Core Concepts and Indirect Alternatives: On the Anti-Duality of Quantifiers

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Abstract

This paper proposes an analysis for the long-standing puzzle observed by Chemla [2007] regarding the anti-duality of the French universal quantifier *tous*, which arises even though French has no word for 'both' to feed a *Maximize Presupposition* competition. This phenomenon has been cited as an example in language where a dual 'conceptual alternative' is at play [Buccola et al., 2018], but no formal account of it has been put forth. Furthermore, a naive implementation of the idea overgenerates anti-duality inferences in other expressions, such as *each*, *which* and *one* in English and French, which might be expected to be observed due to anti-dual counterparts in some languages like Icelandic and Japanese. We propose an account where French *tous* has an unpronounceable dual universal alternative built from a dual core concept, competition with which is licensed by the existence of a pronounceable expression equivalent in meaning, which we call 'Indirect Alternative'. This proposal accounts for *tous*'s anti-duality and lack of anti-*n*-ality for n > 2, as well as the lack of anti-duality in other quantifiers.

20 1 Introduction

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The English universal quantifiers *all* and *every* are 'anti-dual', i.e., cannot be used if their domain is known to contain only two individuals. Instead, the dual universal quantifier *both* can be used in those contexts.

- (1) a. #Lea broke all her arms.
 - b. #Lea broke every arm of hers.
 - c. Lea broke both her arms.

Percus [2006] and Sauerland [2008] argue that the anti-duality of *all* and *every* is due to competition with the dual universal lexical item *both*, which, via *Maximize Presupposition* (MP) [Heim, 1991, Sauerland, 2002], makes a universal quantifier with no size restriction anti-dual.

Chemla [2007] raises a puzzle for this analysis. In French, the universal quantifier *tous* is also anti-dual. But French does not have a lexical item for 'both'. In fact, the most direct translation of 'both' is the complex definite numeral expression *les deux* ('the two').

a. #Léa s'est cassé tous les bras. Léa REFL.AUX broke all the arms #'Léa broke all her arms.'
b. Léa s'est cassé les deux bras. Léa REFL.AUX broke the two arms 'Léa broke both her arms.'

The French data in (2) constitute a problem for the MP-based account, for two reasons: ⁴⁰ First, MP is generally defined for individual lexical items, but *les deux*, unlike *both*, is a complex expression (and a non-constituent string). Second, as noted by Chemla [2007], if we extend it to incorporate complex expressions, it becomes a puzzle why tous can compete with *les deux*, but not with another identically structured numeral expression like les trois ('the three'), which would produce an unattested anti-triality inference of tous.

- Chemla therefore suggests that the explanation of *tous*'s anti-duality lies in the existence 45 of a dual 'core concept' that can participate in competition with tous.¹ This observation has become one of the better-known examples suggesting the need for 'conceptual alternatives', that is, non-utterable meaningful objects that can compete with pronounceable linguistic material and be included in operations over alternatives [Buccola et al., 2018].
- Nevertheless, no full-fledged account of the anti-duality of tous has yet been proposed. 50 There is no discussion of what the relevant core concept is, and the lack of a formal account limits the applicability of the idea of conceptual alternatives because it leaves the predictions unspecified for structures beyond the ones considered in the original work. This paper takes on this challenge.
- We aim to capture two empirical facts: a) the anti-duality of French tous, and its lack 55 of anti-n-ality for n > 2, and b) the absence of anti-duality in other quantifiers, which might be expected to be observed due to anti-dual counterparts in some languages.

We propose a solution for *tous*'s anti-duality by positing the notion of *Indirect Alternative*, which is an expression that essentially 'replaces' an alternative that is generated by

- the grammar but cannot be phonologically realized, and that replacement licenses com-60 petition with the unpronounceable alternative. The replacement is possible if the overt expression is equivalent in meaning to the unpronounceable alternative, and at most as complex as the original utterance. We furthermore assume the existence of a universally available dual core concept, which in French is homophonous with plural. In the restrictor
- of tous, the dual reading will be blocked by the definite numeral expression les deux ('the two') equivalent in meaning. A plural-marked tous expression will thus directly generate a dual-marked *tous* expression as an alternative, which is unpronounceable. Thus MP occurs between the plural-marked tous expression and the dual alternative, generating anti-duality in the *tous* expression. No anti-triality is generated, because there is no trial core concept. The complexity constraint will disallow competition between other expres-
- sions and their dual counterparts due to the lack of corresponding indirect alternatives.

This proposal contributes to the literature on conceptual alternatives by maintaining the intuition, dating from Gricean pragmatics, that a *pronounceable* expression be available as an alternative (albeit indirectly), while at the same time accounting for the intuition that the concept DUAL is playing a central role in the French and other duality effects as seen in (2). This proposal thus puts into question the central hypothesis of the programmatic paper Buccola et al. [2018], which submits that there can be alternatives not supported by linguistic material.

