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# Homogeneity and the illocutionary force of rejection*

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**Abstract** Homogeneity inferences arise whenever an assertion implies a universal positive (*every/both*) and its denial implies a universal negative (*no/neither*). I present an account of homogeneity inferences based on two assumptions which together constrain the behavior of negation: rejection is non-classical, and vacuous models may be omitted (Neglect Zero). If both assumptions are enforced, the only definable negatives are universal (*no/neither*), predicting the homogeneity gap.

**Keywords:** homogeneity, speech acts, rejection, negation, definite plurals, conjunction

## 1 Particular negatives

In (1b), negation of the universal in (1a) implies the contradictory of an existential. The particular negative *not all* is not an available reading of (1b).

(1) a. He answered our questions. ⇒ All questions were answered.
b. He didn't answer our questions. ⇒ No question was answered.

Similarly, negation of conjunction (2b) implies negation of the conjuncts, rather than the particular negative (*not both*).

(2) a. The White House saw Delta and Omicron coming.
⇒ Both Delta and Omicron were expected.
b. The White House didn't see Delta and Omicron coming.[1]
⇒ Neither Delta nor Omicron was expected.

In homogeneity inferences, particular negative readings (*not all/not both*) seem to disappear. I will describe a semantic framework in which two independently plausible assumptions are jointly responsible for the gap:

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1 This example is a simplified variant of a headline in *The Guardian* from 18 December 2021.

(*i*) Rejection is failure of assertion.

(*ii*) Vacuous models may be disregarded in formula verification (Neglect Zero).

These assumptions may be understood as parameters that determine the logic of negation. In classical logic, (*i*) and (*ii*) are false: rejection is assertion of falsity, not merely failure to assert, and formulas can always be vacuously satisfied. However, if (*i*) rejection is non-assertion and (*ii*) formulas are not vacuously satisfied, particular negative operators are not definable. Flexibility in the interpretation of negation, which is indispensable to understand its use in natural language, may be achieved by constraining the illocutionary strength of rejection with (*i*) and (*ii*).

## 2 Homogeneity inferences

Homogeneity inferences are attested at least in English, Hungarian, Russian, Italian, Serbian, and Japanese (Szabolcsi & Haddican 2004). Homogeneity has been documented with definite plurals (Krifka 1996; Schwarzschild 1996), as in (1a/1b), conjunctions (Magri 2014; Szabolcsi & Haddican 2004; Muromatsu 2007), as in (2a/2b), and in various other environments (Higginbotham 1994; Löbner 2000; Cohen 2004; Križ 2016, 2019).

Križ (2019: 6) notes some apparent exceptions to homogeneity with collective predicates "that involve measuring a plurality in some way". Indeed, denial of (3a) does not show homogeneity effects. However, there are also collective predicates that do not show homogeneity effects and that do not measure a plurality, as (3b).

(3) a. The objections were numerous.

b. The ladies form a nice team.

Denial of (3b) does not imply the uninterpretable (4b). However, its assertion does not imply the equally uninterpretable (4a) either.

(4) a. # Every lady forms a nice team.

b. # No lady forms a nice team.

The collective predicates that fail to exhibit homogeneity are not just those that measure a plurality: they are the "purely collective" predicates (in the sense of Dowty 1987) characterized by the lack of an *all*-paraphrase (Champollion 2020). The correct generalization is, therefore, that homogeneity is a conditional: a sentence $\varphi$ supports homogeneity inferences if, and only if, an utterance of $\varphi$ implies a universal positive (*all/both*) only if an utterance of $\neg\varphi$ implies a universal negative (*no/neither*).

In addition, if $\varphi$ supports homogeneity, assertion and denial of $\varphi$ tend to be unacceptable in *mixed contexts* in which the particular negative reading is true.

*Context*. Some boys are performing *Hamlet* and some are not.

(5) a. ?? The boys are performing *Hamlet*. (from Križ 2016: 517–518)

b. ?? The boys aren't performing *Hamlet*.

According to Križ 2019, (5a) "gives rise to a feeling of hesitation" (p. 2), and (5b) is at best misleading and at worst false. A similar pattern is observed with conjunctions: in its mixed context, (6a) is false and (6b) is at least misleading if not false.

*Context*. Dean saw Robin but not Rachel.

(6) a. ?? Dean saw Robin and Rachel.

b. ?? Dean didn't see Robin and Rachel.

Nevertheless, classical interpretations of negation can be recovered. Szabolcsi & Haddican 2004 observed that the contradictory of conjunction can be expressed with the proper intonation: see (7a) below, with pitch accent on *and* for a more dramatic effect. Likewise for (7b), with pitch accent on *boys*.

(7) a. Dean didn't see Robin $[\text{and}]_F$ Rachel. He only saw Robin.

b. $[\text{The boys}]_F$ aren't performing *Hamlet*. Only few of them are.

Moreover, homogeneity effects do not occur, at least in English, if the generalization is overtly expressed by *all* or *both*.

(8) a. Bianca likes the students $\approx$ Bianca likes all the students

b. Bianca doesn't like the students $\not\approx$ Bianca doesn't like all the students

On my proposal, homogeneity effects are explained by the logic of assertion and rejection, which affects the interpretation of negation. One immediate advantage of this proposal is its consistency with widely-accepted semantic accounts of plurals, collective (but not "purely collective") and distributive predicates, bare plurals, and conjunctions: all of these expressions give rise to homogeneity inferences and all standard accounts of their semantics predict a universal reading in the positive. Below, I will compare my proposal with some alternative accounts of homogeneity, focusing in particular on Križ 2016, Križ & Spector 2021, and Bar-Lev 2021.

## 3 Assertion and rejection

The framework presented here follows Sbardolini 2023. The language $\mathscr{L}$ consists in countably many constants $C$, variables $V$, and $n$-ary predicates $A$, combined in the usual fashion.

$$t := c \in C \mid x \in V \qquad \varphi := A^n t_1 \dots t_n \mid \neg\varphi \mid \varphi \wedge \varphi \mid \forall x \varphi$$

Models $M = \langle W_M, D_M, [\![\cdot]\!]^g_{M,w} \rangle$ are a non-empty set of possible worlds $W_M$, a domain of individuals $D_M$, and an interpretation function $[\![\cdot]\!]^g_{M,w}$. I will assume for convenience that all worlds share the same domain.

