Homogeneity as presuppositional exhaustification*

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Abstract The goal of this paper is to reconcile two observations regarding homogeneity and non-maximality. First, homogeneity is sensitive to constraints on presupposition accommodation, both in the positive case and under negation (Wehbe, 2022). Second, there are asymmetries between positive and negative sentences with definite plurals (Bar-Lev, 2021). We argue that taken together, these two observations support an account of homogeneity in terms of presuppositional exhaustification.

1 Introduction

Definite plurals give rise to a truth-value gap known as *homogeneity*. Consider the example in (1): neither (1-a) nor (1-b) are true in a scenario where Mary read only some of the books. The source and pragmatic status of this truth-value gap has received a lot of attention. Early accounts of homogeneity argued that it is a presupposition (Löbner, 2000; Schwarzschild, 1993 a.o.), but several recent accounts have challenged this initial assumption (Križ, 2015; Križ and Spector, 2021; Bar-Lev, 2021).

(1) a. Mary read the books is **true iff** Mary read **all** the books.
b. Mary didn't read the books is **true iff** Mary read **none** of the books.
c. **Neither is true** iff Mary read only some of the books.

Homogeneity has been argued to come hand-in-hand with non-maximality or exception tolerance, first discussed by Brisson (1998). Consider the example in (2), adapted from Bar-Lev (2021). Here, given a context where what's relevant is whether enough kids were laughing to consider the show a success, (2-b) is judged to be true even if a small portion of the kids weren't laughing. Križ (2015) argues that homogeneity and non-maximality are two sides of the same coin, and indeed other phenomena which give rise to homogeneity effects, such as habituals (Agha, 2021) and conditionals (von Fintel, 1994) also exhibit non-maximality. We therefore take it as a desideratum of a successful account of homogeneity to also account for non-maximality.

(2) Context: B knew that A was planning a comedy show for kids at a birthday party the day before and was worried about whether it's going to go well.
a. B asks A: Was the show a success?

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b. A responds: The kids were laughing.

In this paper, we argue for an account of homogeneity and non-maximality in terms of presuppositional exhaustification. Our account builds on Bar-Lev's implicature account but assumes that implicatures are due to the application of a presuppositional exhaustification operator, *pex* (Bassi et al., 2021; Del Pinal et al., 2024) (cf. Paillé, 2022).

We show that no existing account of homogeneity and non-maximality is able to reconcile the following two observations: (1) homogeneity, both in positive and in negative sentences, is sensitive to constraints on presupposition accommodation (Wehbe, 2022) and (2) empirical evidence suggests (although not completely univocally) that there are asymmetries between positive and negative sentences with definite plurals, for example non-maximal readings are harder to access under negation (cf. Bar-Lev, 2021, but see the discussion below).

We suggest that an account based on *pex* naturally predicts both (1) and (2). Paillé (2022) argues for a *pex*-based account of homogeneity in definite plurals based on different considerations, but he predicts symmetry in non-maximality (cf. also Paillé, 2023), thus not reconciling (1) and (2). Here, we provide a novel account of this asymmetry in terms of presupposition accommodation, thus accounting for the fact that non-maximality is available but more difficult in negative sentences beyond *pex*, without resorting to any additional mechanisms.

2 Bar-Lev (2021) and the asymmetries between positive and negative sentences

Bar-Lev (2021) proposes that definite plurals have an existential meaning. In negative sentences, this existential gets negated and the correct meaning is derived semantically. In positive cases, the existential gets strengthened via an implicature: in a procedure akin to Bar-Lev and Fox's (2017, 2020) account of Free Choice inferences, the existential gets strengthened to a universal via Innocent Inclusion of sub-domain alternatives. In appropriate cases, some of the sub-domain alternatives can be pruned, which results in non-maximal readings. This mechanism is not available to derive non-maximality in negative sentences, as there sub-domain alternatives are weaker than the prejacent. For these cases, Bar-Lev proposes a different, more costly mechanism to derive non-maximal readings. This makes for the feature that has sparked interest for Bar-Lev's account (see, e.g., Chierchia, 2022): it predicts positive and negative sentences to behave asymmetrically.