In section 2, we present the data we will aim to explain, and a summary of our solution. In section 3, we show that the anti-duality of French tous carries the signature 80 of an implicated presupposition, corroborating Chemla's original intuition and paving the way for a solution based on competition. In section 4, we present our proposal for indirect alternatives and show how it accounts for the anti-duality of tous. In 5, we discuss what our account predicts for anti-duality with other expressions cross-linguistically, including counterparts of which, each, one, no. the, some, always. In 6, we entertain some plausible 85

¹As a reviewer points out, the term 'core concept' suggests an extra-linguistic status of the notion of duality. But duality also plays a role in grammatical agreement in many languages (see our discussion of Harbour [2014] in the appendix) and therefore has also been viewed as a syntactic feature. This gives rise to the question whether the special status of duality is rooted in grammar or outside of it. At this point, we adopt Chemla's term, but without a commitment to a primarily extra-linguistic status of duality.

alternative explanations to French tous's anti-duality. In 7, we conclude.

2 The puzzle and solution in a nutshell

Building on Chemla's (2007) observation, we present the puzzle in two parts that we aim to address. The first part concerns the special status of anti-duality with French tous. As
⁹⁰ Chemla discusses (also Buccola et al. 2018), there is no difficulty to use French tous or English all with a domain known to be n for any n greater than 2. The examples in (3) might be expected to be odd due to anti-triality and the one in (4) to anti-decality, but all are acceptable.

- (3) a. Léa aime toutes les parties du triathlon. Léa likes all the sections of the triathlon 'Léa likes all sections of the triathlon.'
 - b. Raphael la Tortue Ninja s'est cassé tous les doigts de sa main Raphael the turtle ninja REFL.AUX broken all the fingers of its hand gauche.
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 'Raphael the Ninja Turtle broke all the fingers on his left hand.' (Context: Ninja Turtles have three fingers on each hand.)
- 100 (4) Léa s'est cassé tous les doigts. Léa REFL.AUX broken all the fingers 'Léa broke all her fingers.'

We propose a solution that pushes forward Chemla's intuition that the number concept DUAL is special in a way that higher numbers are not. We propose to relate Chemla's notion of core concept to the work of Harbour [2014] on number morphology. Harbour argues that universally, the numerically stable categories of number morphology are the 105 singular, dual, and plural (he recognizes in addition forms of paucal that are associated with a less stable numerical threshold). The intuition that dual is a core member of our conceptual inventory is not surprising, as it has a significant presence in human experience (and any higher number does not seem to have such a presence, in both absolute terms and relative to numbers higher than it). The special status of the dual as a core concept 110 has allowed Harbour to explain the existence of dual morphology in grammar across otherwise unrelated languages, and will now be used to explain the seemingly unrelated phenomenon of anti-duality in universal quantification. In short, we propose that a dual number concept, which we call DUAL, is universally present across languages, and is the basis for an unpronounceable alternative to the universal quantifier tous, allowing MP 115 to apply, and deriving anti-duality. This part of our proposal is very similar to the one proposed by Aravind [2018, section 4.5.3, pp. 135-139] for the same puzzle. However,

120 Alternative.

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The second part of our puzzle concerns cases in which anti-duality is not observed, and might be expected to arise due to its presence in other languages. Chemla's (2007) puzzle suggests that there is a parallel between the anti-duality of *all* in languages which have a lexicalized dual counterpart *both*, like English, and the anti-duality of *all* in languages that

Aravind's analysis overgenerates anti-duality with other quantifiers, which constitute the second part of the puzzle, and which we address by proposing the novel notion of Indirect

don't, like French. We know no language whose version of *all* is not anti-dual (though it might exist), but there are a number of other items that are anti-dual in some languages,

apparently due to the presence of a lexicalized dual counterpart, but are not anti-dual in other languages.

A striking example involves negative quantifiers. English negative quantifier no (also none) is anti-dual, as shown in (5-a), which can easily be explained by MP competition with its dual counterpart neither. French does not have a counterpart to neither, just like it doesn't have a counterpart to both; but French aucun ('no'/'none'), unlike tous ('all'), does give rise to an anti-duality inference, shown in (5-b). This is also true for German keine ((5-c)), which does not have a word for neither, although it does have one for both.² So whatever makes tous anti-dual in the absence of an overt dual counterpart does not

apply to *aucun*.

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(5) a. $\{\#\text{None}, \text{Neither}\}$ of the sides of this sheet of paper has been u	(5) a	a. {#None,	Neither}	of the	sides o	f this	sheet	of p	oaper	has	been	use	d.	
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b.	Aucun	des o	côtés de cette	e feuille	n'a	été	utilisé.		
	no	of.the s	sides of this	paper	neg.has	been	used		
	'Neithe	er of the	e sides of this	sheet of	of paper	has b	been used.	,	French
c.	Keine	der	Seiten	dieses	Blatte	es	wurde	verwendet.	
	none.se	G the.G	EN sides.GEN	this.GE	EN sheet.	GEN	AUX.PAST	used	
	'Neithe	er of the	e sides of this	sheet o	of paper	has b	peen used.	,	German