An atomic formula $A^n t_1 \dots t_n$ is true at a world $w$ relative to (a model $M$ and) a variable assignment $g$ if and only if the interpretations of $t_1, \dots, t_n$ belong to the interpretation of $A^n$ at $w$ (relative to $M$); otherwise it is false.

$$\mathscr{V}_g(w, A^n t_1 \dots t_n) = 1 \text{ iff } \langle [\![t_1]\!]^g_w, \dots, [\![t_n]\!]^g_w \rangle \in [\![A^n]\!]^g_w$$
$$\mathscr{V}_g(w, A^n t_1 \dots t_n) = 0 \text{ iff } \langle [\![t_1]\!]^g_w, \dots, [\![t_n]\!]^g_w \rangle \notin [\![A^n]\!]^g_w$$

Homogeneity inferences are reasonable inferences perceived to obtain in natural language which deviate quite significantly from classical logic. To account for this discrepancy, I will look at the conditions for assertion rather than truth, assuming that "assertion aims at more than truth, and inference at more than preserving truth" (Stalnaker 1975: 270).

The semantics is *bilateral*, since it is specified by assertion- and rejection-conditions, and *state-based*, since formulas are asserted or rejected relative to information states, which are sets of possible worlds. Other applications of bilateral state-based models include Sbardolini 2023, Aloni 2022, and Cresswell 2004.

A state asserts ($\vDash$) an atomic formula with respect to (a model $M$ and) a variable assignment $g$ if and only if the formula is true under $g$ at every world in the state (in $M$). A state rejects ($\Dash$) an atomic formula if and only if the state is empty or it fails to assert. I will use $p$ as a metavariable for atomic formulas.

**Definition 1.** Bilateral conditions for atoms in $\mathscr{L}$.

$$s, g_x \vDash p \text{ iff } \forall w \in s : \mathscr{V}_{g_x}(w, p) = 1 \qquad s, g_x \Dashv p \text{ iff } s = \varnothing \text{ or } s, g_x \nvDash p$$

On this definition, refusal is less demanding than endorsement: all worlds in $s$ must agree that $p$ is true for $s$ to assert it, whereas a single dissenting voice is enough for rejection. Since on this definition rejection is the polar (or contrary) opposite of assertion, I will refer to it as *polar rejection* (Incurvati & Sbardolini 2022).

Polar rejection is non-classical, since assertion and polar rejection are still compatible: a state that rejects $p$ might have a substate that asserts it. For example, suppose that $p$ is true at $w_1$ and false at $w_2$. Then $p$ is rejected in state $\{w_1, w_2\}$, but it is asserted in state $\{w_1\}$. Classical logic requires mutually exclusive assertion and rejection (Cresswell 2004; Sbardolini 2023).

The empty state represents absurdity, and management of absurdity is the second point of departure with classical logic. By Definition 1, if $s = \varnothing$ then both $s, g_x \vDash p$ and $s, g_x \Dashv p$. From a classical perspective, absurdity is always a permissible ground for conversation: with no information, anything goes (*ex absurdum quodlibet*).

However, we are interested in reasonable pragmatic inferences, and it may not be very reasonable for a speaker to stand on the flimsy ground of "anything goes".

In the next two sections I will introduce a semantics for conjunction and (plural-generated) universal quantification, and a proposal about absurdity management inspired by recent work on Neglect Zero (Aloni 2022). I close this section with the notion of entailment. A sentence $\varphi$ follows from $\Gamma$ if and only if $\varphi$ is asserted relative to all models, states, and assignments, on which all sentences in $\Gamma$ are asserted.

**Definition 2.** Entailment.
$\Gamma \vDash \varphi$ iff $M, s, g_x \vDash \varphi$ for all $M$, $s$, and $g$, such that $M, s, g_x \vDash \gamma$ for all $\gamma \in \Gamma$.

I indicate entailment by '$\vDash$', abusing notation. There is no ambiguity, since entailment is a relation between sentences, and assertion a relation between a sentence, a model, a state, and an assignment.

### 3.1 Connectives and quantifiers

Negation switches assertion and rejection. Conjunction has familiar assertion-conditions, and rejected conjunction "splits" the state: a state rejects $\varphi \wedge \psi$ if and only if it can be split into two substates that reject $\varphi$ and $\psi$ respectively (Cresswell 2004; Yang & Väänänen 2017; Hawke & Steinert-Threlkeld 2021; Aloni 2022; Sbardolini 2023).[2]

**Definition 3.** Bilateral conditions for the connectives in $\mathscr{L}$.

$$
\begin{array}{ll}
s, g_x \vDash \neg\varphi \text{ iff } s, g_x \mathrel{=\!\mid} \varphi & s, g_x \mathrel{=\!\mid} \neg\varphi \text{ iff } s, g_x \vDash \varphi \\
s, g_x \vDash \varphi \wedge \psi \text{ iff } s, g_x \vDash \varphi \;\&\; s, g_x \vDash \psi & s, g_x \mathrel{=\!\mid} \varphi \wedge \psi \text{ iff } \exists t, t' : s = t \cup t' \;\& \\
 & \qquad t, g_x \mathrel{=\!\mid} \varphi \;\&\; t', g_x \mathrel{=\!\mid} \psi
\end{array}
$$

For illustration, consider Figure 1. Let $D = \{a, b\}$. The four worlds $w_\varnothing, w_a, w_b, w_{ab}$ represent all possible extensions of $A$, indicated by the subscripts in the obvious way. Both states $s = \{w_a, w_b\}$ and $s' = \{w_a\}$ reject $Aa \wedge Ab$. Since $s = \{w_a\} \cup \{w_b\}$ and each of the two substates of $s$ rejects a conjunct, $s, g \mathrel{=\!\mid} Aa \wedge Ab$. Moreover, $s', g \mathrel{=\!\mid} Aa \wedge Ab$, since $s' = s' \cup \varnothing$ and $s', g \mathrel{=\!\mid} Ab$ and anything, including $Aa$, is rejected by the empty state.