Bar-Lev argues that this prediction captures at least two empirical patterns. Firstly, controlling for context, non-maximal readings are more easily available in positive cases than under negation. For example, in the context in (3), (3-a) allows for a non-maximal reading where it suffices that every kid took at least 2 vitamins. On the other hand, with the negative quantifier in (3-b) the analogous non-maximal reading (*no kid took at least 2 vitamins*) is not available (examples from Bar-Lev, 2021).

(3) Context: the kids are required to take at least 2 of the 4 vitamins I gave each of them.
  a. All of the kids took their vitamins. = *Every kid took at least 2 vitamins.*
  b. None of the kids took their vitamins. = *No kid took any vitamin (i.e., not even one vitamin).*

This is partly confirmed experimentally by recent work by Augurzky *et al.*, who compared positive sentences like *Every boy opened his presents* to negative sentences like *No boy opened his presents* across different types of contexts. In contexts not favouring non-maximality, exceptions were taken by participants to make false both positive and negative sentences. However, in contexts favouring non-maximality, positive sentences, but not negative sentences were judged true in the presence of exceptions. The results were not as clear with other quantifiers such as *not every*, which behaved more like *every* than like *no*. In fact, the empirical landscape has yet to be made completely clear concerning the asymmetry in non-maximality. It is not the aim of this paper to argue that there is in fact an asymmetry in non-maximality; rather, that if there is such an asymmetry, *pex* (and its accommodation) provide a suitable platform to understand it.

Secondly, experimental evidence by Tieu *et al.* (2019) shows that while some children accept sentences like 'the hearts are red' as true in a situation where some but not all of the hearts are red (Karmiloff-Smith 1981; Caponigro et al. 2012), no children accept sentences like 'the hearts aren't red' as true in such a situation. This, Bar-Lev argues, is explained if we assume that children are not computing the implicature in the positive case.

3 The non-at-issueness of homogeneity

Wehbe (2022) uses a constraint on presupposition accommodation to argue that homogeneity is in fact a presupposition. In particular, homogeneity has been argued to differ from standard presuppositions due to its apparently distinct projection patterns (Spector, 2013; Križ, 2015). For example, while presuppositions project from the antecedents of conditionals (4-b), homogeneity does not project from this same environment (4-a).

(4) a. If Mary read the books, she passed the exam.
$\not\rightarrow$ Mary read all or none of the books.
b. If it is Mary who read the books, she passed the exam.
$\rightarrow$ Someone read the books.

One confound in these diagnostics is the availability of local accommodation. For example, given (4-a), it is possible that homogeneity is in fact a presupposition but that it is locally accommodated in the antecedent of the conditional, thus explaining the lack of projection. Of course one still has to explain the difference between (4-a) and (4-b), but this confounds calls for a diagnostic that does not rely on projection. Doron and Wehbe (2022) argue for such a diagnostic based on a constraint on accommodation first proposed by Orin Percus and Irene Heim in lecture notes.

Doron and Wehbe argue that conditions on assertability offer a way to detect the division of labor between presupposition and assertion. In particular, assertions must not be trivial (Stalnaker, 1974), and given that anti-triviality is a constraint on assertions, it is evaluated with respect to the common ground after presupposition accommodation. We therefore end up with the principle in (5). Empirical evidence for this principle comes from contrasts such as in (6). After collapsing presupposition and assertion, (6-a) and (6-b) convey the same information, yet (6-a) is infelicitous. The second sentence in (6) presupposes that John has 10 children, but accommodating this presupposition gives rise to infelicity. This is because after accommodating the presupposition, the assertion becomes trivial, violating PAI.

(5) **Post-Accommodation Informativity (PAI):** A sentence S_p (presupposing p) can be uttered felicitously only if S_p is informative w.r.t the common ground after accommodating p.

