700ms after noun phrase onset, there is a main effect of DEF ($p<.05$), but no interaction with STEREO-TYPICALITY. The effect is significant for the typically unique cases in both time windows ($p<.01$). But it is also marginally significant for the non-typically unique cases in time window 300-500ms ($p<.06$) and significant in the time window 500-700ms ($p<.05$). The interaction between both factors on looks to pic 1 is still marginal significant ($p<.06$), and significant when only looking at data from trials resulting in target choices, see figure 12.
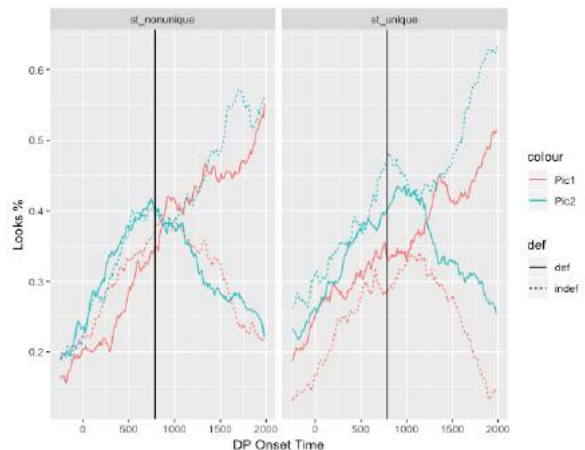
Figure 12: Looks to pic 1 and pic 2 by determiner and stereo-typical uniqueness, accurate trials)

In the time window 700-900 ms after noun phrase onset there is a significant interaction between STEREO-

TYPICALITY and DEFINITENESS in the predicted direction for Target Advantage: stereo-typicality has an effect on indefinites, but not on definites; as shown by the significant simple effect for the former ($p<.01$) and lack thereof for the latter. There is also a significant interaction between both factors in the time window 900-1100ms after noun phrase onset ($p<.01$). Looking at the simple effects shows that the interaction is due to stereo-typicality having a marginal effect on the definite ($p<.07$), but not the indefinite at this point, opposite to our predictions.

To better see potential differences from the properties of the respective target pictures for definites and indefinites, we also investigated looks to pic 1 and pic 2 separately for these time windows. There only are main effects of stereo-typicality for both pictures ($p<.05$ for pic 2, $p<.01$ for pic 1), suggesting that the interactions above are due to the pictures themselves attracting more attention depending on whether the item is typically unique.

No effects show up in time windows between 1100 and 1900 ms for target advantage. However, when considering looks to pic 1 and pic 2 we see a main effect of determiner for both pictures in all time windows between 1100 and 1900 ms after noun phrase onset ($p<.01$) for all of them).

There were no interactions between definite and time windows, and no interactions between block order and definite in all time windows.

Discussion

In combination, these results support the idea that, contrary to a view that sees anti-uniqueness as being based on a lexically encoded presupposition on par with the uniqueness presupposition of definites (theory B), the anti-uniqueness inference for indefinites is pragmatically derived from reasoning over the alternative expression (the definite) and its presupposition (uniqueness) (theory A). This is because, as predicted by theory A, the inference is not present as robustly from the start but is boosted by exposure to the alternatives and how they could matter: when the production follows comprehension, choice of the indefinite in the sentence construction phase increases for pictures with two objects of the relevant sort; and when the comprehension block follows the production block, choices of the picture with two of the relevant items increases for indefinite sentences.

With regards to the eye movement data, we find some effects that are at least in part complicated by the properties of the different target pictures. For the most part, except for very early time windows, the differences between definite and indefinite disappear when looking at only not-stereo-typically unique cases. This becomes es-

pecially apparent when looking at trials resulting in target choices, where there is no difference in time course between determiners, at least in the present task. We'd note, though, that the fixation shifts in our data are overall relatively late, which is likely at least partly due to the nature of the task requiring clicking and dragging splash-pictures around. Be this as it may, our data provides no evidence that the additional reasoning involved in deriving the inference by reasoning over the lexical presupposition of the alternative requires extra processing time if the conditions for this contextual reasoning over alternatives are met. This finding will need to be considered in relation to the complex empirical situation in the implicature processing literature, with some studies finding delays for implicature computation, and others not. The present results seem to constitute a case of a different type of a pragmatically derived inference that seemingly does not lead to any delays involved in accessing it. But further work is needed to try to establish this in task variations allowing for an earlier emergence of effects. Finally, a methodological lesson worth noting is that studying anti-uniqueness effects of indefinites experimentally requires careful fine-tuning of the task, as they can be evasive and are highly sensitive to various contextual factors.

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