Let us now consider the quantifiers. For any variable assignment $g$, a variable assignment that is an *alternative* of $g_x$ (differing from $g_x$ nowhere except possibly on

2 Definition 3 is intended to account for the behavior of conjunction in homogeneity inferences. As pointed out by P. Elliott (p.c.), the disjunction defined as the dual of $\wedge$ under negation yields incorrect predictions concerning the use of *or*. This is due to the definition of polar rejection. Such problems are eliminated by following more closely the approach of Aloni 2022. I leave an account of homogeneity inferences and free choice based on Neglect Zero to future work.

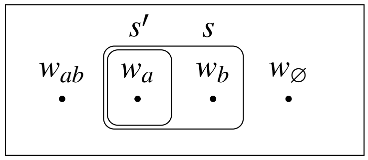


**Figure 1** $s = \{w_a, w_b\}$ and $s' = \{w_a\}$. For all worlds, $D = \{a, b\}$.

$x$) will be indicated by '$g'_x$'. The universal quantifier introduced by definite plurals is defined as follows: asserted $\forall$ is familiar, and rejected $\forall$ is a generalization of split conjunction.

**Definition 4.** Bilateral conditions for the universal quantifier in $\mathscr{L}$.

$$s, g_x \vDash \forall x\varphi \text{ iff } \forall g'_x : s, g'_x \vDash \varphi$$
$$s, g_x \mathrel{=\!\!|} \forall x\varphi \text{ iff } \exists S : s = \cup S \;\&\; \forall t \in S.\exists g'_x : t, g'_x \mathrel{=\!\!|} \varphi \;\&\; \forall g'_x.\exists t \in S : t, g'_x \mathrel{=\!\!|} \varphi$$

The logic determined by these models is not classical logic, as noted above. Nevertheless, classical logic is described by the same assertion- and rejection-conditions for complex formulas, provided the notion of rejection on atomic formulas is given by the classical condition (as in Aloni 2022 and Cresswell 2004; for more details on the propositional fragment, see Sbardolini 2023).

### 3.2 Neglect Zero

The empty state $\varnothing$ allows to trivially assert and reject any formula. It is a staple of classical logic that one can always reason vacuously by relying on "empty" information. Thus if someone knows that Chomsky wrote *Syntactic Structures* and Harris didn't, they may assert (9) making no mistake in classical reasoning.

(9) Either Chomsky or Harris wrote *Syntactic Structures*.

Vacuous speech arises in classical logic from more than one source. It is well known that classical logic licenses universal generalizations if the quantifier has an empty domain (Geurts 2008). By the definition above, $s, g_x \vDash \forall x\varphi$ if nothing is $\varphi$ in $s$, since there are no assignments of variables to elements of the domain.

Following Aloni 2022, Neglect Zero is the hypothesis that speakers are biased against vacuous models. Plausibly, speakers disregard mathematically possible scenarios that are not cognitively salient. For recent work on reasoning and cognitive biases which provides some indirect evidence for the Neglect Zero hypothesis, see Bott, Schlotterbeck & Klein 2019, Knowlton, Pietroski, Williams, Halberda & Lidz 2020 and Knowlton, Pietroski, Halberda & Lidz 2022.

In order to implement Neglect Zero, I will introduce the star $\star$. The star is a speech act operator: it modifies the illocutionary force of a speech act by making its performance non-vacuous. The star chases empty state and empty domain out of the assertion- and rejection-conditions of a formula.[3]

**Definition 5.** The star.

$$
\begin{array}{ll}
s, g_x \vDash p^\star \text{ iff } s, g_x \vDash p \ \&\ s \neq \varnothing \ \&\ D \neq \varnothing & s, g_x \vDash [\neg\varphi]^\star \text{ iff } s, g_x \vDash \neg\varphi^\star \\
s, g_x \dashv p^\star \text{ iff } s, g_x \dashv p \ \&\ s \neq \varnothing \ \&\ D \neq \varnothing & s, g_x \dashv [\neg\varphi]^\star \text{ iff } s, g_x \dashv \neg\varphi^\star \\
s, g_x \vDash [\varphi \wedge \psi]^\star \text{ iff } s, g_x \vDash \varphi^\star \wedge \psi^\star & s, g_x \dashv [\varphi \wedge \psi]^\star \text{ iff } s, g_x \dashv \varphi^\star \wedge \psi^\star \\
s, g_x \vDash [\forall x\varphi]^\star \text{ iff } s, g_x \vDash \forall x\varphi^\star & s, g_x \dashv [\forall x\varphi]^\star \text{ iff } s, g_x \dashv \forall x\varphi^\star
\end{array}
$$

The star allows us to distinguish between possibly vacuous and obligatorily non-vacuous speech. In classical logic, speech is always possibly vacuous. In the current framework, under the star, vacuous models are ruled out. For illustration, consider Figure 1: both $s, g_x \dashv Aa \wedge Ab$ and $s', g_x \dashv Aa \wedge Ab$, but $s, g_x \dashv [Aa \wedge Ab]^\star$ and $s', g_x \not\dashv [Aa \wedge Ab]^\star$, since the empty state is necessary to reject $As \wedge Ab$ in $s'$.

### 3.3 Results

Negation of the universal quantifier and of conjunction, under Neglect Zero, express the semantic values of *no* and *neither*, respectively.

**Observation 1.** $[\neg\forall x\varphi]^\star \vDash [\neg\varphi a]^\star$ and $[\neg\varphi a]^\star \nvDash [\neg\forall x\varphi]^\star$

For illustration, assume that $s, g_x \vDash [\neg\forall xA]^\star$. Then $s, g_x \dashv \forall xA^\star$, hence there is $S : s = \cup S$ and for all $t \in S$ there is $g'_x$ such that $t, g'_x \dashv Ax^\star$ and for all $g'_x$ there is a $t \in S$ such that $t, g'_x \dashv Ax^\star$. From the first conjunct, it follows that $S$ is split into non-empty substates and that there is an $x$ in the domain in each substate for which $Ax$ does not hold. From the second conjunct, it follows that for every value of $x$ there is one of these non-empty substates of $S$ in which $Ax$ rejected. Since each substate of $S$ is included in $s$, any world that makes $Ax$ false belongs to $s$. Thus $s, g_x \dashv Aa^\star$ whatever $a$ is. Hence $s, g_x \vDash [\neg Aa]^\star$.