(6) a. I knew that all of John's kids are adopted but today I discovered something amazing. # All 10 of John's kids are adopted!
  b. I knew that all of John's kids are adopted but today I discovered something amazing. John has 10 adopted kids!

We can therefore use PAI to test whether homogeneity is a presupposition without using projection. Consider the examples in (7). If homogeneity was part of the asserted meaning, as in Bar-Lev's account, there is no reason to expect any infelicity in (7-a) and (7-b). On the other hand, this infelicity is predicted by PAI assuming that homogeneity is a presupposition. In (7-a), given that it is common ground that Mary read at least some of the books, once we accommodate the homogeneity presupposition in (8), the second sentence becomes trivial. Similarly in (7-b), the second sentence is trivial once we accommodate homogeneity, given that it is known that Mary didn't read all of the books.

(7) a. I knew that Mary read at least some of the books, but today I learned something interesting. # She read the books.
  b. I knew that Mary didn't read all of the books, but today I learned something interesting. # She didn't read the books.

(8) **Homogeneity presupposition:** Mary read either none or all of the books.

Another example that illustrates the PAI data under negation is given in (9). Again, in (9-b), once you accommodate homogeneity, the second sentence becomes trivial, violating PAI.

(9) a. This library has books in Mandarin, English, and Spanish, but none of the books are in Vietnamese.
  b. # This library has books in in Mandarin, English, and Spanish, but the books aren't in Vietnamese. (Omri Amiraz, p.c.)

Homogeneity is thus sensitive to constraints on presupposition accommodation, and we will take this as evidence that homogeneity is a presupposition.

4 Applying *pex* to homogeneity

At this point, let us observe that accounts viewing homogeneity as arising from a lexical presupposition (Schwarzschild, 1993 a.o.) account well for the non-at-issueness of homogeneity laid out in section 3. However, since they are symmetric, these accounts are unable to account for the asymmetries between positive and negative sentences. Conversely, Bar-Lev captures this asymmetry, but the data in (7) poses a problem for his account. Given that exhaustification simply strengthens the asserted meaning, it is not clear why the second sentence in (7-a) is infelicitous, since its strengthening provides new information (i.e., that Mary read *all* of the books).

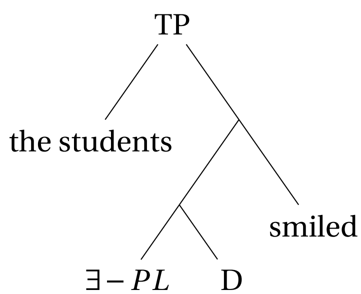
Even granting that there is some mechanism by which we get infelicity when the proposition is trivial before applying *Exh*, it is not clear why (7-b) is infelicitous, since in this case it is the literal meaning that provides new information (i.e., that Mary didn't read *any* book).

In what follows, we lay out our account, which combines ingredients from presuppositional theories and from Bar-Lev's implicature theory. Following Bar-Lev (2020), we propose that there is an existential pluralization operator which is always present when a distributive predicate is predicated of a plural individual. The lexical entry, slightly modified from Bar-Lev (2020), is given in (10): the operator takes a domain variable which must include all subparts of the definite plural, a 1-place predicate and an individual and returns true if the predicate is true of some atomic part of the individual.

(10) $[\![\exists-\text{PL}]\!] = \lambda D_{\langle e,t\rangle}\lambda P_{\langle e,t\rangle}\lambda x.\exists y \leq_{AT} x : y \in D \wedge P(y) = 1$

Consider an example derivation in (11). The basic truth conditions for *the students smiled* return true if at least one of the students smiled.

(11) a. The students smiled.

b. 

c. $[\![\text{TP}]\!] = 1$ iff $\exists y \leq_{AT} [\![\text{the students}]\!] : y \in D \wedge [\![\text{smiled}]\!](y)$
$= 1$ iff $\exists y \leq_{AT} [\![\text{the students}]\!] : [\![\text{smiled}]\!](y)$ (since D contains all atomic parts of $[\![\text{the students}]\!]$).