For the second conjunct in Observation 1, assume that $s, g_x \vDash [\neg Ax]^\star$ with $g_x = a$. It does not follow that $s, g_x \vDash [\neg\forall xA]^\star$. For a countermodel, suppose that under an alternative assignment $g'_x$ such that $g'_x = b$ we have $s, g'_x \vDash Ax$. Then it is not the case

3 For another implementation of Neglect Zero, which makes different predictions, see Aloni 2022. In current notation, the star appears as a superscript on formulas. This is for convenience, but it may be misleading. The star is not a function of a sentence, but takes as argument a whole speech act, such as '$s, g_x \vDash \varphi$'. The notation emphasizes that non-vacuous assertion and rejection of complex formulas are defined by the non-vacuous assertion and rejection of their constituents.

that $s$ is the union of a set of states $S$ such that, for every alternative of $g$, there is some non-empty $t \in S$ that rejects $Ax$, since for $g'_x$ we have $t, g'_x \dashv\!\!\!/\, Ax$. In this way we can account for the homogeneity inference of definite plurals (by the first conjunct of Observation 1: see (1a/1b) above) without trivializing their semantics (by the second conjunct of Observation 1; cf. Bar-Lev 2021: 1047).

Neglect Zero matters for the derivation above: $\neg\forall xA \nvDash \neg Aa$, since some variable assignments can be vacuously satisfied in asserting the premise but not the conclusion. Under the star, such countermodels are out. Moreover, since $a$ is arbitrary in the derivation of the first conjunction of Observation 1, the same derivation shows that $[\neg\forall xA]^\star \vDash [\forall x\neg A]^\star$: the universal quantification contributed by the definite plural is not "seen" by negation, under Neglect Zero (of course, $\neg\forall xA \nvDash \forall x\neg A$). The case of conjunction is similar.

**Observation 2.** $[\neg(\varphi \wedge \psi)]^\star \vDash [\neg\varphi]^\star$ and $[\neg\varphi]^\star \nvDash [\neg(\varphi \wedge \psi)]^\star$

For illustration, assume that $s, g_x \vDash [\neg(p \wedge q)]^\star$. Then there are $t, t'$ such that $s = t \cup t'$ and $t, g_x \dashv p^\star$ and $t', g_x \dashv q^\star$. Hence there are $w \in t : \mathscr{V}_g(w, p) = 0$ and $w' \in t' : \mathscr{V}_g(w', q) = 0$. Since $w$ and $w'$ belong to $s$, we have $s, g_x \dashv p^\star$ and $s, g_x \dashv q^\star$, hence both $s, g_x \vDash [\neg p]^\star$ and $s, g_x \vDash [\neg q]^\star$. For the second conjunct, consider a state $s = \{w\}$ such that $\mathscr{V}_g(w, p) = 0$ and $\mathscr{V}_g(w, q) = 1$. Then $s, g_x \vDash [\neg p]^\star$, but $s, g_x \nvDash [\neg(p \wedge q)]^\star$ since $s$ has no non-empty substate that rejects $q$. This accounts for the homogeneity inference with conjunction (by the first conjunct of Observation 2: see (2a/2b) above) without trivializing its semantics (by the second conjunct of Observation 2).

As for definite plurals, the reasoning above shows that $[\neg(\varphi \wedge \psi)]^\star \vDash [\neg\varphi \wedge \neg\psi]^\star$: on the models presented here, Neglect Zero allows us to simulate in the semantics the effects of a negation that does not have fixed scope with respect to conjunction. We can do so without substantial hypotheses about the syntax. The rationale behind this approach is that natural language negation is not merely the contradiction operator of classical logic: the thesis "that all forms of negation are reducible to a suitably placed *it is not the case that*" is false (Prior 1967: 459).

## 4 The Rejection account of homogeneity

Bar-Lev 2021 distinguishes three approaches to homogeneity: the Trivalent account (Schwarzschild 1996; Križ 2016), the Ambiguity account (Krifka 1996; Malamud 2012; Križ & Spector 2021), and the Exhaustification account (Magri 2014; Bar-Lev 2021). I recommend a fourth approach—the Rejection account. In my discussion of existing literature, I will focus on a selection of authors who provide what seems to me to be a state of the art version of their respective proposals. The first desideratum is to account for the following inference (see also (1a/1b)).

(10) a. He saw the girls. ⇒ He saw every girl.
b. He didn't see the girls. ⇒ He saw no girl.

I assume that *the girls* receives an interpretation that supports the inference to the universal positive in (10a). It is widely accepted that the semantics of definite plurals supports such an inference, and there are various models of it (Sharvy 1980; Link 1983; Farkas & de Swart 2010; Schwarz 2013; Šimík & Demian 2020)). On my proposal, we need not decide between these models, since homogeneity is due to how the illocutionary force of a speech act affects negation, not to the semantics of plurals (nor to the semantics of any other expressions that display homogeneity effects). The inference in (10b) follows from Observation 1 under the Neglect Zero hypothesis.

Other accounts of homogeneity do not take it to be an effect of rejection. On Križ's Trivalent account, homogeneity is a property of some lexical predicates. According to Križ, a homogeneous predicate $\varphi$ is defined only if everything in the contextually salient domain is $\varphi$ or nothing is. Thus, if $\varphi([\![\textit{the girls}]\!])$ is defined and true, $\varphi x$ is true for every girl $x$ in the domain; if it is defined and false, $\varphi x$ is true for no girl. On Križ and Spector's Ambiguity account, homogeneity is a property of plurals, which are semantically underdetermined between $\forall$- and $\exists$-readings. By the strong meaning hypothesis (Dalrympe, Kanazawa, Mchombo & Peters 1994), assertion of $\varphi$ receives the $\forall$-reading, and its negation the $\neg\exists$-reading. Finally, according to Bar-Lev 2021, homogeneity is an implicature. Bar-Lev assumes that $\varphi([\![\textit{the girls}]\!])$ is interpreted existentially. However, the (10a) inference follows from a process of exhaustification, which does not unfold under negation. All three accounts appear to offer a satisfactory model of homogeneity inferences, at least with regards to examples (1a/1b) and (10a/10b).

There is a worry for accounts of homogeneity that rely on a tight connection with plurals: some languages do not have English-style plurals, such as Japanese, and yet homogeneity inferences are observed with singular generics and demonstratives:[4]

(11) a. Inu-wa kasiko-i.
Dog-TOP intelligent-PRES
'All dogs are intelligent.'

b. Inu-wa kasikoku-na-i.
Dog-TOP intelligent-NEG-PRES

4 For some speakers, plural readings of the morphologically singular demonstrative *sono* in (12a/12b) are not available, and a plural demonstrative *sorerano* is preferred. For others, *sono* has both singular and plural readings. Thanks to T. Nakamura. The same point can be made in Latin: medieval logicians took *Homo est rationale* (morphologically singular: 'Man is rational') to imply *Socrates est rationale*, and *Homo non est equus* ('Man is not horse') to imply *Socrates non est equus*, in what was then not called homogeneity but *dictum de omni et nullo*.

'No dogs are intelligent.'

(12) a. Kanojo-ga so-no hon-o yon-da.
She-NOM it-GEN book-ACC read-PAST

'She read every book.'

b. Kanojo-ga so-no hon-o yoma-na-katta.
She-NOM it-GEN book-ACC read-NEG-PAST

'She read no book.'

If homogeneity is an effect of the semantic underspecification of plural morphology, as Križ & Spector 2021 claim, it is unclear how to account for Japanese-like languages, in which homogeneity arises without plural morphology. The present account runs into no troubles of this kind since I take rejection to be the culprit for homogeneity inferences, and rejection, as expressed by negation, is always on the crime scene.

The second desideratum is to derive homogeneity inferences with conjunction, as in (2a/2b) repeated below (cf. also Szabolcsi & Haddican 2004, Muromatsu 2007, and Magri 2014).

(2) a. The White House saw Delta and Omicron coming.
$\Rightarrow$ Both Delta and Omicron were expected.

b. The White House didn't see Delta and Omicron coming.
$\Rightarrow$ Neither Delta nor Omicron was expected.

Data about conjunction show that lexical properties of predicates are not necessary for homogeneity, and so the Trivalent approach fails to predict homogeneity with conjunctions—as acknowledged by Križ 2016: 522. Plural semantics is not necessary either, hence Križ and Spector's Ambiguity approach is no improvement, unless we assume that conjunctions are semantically underdetermined even if the conjuncts are not.

Bar-Lev's approach to homogeneity with plurals does not extend to conjunctions either. Perhaps definite plurals are interpreted existentially and strengthened into universals by exhaustification, but it seems unlikely that $\varphi \wedge \psi$ should have the semantics of a disjunction, exhaustified into a conjunction. A previous exhaustificationist proposal for both plurals and conjunctions, by Magri 2014, is criticized and rejected by Bar-Lev 2021: 1055–1057. Clearly, however, the exhaustification mechanism delivers the wrong results: assuming the account of the relationship between $\wedge$ and $\vee$ outlined in Bar-Lev & Fox 2017, the set of innocently excludable alternatives to $\neg(\varphi \wedge \psi)$ is $\{\neg(\varphi \vee \psi)\}$, and the set of innocently includable ones is $\{\neg(\varphi \wedge \psi)\}$. Thus, exhaustification asserts $(\varphi \wedge \neg\psi) \vee (\neg\varphi \wedge \psi)$, which is incorrect.[5]

5 As suggested by Jacopo Romoli (p.c.), perhaps one could keep Bar-Lev's account of homogeneity

Therefore, no alternative approach to homogeneity explains homogeneity with conjunctions, and no explanation extending these approaches seems forthcoming. In contrast, homogeneity inferences with conjunctions are predicted if rejection is non-vacuous, as shown by Observation 2.

A third desideratum concerns mixed contexts, in which neither assertion nor denial of $\varphi$ is acceptable if $\varphi$ supports homogeneity inferences.

*Context*. Some of the boys are performing *Hamlet* and some are not.

(5) a. ?? The boys are performing *Hamlet*.

b. ?? The boys aren't performing *Hamlet*.

Suppose that $a, b$ and $c$ are the boys, and that only $a$ is performing *Hamlet* in $w_a$. Thus, $\{w_a\}$ is a state that captures the information of the mixed context of (5a) and (5b): some boy is performing *Hamlet* and some is not. If $s = \{w_a\}$, the following holds (with quantification restricted to $\{a,b,c\}$).

**Observation 3.** $s, g_x \not\models [\forall x : [\![\textit{performing-Hamlet}]\!]]^\star$
$s, g_x \not\models [\neg\forall x : [\![\textit{performing-Hamlet}]\!]]^\star$

Therefore, in a mixed context, neither (5a) nor (5b) is non-vacuously asserted. The case of conjunction is similar.

*Context*. Dean saw Robin but not Rachel.

(6) a. ?? Dean saw Robin and Rachel.

b. ?? Dean didn't see Robin and Rachel.

In an information state that captures the information of the mixed context of (6a) and (6b), neither sentence is non-vacuously asserted. Suppose that $p$ is true and $q$ is false at $w_p$. If $s = \{w_p\}$, the following holds.

**Observation 4.** $s, g_x \not\models [p \wedge q]^\star$
$s, g_x \not\models [\neg(p \wedge q)]^\star$

The predictions of other accounts of homogeneity concerning mixed contexts are not always straightforward, due to different approaches to non-maximal readings of definite plurals. Following Križ 2016, some authors have argued that definite plurals systematically give rise to non-maximal generalizations, and that homogeneity and non-maximality are "two sides of the same coin" (Križ & Spector 2021: 1132).

with plurals while maintaining that $\varphi \wedge \psi$ has its classical meaning, by making some additional assumptions about which alternatives are computed in this setting—making sure that the additional assumptions are not *ad hoc*.