We propose that homogeneity arises from the presuppositional exhaustification operator *pex*, first proposed by Bassi et al. (2021) and Del Pinal et al. (2024):

(12) $\textbf{pex}(\varphi) :=$

a. **asserts:**
φ

b. **presupposes:**

(i) $\bigwedge \neg\psi$: ψ is innocently excludable

(ii) $\forall\alpha(\alpha$ is innocently includable $\wedge [\![\alpha]\!] \in R \rightarrow [\![\alpha]\!] = 1) \vee$
$\forall\alpha(\alpha$ is innocently includable $\wedge [\![\alpha]\!] \in R \rightarrow [\![\alpha]\!] = 0)$
where R = a contextually assigned 'relevance' predicate which satisfies the following conditions:

[(a)] the prejacent, φ, is relevant (i.e., $[\![\varphi]\!] \in R$), and
[(b)] any proposition that is contextually equivalent to the prejacent is also in R (i.e., if $[\![\varphi]\!] \cap c \equiv [\![\psi]\!] \cap c$, then $[\![\psi]\!] \in R$

Del Pinal *et al.* (2024)

Pex presupposes (i) the negation of all innocently excludable alternatives, as shown in (12-b).

For innocently includable alternatives, it **(ii)** presupposes that they are either all true and all false.

At this point, we can derive the universal meaning for (11-a). We assume that *pex* obligatorily applies at the highest node. In line with Bar-Lev (2021), we assume that the alternatives for (11-a) are the subdomain alternatives, which consist of replacing D in (11-b) with its subsets. As discussed by Bar-Lev (2021) and Chierchia (2013), in order to get the required strengthening, we have to assume that alternatives where the intersection with ⟦the students⟧ is empty are not considered. We therefore end up with the alternative set in (13) for (11-a).

(13) Alt (⟦the students smiled⟧)=
$\{\exists y \leq_{AT} [\![\text{the students}]\!] : y \in D' \wedge [\![\text{smiled}]\!](y) \mid D' \subseteq D \wedge D' \cap [\![\text{the students}]\!] \neq \emptyset\}$

Given this set of alternatives applying *pex*, as defined in (12), gives us the result in (14). The subdomain alternatives are not innocently excludable, but they are innocently includable, which gives rise the homogeneity presupposition in (14-b). In short, we predict that *the students smiled* presupposes that either all or none of the student smiled and is true if all of them smiled. This gives us the universal meaning for (11-a), after collapsing presupposition and assertion. This can be seen clearly by applying the A operator to the lexical entry in (14), as shown in (15).

(14) **pex**(⟦The students smiled⟧)

a. **asserts:**
$\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D \wedge [\![\text{smiled}]\!](x)$

b. **presupposes** (as far as sub-domain alternatives are concerned, here and henceforth):
$\big[\forall \alpha.\alpha \in R \wedge \alpha \in \{\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D' \wedge [\![\text{smiled}]\!](x) | D' \subseteq D \wedge D' \cap [\![\text{the students}]\!] \neq \emptyset\} \rightarrow \alpha = 1 \vee$
$\big[\forall \alpha.\alpha \in R \wedge \alpha \in \{\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D' \wedge [\![\text{smiled}]\!](x) | D' \subseteq D \wedge D' \cap [\![\text{the students}]\!] \neq \emptyset\} \rightarrow \alpha = 0\big]$
$\models$
$\forall x : x \leq_{AT} [\![\text{the students}]\!] \rightarrow [\![\text{smiled}]\!](x) \vee \neg \exists x : x \leq_{AT} [\![\text{the students}]\!] \wedge [\![\text{smiled}]\!](x)$
(modulo pruning)

(15) A(⟦pex The students smiled⟧)= 1 iff $\forall x : x \leq_{AT} [\![\text{the students}]\!] \rightarrow [\![\text{smiled}]\!](x)$

This straightforwardly captures the PAI data from Wehbe (2022) in the positive case: given a context where it is common ground that some of the students smiled, accommodating the homogeneity presupposition makes the assertion trivial, thus violating PAI.