Although definite plurals may have non-maximal readings, homogeneity and non-maximality pattern differently and should not be equated.

### 4.1 Non-maximality

The purported non-maximality of (5a) and (5b) is directly in tension with a previous datapoint, namely that (5a) implies that all boys are performing *Hamlet* and that (5b) implies that no boys are performing *Hamlet*. By non-maximality, (5a) and (5b) imply that almost all boys are performing, and that almost none are performing, respectively. If so, at least one of (5a) or (5b) should be assertable in a mixed context. But this is not so, at least not without some pragmatic arm-twisting. This observation is important: homogeneity and non-maximality are distinct phenomena, though sometimes overlapping. The kind of pragmatic considerations that license non-maximal interpretations are orthogonal to the acceptability of homogeneity inferences.

First of all, definite plurals and non-maximal generalizations are not equivalent (Lasersohn 1999: 525).

| | |
|---|---|
| A: She read the required papers. | A: She read almost all the required papers. |
| B1: No, she didn't read *On Denoting*. | B1: *No, she didn't read *On Denoting*. |
| B2: Yes, except for *On Denoting*. | B2: *Yes, except for *On Denoting*. |

B1 cannot disagree with A's *almost all* generalization on the right, since they are not disagreeing, but can disagree with A's definite plural on the left. Similarly, B2 cannot partially agree with A's *almost all* generalization, since they are fully agreeing, but can partially agree with A's definite plural.

Secondly, as Križ 2016 recognized, non-maximal readings of definite plurals have the treacherous quality of disappearing even in contexts in which they are true. If we are going for a stroll after sunset while walking next to a very loud house party, (13a) is not acceptable, even if all townspeople are asleep in other neighborhoods. In the same context, the use of (13b) would raise no eyebrows.

(13) a. The townspeople are asleep. (from Lasersohn 1999: 522)

b. All townspeople are asleep, except those who live on this block.

There may be some overlap but no strong correlation between authentic non-maximal generalizations and the use of definite plurals. On the basis of these and additional considerations, Bar-Lev 2021 argues that non-maximal readings of definite plurals are significantly more context-sensitive than homogeneity inferences.

Thirdly, conjunctions are extremely problematic if non-maximality and homogeneity are unified, as acknowledged by Križ 2016: 522, and Bar-Lev 2021: 1081, fn. 52. Since conjunctions support homogeneity inferences, equating homogeneity and non-maximality implies that the truth of a conjunction should allow for exceptions. Then, $\varphi \wedge \psi$ may be true while $\varphi$ is not true. This prediction is disastrous and should be avoided at all costs.

Therefore, homogeneity does not imply non-maximality. In addition, non-maximality can be explained by independently available resources, which are also independently necessary to account for pragmatic imprecision.

For Križ, (5a) and (5b) are truth-valueless in their mixed context, since they have universal truth-conditions, but they may be accepted if the QUD allow for "true enough" non-maximal answers. Križ and Spector's appeal to the strong meaning hypothesis would make both (5a) and (5b) unacceptable in the mixed context, but not if homogeneity and non-maximality coincide. On the Ambiguity account they coincide, hence the prediction is that (5a) and (5b) are both acceptable, which is wrong. For Bar-Lev, non-maximality is a side-effect of exhaustification, and since negative plurals are not exhaustified, (5a) may be acceptable, but (5b) is not.

Experimental evidence shows that, in mixed contexts, positive plural definites are somewhat acceptable, that their negative counterparts tend to be judged unacceptable, and that a suitable QUD can improve the status of both (Tieu, Križ & Chemla 2019; Augurzky, Bonnet, Breheny, Cremers, Ebert, Mayr, Romoli, Steibach & Sudo 2023). The symmetricalists are correct in expecting non-maximal readings with both positives and negatives, but the asymmetricalist prediction that negatives resist non-maximality is also correct.

The basic prediction of the present account sides with Križ in the symmetricalist camp (Observation 3). Following Križ's proposal, QUD manipulations can redeem (5a) and (5b) in the mixed context, at least to some extent. Thus, while (5a) and (5b) are both unacceptable in their mixed context, both have weaker consequences: roughly, *Some boys are performing* and *Some boys are not performing*, respectively (with $\exists$ defined as $\neg\forall\neg$).

$$[\forall x\varphi]^{\star} \vDash \exists x\varphi \qquad\qquad [\neg\forall x\varphi]^{\star} \vDash \exists x\neg\varphi$$

Both weakenings are assertable in the mixed context of (5a) and (5b), in which some boys are performing and some are not. These weakenings, I suggest, approximate the non-maximal readings of (5a) and (5b) respectively, and can be retrieved with a suitable QUD. Following Augurzky et al. 2023, an Existential QUD (*Is any boy performing?*) facilitates a non-maximal interpretation of (5a), and a Universal QUD (*Is every boy performing?*) facilitates a non-maximal interpretation of (5b). Speakers may be driven by the appropriate QUD to accept (5a) by assenting to its true consequence $\exists x : [\![\textit{performing-Hamlet}]\!]$, and to accept (5a) by assenting to its true consequence $\exists x : \neg[\![\textit{performing-Hamlet}]\!]$. Hence, QUD manipulations can improve the status of definite plurals in mixed contexts, whether positive or negative.

However, a complication arises in the negative case. An existential assertion, under a Universal QUD, invites a quantity implicature to the denial of the universal. The same implicature is not supported under an Existential QUD.

| | |
|---|---|
| A: Who ate all the cookies? | A: Who ate some cookies? |
| B: I ate some. | B: I did. |
| $\Rightarrow$ I didn't eat all the cookies. | $\not\Rightarrow$ I didn't eat all the cookies. |

Therefore, an utterance of $\neg\forall x\varphi$, such as *The boys aren't performing* (5b), implies both $\forall x\neg\varphi$ (*No boy is performing*) under Neglect Zero, and a weakening $\exists x\neg\varphi$ (*Some boys are not performing*) that is assertable in the mixed context, and that is in principle retrievable under a Universal QUD. However the same QUD also invites a scalar inference from the latter implication ($\exists x\neg\varphi$) to $\exists x\varphi$ (*Some boys are performing*, or *Not all boys are not performing*). This conclusion is inconsistent with the universal reading of (5b) given by Neglect Zero ($\forall x\neg\varphi$). Hence, non-maximal readings of negative definite plurals short-circuit if a scalar implicature is derived, as the diagram below illustrates.

$$[\forall x\neg\varphi]^\star \quad \Longleftarrow \quad [\neg\forall x\varphi]^\star \quad \Longrightarrow \quad \exists x\neg\varphi \quad \rightsquigarrow \quad \exists x\varphi$$

contradiction!

**Figure 2**

Therefore, it is hard for speakers to isolate a felicitous non-maximal reading for (5b) while avoiding contradiction. The reason is general. Typically, *nobody* is compatible with its non-maximal counterpart *somebody-not*, unless the context supports an inference from the latter to *somebody*, because this contradicts *nobody*. Hence, negative definite plurals resist non-maximal readings. Since non-maximal readings of positive definite plurals are licensed by an Existential QUD in mixed contexts, no contradiction arises.[6]

Summarizing, non-maximality judgments do not apply to all sentences that support homogeneity. Moreover, non-maximal generalizations are not sensitive to

6 This account of non-maximality makes two assumptions. (1) A suitable QUD may let us see through failures of assertability, if the pragmatically anomalous sentence entails an assertable answer. This is implicit in Križ's "true enough" approach to non-maximality, and it is a familiar phenomenon: *The man in the corner drinking champagne is happy tonight* may be accepted as true even if the man is drinking water, provided he is happy, if the question is whether anyone is happy (Donnellan 1966; Kripke 1977). Similarly, von Fintel 2004 discusses utterances that are rejected as false despite presupposition failure. (2) More robust infelicities such as contradictions are hard to ignore even under a suitable QUD. Thus, *The man in the corner drinking champagne is happy tonight and I don't believe he is* (an instance of Moore's paradox) is unacceptable even if the interlocutors manage to get around the lack of champagne drinkers.

context in the same way as sentences that support homogeneity, and are not used in the same way. Although Križ and others have argued for a tight connection between non-maximality and homogeneity, Bar-Lev is more cautious: non-maximality is subject to different constraints and originates from different sources. I agree with this assessment. Non-maximality is pragmatic slack, not the counterpart to homogeneity. QUD manipulations in mixed contexts can explain the empirical findings on the non-maximality of definite plurals, consistently with the present account.

### 4.2 Focus and overt universal generalizations

There remain two desiderata: to explain why focus and explicit generalization by insertion of *all* and *both* can block homogeneity inferences. I will suggest that the same constraint on Neglect Zero explain both cases. Sharp data about focus can be obtained if we assume contrastive focus on *and* in (7a), as observed by Szabolcsi & Haddican 2004, and on *the boys* in (7b), repeated below. The relevant readings are also possible with narrow focus on a subsentential constituent that contains the logical element, *and* or *the -s* in the examples. There are other possible focus placements but not relevant to the present discussion.

(7) a. Dean didn't see Robin [and]$_F$ Rachel.

b. [The boys]$_F$ aren't performing *Hamlet*.

The focus data can be explained by extending my account of homogeneity inferences with some account of the well-known semantic effects of focus (Rooth 1992; Beaver & Clark 2008; Roberts 2012). There is more than one proposal in this area, but including some theory of focus is independently necessary. There are also many finer points about focus that I will not discuss.

Focus signals that an exception to Neglect Zero is to be made for the focused element. After all, if the element is focused speakers should pay attention, and shouldn't let biases determine interpretation. Consider (7a). Standard theories of focus interpretation have the consequence that (7a) presupposes that Dean saw someone, or someone among Robin and Rachel, depending on the domain of alternatives. Such consequences are incompatible with the non-vacuous assertion of (7a), since if $s, g_x \vDash [\neg(\varphi \wedge \psi)]^\star$ then $s, g_x \vDash \neg\varphi$ and $s, g_x \vDash \neg\psi$. That is, if (7a) is non-vacuously asserted then Dean saw neither Robin nor Rachel, or, assuming that the domain is limited to the set of alternatives, Dean didn't see anyone. Thus, focus on a subsentential constituent that contains *and* in (7a) is incompatible with the non-vacuous performance of the speech act. Therefore, vacuous models cannot be neglected. If vacuous models are not neglected, namely if $s, g_x \vDash \neg(\varphi \wedge \psi)$, assertion of (7a) is compatible with the continuation *He only saw Robin*, for $\neg(\varphi \wedge \psi) \nvDash \neg\varphi$.

Likewise for (7b). Focus on a subsentential constituent which includes *the -s* may carry a consequence, by standard theories of focus interpretation, that is incompatible with non-vacuous assertion of (7b). Suppose contrastive focus on *the boys*. Depending on the domain of alternatives, (7b) may presuppose that a subset of boys are performing *Hamlet*, but not all of them.[7] However, the presupposition that a subset of boys are performing *Hamlet* is incompatible with the non-vacuous assertion of (7b), since $s, g_x \vDash [\neg\forall x : [\![\textit{performing-Hamlet}]\!]]^\star$ implies $s, g_x \vDash \neg[\![\textit{performing-Hamlet}]\!]x$ for all boys $x$.

Thus focus signals an exception to the bias against vacuous speech. In addition, the exception is local: it is only the focused constituent that gets a free pass, so to speak. After all, focus is not optional, but a part of grammar, and if its effect was to block Neglect Zero everywhere then Neglect Zero should never have any visible consequences. Example (14) shows that the exception to the star is on the focused constituent and not on the entire speech act, since homogeneity inferences are still possible outside the focused element.

(14) Lea [and] $_F$ Bianca didn't talk to the professors. Only Lea did.
$\Rightarrow$ Bianca didn't speak to any professor.

In order to account for the effects of focus, I propose the following rule: if a complex sentence with focus on a constituent $\psi$ is non-vacuously asserted or rejected, the focused constituent filters through the star.