Finally, we are able to get non-maximality in the same way as Bar-Lev (2020), by pruning alternatives. Crucially here, pruning makes the homogeneity presupposition weaker which results in non-maximal truth-conditions once this presupposition is accommodated. To see this with a toy example, consider the model with only three students in (16) and suppose that we prune all alternatives except for the ones where the domain includes exactly 2 of the students (16-b). The weakened homogeneity presupposition would be the one given in (16-c). After collapsing presupposition and assertion, we predict that given the R in (16-b), *the students smiled* is true if at least 2 out of the three students smiled. We therefore derive non-maximality within the *pex* account in a parallel way to what Bar-Lev does with *exh*.

(16) a. $[\![\text{the students}]\!] = \text{a} \oplus \text{b} \oplus \text{c}$

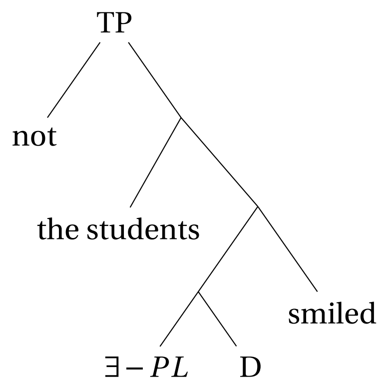
b. $\text{R}= \{\exists x \leq_{AT} y : [\![\text{smiled}]\!](x) | y \in \{ \text{a}\oplus \text{b}, \text{b} \oplus \text{c}, \text{a}\oplus \text{c}\}\}$

c. $[\exists x \leq_{AT} a\oplus b : [\![\text{smiled}]\!](x) \wedge \exists x \leq_{AT} b\oplus c : [\![\text{smiled}]\!](x) \wedge \exists x \leq_{AT} a\oplus c : [\![\text{smiled}]\!](x)] \vee$
$[\neg\exists x \leq_{AT} a\oplus b : [\![\text{smiled}]\!](x) \wedge \neg\exists x \leq_{AT} b\oplus c : [\![\text{smiled}]\!](x) \wedge \neg\exists x \leq_{AT} a\oplus c : [\![\text{smiled}]\!](x)]$

d. **Final TC after accommodation**: 1 iff at least two out of the three students smiled.

Turning to negative sentences, Bar-Lev assumes that no exhaustification applies in this case and the negated existential meaning delivers the correct truth conditions, as shown in (17). In this case, even if *exh* were to apply above negation, its contribution would be trivial since the subdomain alternatives are weaker than the prejacent.

(17) a. The students didn't smile.

b. 

c. $[\![\text{TP}]\!] = 1$ iff $\neg\exists y \leq_{AT} [\![\text{the students}]\!] : y \in D \wedge [\![\text{smiled}]\!](y)$

While the correct truth-conditions are predicted if we assume that *pex* doesn't apply here, the data with PAI would remain unexplained. Consider (18): if the LF in (17-b) were the correct one for (17), there would be no presupposition and therefore no reason to expect a PAI effect.

(18) I knew that not all of the students smiled, but today I learned something interesting. # The students didn't smile.

We will argue that (18) illustrates a case where, somewhat surprisingly, the contribution of *pex* can be detected even though it doesn't affect the overall truth-conditions after collapsing presupposition and assertion. This is a conclusion also argued for by Wehbe and Doron (2024) looking at implicatures with *or* under negation.

We assume, following Magri (2009), that exhaustification applies not only at the highest node, but also, obligatorily, at every scope site below it. Therefore pex has to be inserted below negation, giving rise to the same homogeneity presupposition we derive for the positive case in (14). This presupposition will project from the scope of negation, giving rise to the truth-conditions in (19).

(19) $\neg\textbf{pex}[\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D \wedge [\![\text{smiled}]\!](x)]$

a. **asserts:**
$\neg\exists x \leq [\![\text{the students}]\!] : [\![\text{smiled}]\!](x)$

b. **presupposes:**
$\forall x : x \leq_{AT} [\![\text{the students}]\!] \rightarrow [\![\text{smiled}]\!](x) \vee \neg\exists x : x \leq_{AT} [\![\text{the students}]\!] \wedge [\![\text{smiled}]\!](x)$
(modulo pruning)

This gives correct truth conditions for 'The students didn't smile'. However, given the assumption that *pex* applies at every scope site, another *pex* has to apply above negation. In order to determine what the contribution of this higher *pex* will be, we have to consider how *pex* deals with cases when its prejacent and alternatives have presuppositions. We assume that the innocent inclusion presupposition, restated in (20), targets truth and falsity such that in both disjuncts the presupposition of α has to be satisfied. Additionally, the presupposition of the prejacent projects from the scope of *pex*.

(20) $\forall\alpha(\alpha \text{ is innocently includable } \wedge [\![\alpha]\!] \in R \rightarrow [\![\alpha]\!] = 1)\vee$
$\forall\alpha(\alpha \text{ is innocently includable } \wedge [\![\alpha]\!] \in R \rightarrow [\![\alpha]\!] = 0)$

We can now compute our final truth-conditions. Romoli (2012) shows that there can be no alternatives in which negation is deleted. Additionally, we assume that the lower *pex* cannot be deleted in the alternatives. The only alternatives for the higher *pex* are therefore the subdomain alternatives given in (21-b). Given these assumptions, the higher *pex* does not affect the truth-conditions and innocent inclusion again simply gives a homogeneity presupposition, as shown in (21-d).

(21) a. $[\![\text{The students didn't smile}]\!] = \mathbf{pex}_1 \neg \mathbf{pex}_2 [\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D \wedge [\![\text{smiled}]\!](x)]$
b. $\text{Alt}_{\mathbf{pex}_1} = \{\neg \mathbf{pex}_2 [\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D' \wedge [\![\text{smiled}]\!](x) | D' \subseteq D \wedge D' \cap [\![\text{the students}]\!] \neq \emptyset\}$
c. **Assertion:** $\neg\exists x \leq [\![\text{the students}]\!] : [\![\text{smiled}]\!](x)$
d. **Presupposition:** $\forall D' \subset D : D' \cap [\![\text{the students}]\!] \neq \emptyset \ \rightarrow (\neg\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D' \wedge [\![\text{smiled}]\!](x) \vee \forall x \leq_{AT} [\![\text{the students}]\!] : x \in D' \rightarrow [\![\text{smiled}]\!](x))$
$\Leftrightarrow \forall x : x \leq_{AT} [\![\text{the students}]\!] \rightarrow [\![\text{smiled}]\!](x) \vee \neg\exists x : x \leq_{AT} [\![\text{the students}]\!] \wedge [\![\text{smiled}]\!](x)$

As shown in (22), the truth-conditions after accommodation are identical to those in (17-c). Nevertheless, since there is a homogeneity presupposition now, we predict the PAI effect in (18): after accommodating homogeneity, the second sentence in (18) becomes trivial, violating PAI. We have therefore accounted for the symmetric PAI effects while maintaining an asymmetric account of homogeneity in terms of *pex*.

(22) $\text{A}([\![\text{(21-a)}]\!]) = \neg\exists x \leq [\![\text{the students}]\!] : [\![\text{smiled}]\!](x)$

As for non-maximality, at this point we predict that there is no non-maximality under negation. Since the asserted component in (19-a) and (21-d) entails homogeneity, weakening the homogeneity presupposition in (19-b) by pruning does not affect the overall truth-conditions after accommodation. In the next section, we argue that non-maximality is in fact possible under negation, but only if the homogeneity presupposition is accommodated under negation. This will account for the asymmetry in non-maximality between positive and negative environments: under negation, non-maximality requires local accommodation, which is known to be a costly mechanism.