**Definition 6.** Focus exception to the star.

$$[\varphi[\psi]_F]^\star \equiv \varphi^\star(\psi)$$

This rule predicts that the conjunction in (14) does not have homogeneity effects, but the definite plural does.[8] Alternative accounts of homogeneity inferences do not address their focus-sensitivity, and it is an open question whether they can be extended to account for the data about focus.

The final desideratum is to account for homogeneity cancellation with universal expressions such as *all* and *both*. For reasons of space I will only sketch how a proper account might go, and I hope to follow up in future work.

7 For a derivation of subsets of the set of boys as alternatives, compatible with the present account, see the derivation of non-maximal pluralities in Križ & Spector 2021. Depending on the domain of alternatives, (7b) may also presuppose that some set of people other than the boys are performing *Hamlet*, such as the girls. This interpretation is compatible with a homogeneity inference.

8 Suppose that $s, g_x \vDash [\neg(\forall x\varphi(l,x)[\wedge]_F\forall x\varphi(b,x))]^\star$, formalizing an utterance of (14) under Neglect Zero. Then $s, g_x \mathrel{=\!\!|} [\forall x\varphi(l,x)[\wedge]_F\forall x\varphi(b,x)]^\star$, and so $s, g_x \mathrel{=\!\!|} [\forall x\varphi(l,x)]^\star \wedge [\forall x\varphi(b,x)]^\star$ by the focus rule. This implies $s, g_x \vDash \neg\exists x\varphi(l,x) \vee \neg\exists x\varphi(b,x)$, that is, roughly, either Lea didn't talk to any professor or Bianca didn't talk to any professor.

(8) a. Bianca likes the students ≈ Bianca likes all the students

b. Bianca doesn't like the students ≉ Bianca doesn't like all the students

A strategy that I think is promising is to reduce the contrast in (8a/8b) to the effects of focus. English expressions such as *all* and *both* are known to be focus-sensitive (Rooth 1985, 1992; von Fintel 1994; Sæbø 1997; Roberts 1995, 2012; Beaver & Clark 2008): they quantify over contextually restricted domains of alternatives contributed by focus. If so, the rule of focus exception applies. Then (8a) is an equivalence with or without the star: in the former case, focus lifts the effects of the star, but not those of other pragmatic operators (such as Aloni's +) that rule out empty domains. In contrast, the equivalence in (8b) fails if speech is not vacuous, since the existence of students liked by Bianca is ruled out by the negated definite plural but not by the *not all the students* construction. Additional pragmatic effects cannot restore the (8b) equivalence without deriving the homogeneity inference.[9]

On this approach, the effects of the rule of focus exception are limited to the focused constituent. This prediction is borne out with *both* and *all*: the exception to the star introduced by focus-sensitive elements is local, as (15) shows in a case analogous to (14).

(15) Not all the students answered the questions.
⇒ Some student answered no question.

Further evidence may come from languages in which the contrast in (8a/8b) is not replicated. In Japanese, some combinations of negation with a universal quantifier behave as in English, but in other cases homogeneity readings are possible if not preferred. (Case (16) is from Han, Storoshenko & Sakurai 2004: 123.)

(16) Pai-o zenbu tabe-rare-na-katta.
Pie-ACC all eat-can-NEG-PAST

Both 'I could not eat all of the pie' and 'I could eat none of the pie'

(17) a. Kanojo-ga dono-hon-mo yon-da.
She-NOM which-book-also read-PAST

'She read every book'

b. Kanojo-ga dono-hon-mo yoma-na-katta.
She-NOM which-book-also read-NEG-PAST

'She read no book'

In (16), interpretation is ambiguous despite the overt *zenbu* (*all*). Moreover, the phrase *donohonmo* (*every book*) yields a universal positive in (17a) and a universal

9 More needs to be said here on how to combine Aloni's Neglect Zero-based account of free choice with the present approach to homogeneity. This task is left for future work.

negative in (17b). A hypothesis consistent with the current account is that, while English *all* conventionally associates with focus, having lexicalized the rule of focus exception, focus association for some Japanese universal quantifiers is contextual, and the rule may or may not apply.

On competing accounts, the equivalence in (8a) may be derived semantically (Križ 2016) or by disambiguation (Križ & Spector 2021). In addition, according to both the Trivalent and the Ambiguity account, one function of English *all* is to eliminate homogeneity, understood as a property of predicates. This approach is similar to the one I sketched, and predicts the non-equivalence in (8b). A further stipulation that some universal determiners, for example in Japanese, lack the homogenity-canceling function, would be consistent with both accounts. On Bar-Lev's account, the equivalence in (8a) is derived by exhaustification, but since the latter is blocked by negation, (8b) is predicted.

Summarizing, the Rejection account of homogeneity predicts homogeneity inferences with definite plurals and conjunctions, explains the unassertability facts in mixed contexts, the focus data, and (with more work to be done) the cancellation effects of focus-sensitive expressions like *both* and *all*. Alternative accounts, in particular the Trivalent, Ambiguity, and Exhaustification accounts cover some of these data, but none covers them all.

## 5 Conclusion

I presented an account of homogeneity inferences according to which rejection is responsible: homogeneity is predicted if rejection modifies the interpretation of negation. Speech acts are characterized by two assumptions: polar rejection as non-assertion (as opposed to classical logic, in which rejection is the complement of assertion), and a Neglect Zero option (as opposed to classical logic, in which there is no such option). Neglect Zero is a cognitive hypothesis about language use: speakers are biased against mathematically possible but vacuous scenarios, which can consequently be ignored in formula verification in contexts in which we can assume that interlocutors are not particularly vigilant.

Polar rejection and Neglect Zero are two separate components, though the account depends on both. They are motivated by different considerations: the force of a speech act (Incurvati & Schlöder 2017; Incurvati & Sbardolini 2022), and the cognitive effort required by reasoning about vacuous models (Bott et al. 2019; Knowlton et al. 2020, 2022). Methodologically, it is useful to keep them separate: in Aloni's account of free choice, the free choice inference is derived as an effect of Neglect Zero, but negation may remain classical. An account of homogeneity which follows Aloni's approach more closely, in particular by keeping negation classical, is desirable, and it is left for future work.

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