5 Non-maximality in negative sentences

While non-maximality readings are more difficult to obtain in downward-entailing environments, they are still available. This has been confirmed by experimental evidence, showing that non-maximal readings with under universal quantifier (*every*) are easier to obtain than under a negated existential quantifier (*no*) (Augurzky *et al.*, 2023). We therefore want to predict that non-maximal readings are, though **(i)** harder, **(ii)** not impossible to obtain under in downward-entailing environments. In the following, we show that both **(i)** and **(ii)** can be explained within a *pex*-based account. In a nutshell, we will show that non-maximality under negation can be obtained if homogeneity is locally accommodated under negation, and then a second *pex* applies globally, as in (23). It has been argued that local accommodation is more difficult to obtain than global accommodation (Heim, 1983; Chemla and Bott, 2013). The asymmetry in non-maximality between positive and negative sentences can therefore be attributed under this account to the fact that the in the latter, non-maximality requires local accommodation.

(23) $[\![\text{The students didn't smile.}]\!] = \textbf{pex}[\neg A[\textbf{pex}[\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D \wedge [\![\text{smiled}]\!](x)]]]$

As argued in the previous section, *pex* is obligatory at every scope site. This will ensure that the parse in (23) is the only available one when there is local accommodation below negation. The prejacent of the higher *pex* will have the *not-all* truth-conditions brought about by accommodation. These will be strengthened to *not-some* via innocent inclusion of subdomain alternatives.

To see this step by step, consider first truth-conditions for the prejacent of the higher *pex* in (24) (which are the negation of (15)).

(24) $\neg A[\textbf{pex}[\exists x.\mathit{stud}(x) \wedge \mathit{smiled}(x)]]]$

a. **asserts:**
$\neg\forall x \leq_{AT} [\![\text{the students}]\!] : x \in D \rightarrow [\![\text{smiled}]\!](x)$

Now we want to compute assertion and presupposition of the parse with the global *pex*. To do this, we first need to examine what the alternatives to (24) are. As shown by Romoli (2012), considering alternatives in which negation is deleted leads to problems. We thus assume that the only alternatives for the higher *pex* are again the subdomain alternatives, with the effect that it again gives rise to the homogeneity presupposition in (25-b).

(25) $[\![\text{The students didn't smile.}]\!] = \textbf{pex}[\neg A[\textbf{pex}[\exists x.\mathit{stud}(x) \wedge \mathit{smiled}(x)]]]$

a. **asserts:**
$\neg\forall x \leq_{AT} [\![\text{the students}]\!] : x \in D \rightarrow [\![\text{smiled}]\!](x)$ *modulo pruning*

b. **presupposes:**
$\big[\forall \alpha.\alpha \in R \wedge \alpha \in \{\neg\forall x \leq_{AT} [\![\text{the students}]\!] : x \in D' \rightarrow [\![\text{smiled}]\!](x) : D' \subseteq D\} \rightarrow \alpha = 1 \vee$
$\forall \alpha.\alpha \in R \wedge \alpha \in \{\neg\forall x \leq_{AT} [\![\text{the students}]\!] : x \in D' \rightarrow [\![\text{smiled}]\!](x) : D' \subseteq D\} \rightarrow \alpha = 0\big]$
$\models$
$\neg\exists x \leq_{AT} [\![\text{the students}]\!] : x \in D \wedge [\![\text{smiled}]\!](x) \vee$
$\forall x \leq_{AT} [\![\text{the students}]\!] : x \in D \rightarrow [\![\text{smiled}]\!](x)$ *modulo pruning*

In case there is no pruning, the truth-conditions after accommodation will be identical to (22). However, crucially, since the asserted component does not entail homogeneity, pruning is now able to weaken the meaning and therefore give rise to non-maximality. For simplicity, we consider here pruning only in the alternatives for the higher *pex* and show that we can get the desired non-maximal readings.

Consider the toy example in (26) with 3 students, and let's assume that only c smiled. We want to predict a non-maximal reading where *the students didn't smile* is true even though c did smile.

(26) a. $D = \{a, b, c\}$
b. $[\![\text{student}]\!] = \{a, b, c\}$
c. $[\![\text{smiled}]\!] = \{c\}$

Suppose we prune the alternative $D' = \{c\}$. Then, assuming a parse of "The students didn't smile" with accommodation (as in (23)), the homogeneity presupposition will be as in (27). Coupled with the *not-all* assertion, the truth-conditions after accommodation are as in (28): (28) is true as long as everyone but c didn't smile. This is exactly the non-maximal reading we want to predict.

(27) $\big[\forall\alpha.\alpha \in R \wedge \alpha \in \{\neg\forall x \leq_{AT} [\![\text{the students}]\!] : x \in D' \rightarrow [\![\text{smiled}]\!](x) : D' \neq \{c\} \wedge D' \subseteq D\} \rightarrow \alpha = 1 \vee$
$\forall\alpha.\alpha \in R \wedge \alpha \in \{\neg\forall x \leq_{AT} [\![\text{the students}]\!] : x \in D' \rightarrow [\![\text{smiled}]\!](x) : D' \neq \{c\} \wedge D' \subseteq D\} \rightarrow \alpha = 0\big]$

(28) $\neg\exists x \leq [\![\text{the students}]\!] : x \in D/\{c\} \wedge [\![\text{smiled}]\!](x)$

As a result, given our assumption that *pex* applies at every scope site, the asymmetry in non-maximality is straightforwardly predicted: non-maximality is harder under negation since it requires local accommodation of the homogeneity presupposition below negation [1].

6 Conclusion

We have argued that an account based on presuppositional exhaustification provides a promising avenue for accounting for two empirical observations which, taken together, challenge all existing accounts of homogeneity and non-maximality: (i) homogeneity is senstive to constraints on presupposition accommodation and (ii) non-maximal readings are more difficult to obtain in upward-entailing environments. Several details of the *pex*-based account remain to be worked out.

First, we only looked at cases where the definite plural was unembedded or embedded under negation. The predictions for how non-maximality arises when definite plurals are embedded in the scope of different quantifiers should be investigated in detail.

[1] Note that the experimental evidence in Augurzky *et al.* (2023) considers definite plurals under negative quantifiers and not simply under negation. For reasons of space, we do not include a derivation of non-maximality under *no*, but just like with negation, local accommodation in the scope of *no* will be needed to derive non-maximal readings.

Additionally, looking beyond definite plurals, we observe that other phenomena which have been argued to give rise to homogeneity are also sensitive to PAI in the same way as definite plurals. Consider the examples below with homogeneity in other domains. If our analysis in terms of *pex* can be extended to these cases of homogeneity in other domains, we predict the infelicity of the second sentences in (29): in all of these cases, accommodating homogeneity makes the asserted component trivial. We can therefore use this as a diagnostic of whether an observed truth-value gap is in fact due to homogeneity.

(29)
a. **Habituals** (Agha, 2021):
I already knew that Mary sometimes goes to the gym on Tuesdays, but today I learned something interesting. # Mary goes to the gym on Tuesdays.
b. **Generics** (Löbner, 2000):
I knew that lions sometimes hunt, but today I learned something interesting. # Lions hunt.
c. **Episodic universal bare plurals** (Condoravdi, 1996; Chierchia, 2022):
I already knew that some birds are migrating right now, but today I learned something interesting. # Birds are migrating right now.
d. **Predicate homogeneity** (Križ, 2015; Paillé, 2022):
I already knew that the wall was partly red, but today I learned something interesting. # The wall is red.
e. **Conditionals** (von Fintel, 1997):
I already knew that sometimes, if you hit the brakes, the car stops, but today I learned something interesting. # If you hit the brakes, the car stops.

It remains an open question whether there can be a unified analysis of all these homogeneity phenomena in terms of *pex*, but at first sight it seems promising that all of these cases show the same pattern with respect to PAI.

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