This type of observation extends to other quantificational items, such as interrogative *which*, which has dual counterparts in Japanese and Icelandic, and distributive *each* and existential *one*, which have dual counterparts in Japanese. Their corresponding plural equivalents exhibit anti-duality in those languages. We show below the relevant data for *which* in Icelandic ((6); personal communication) and Japanese ((7); native speaker intuition of one of the authors), and for Japanese *each* and *one* in (8) and (9) respectively.³

(6)	a. Á hvor-um On which.DUAL- Which arm did	handlegg-num brotna-i DAT arm-DAT.DEF break.INT-F	hún? PST she I	colondic
	b. ?Á hvaa handle On which arm.D	egg brotna-i hún? AT broke.INT-PST she	1	celanuic
(7)	a. Taroo-wa dotti-n Taro-TOP IND.D 'Which arm did	no ude-o o-tta-no? UAL-GEN arm-ACC break-past-(Taro break?'	Ĵ	apanese
	b. #Taroo-wa dono Taroo-TOP IND	ude-o o-tta-no? arm-ACC break-past-Q		
(8)	a. Taroo-wa dotti Taro-TOP IND.D 'Taro broke each	no ude-mo o-tta. UAL-GEN arm-MO break-PAST n of his arms.'	J	apanese
	b. #Taroo-wa dono u Taro-TOP IND a	ude-mo o-tta. arm-MO break-PAST		
(9)	a. Taroo-wa dotti-n Taro-TOP IND.D 'Taro broke one	no ude–ka-o o-tta. UAL-GEN arm-KA-ACC break-PA of his arms.'	.st J	apanese
	b. #Taroo-wa dono i Taro-TOP IND a	ude-ka-o o-tta. arm-KA-ACC break-PAST		1

²We thank our editor Yasutada Sudo (p.c.) for bringing our attention to this relevant data.

³We analyze 'dotti-no... mo' as *each* because it does not allow collective or cumulative interpretations in cases where *both* and *all* do, e.g. 'Together both/all/*each of my children weighs 100 kg.'

¹⁶⁰ But in both English and French, no anti-duality arises in any of these cases.

(10) a. Which arm hurts you?

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- b. I have a problem with each arm.
 - c. One arm hurts me.
- (11) a. Quel bras te fait mal? which arm you cause pain 'Which arm hurts you?'
 - b. J'ai un problème à chaque bras.
 I-have a problem to each arm 'I have a problem with each arm.'
 c. Un bras me fait mal.
 - one arm me cause pain 'Which arm hurts you?'
- On a Chemla-inspired account in which dual is a core concept, we would expect that the dual quantifiers in Japanese and Icelandic are lexicalizations of that core concept together with corresponding quantifiers. But then we would expect the possibility of that combination to occur in all languages, even those that do not lexicalize it, and generate anti-duality in the corresponding quantifiers, just like it does with French *tous*. Therefore,
- a proposal for the anti-duality of French *tous* should also be equipped to explain the absence of anti-duality with French and English *quel/which*, *chaque/each*, *un/one*.

As a final data point to consider, one may wonder specifically about the differences between universal quantifiers, where *all*, *every*, and *tous* are anti-dual, but not *each*, mentioned above, or definite plurals, the latter shown in (12) and (13) for English and French respectively.

- (12) My arms hurt.
- (13) Mes bras me font mal. my arm me cause pain 'My arms hurt.'

An account that simply has the dual as a core concept would struggle to explain the lack of anti-duality in all of the above cases. Our proposal however provides a natural explanation for them.

In a nutshell, our solution will be to limit the ability of the core concept DUAL to compete with structural alternatives like French *tous* to those cases where the core concept can be 'linked' – in a way to be made precise – to an existing pronounceable expression. For

French tous ('all'), the mechanism links it to les deux ('the two'). But for all the other nondual expressions mentioned above, the mechanism will not link it to any pronounceable linguistic expression.

We will call such an expression that can stand in for an unpronounced core concept an *indirect alternative*. We give a general definition of indirect alternatives as expressions which are not directly generated by known alternative-generation algorithms (e.g., standard structural alternatives as proposed in Katzir 2007), but nevertheless enter competition because they are equivalent in meaning to an unpronounceable alternative such as an expression containing the core concept DUAL. In this proposal, the ability of *tous* to compete with *les deux* necessarily depends on the presence of the dual core concept,

²⁰⁰ which explains why anti-duality but not anti-triality is observed with French *tous*, as there

is no trial core concept.

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Furthermore, indirect alternatives will be subject to a familiar complexity limit on alternatives, in that they cannot surpass the complexity of the expression they are a competitor to. This requirement will reliably block the quantifiers observed in this section from having dual indirect alternatives, since expressions equivalent to their dual counterparts are more complex than the quantifier expressions themselves: *aucun des deux* or *ni l'un ni l'autre* (French expressions equivalent to 'neither'), which of the two, one of the two, each of the two, the two or their French equivalents.

3 Tous's anti-duality is an implicated presupposition

A necessary component of our proposal is that the anti-duality of French *tous* is indeed an implicated presupposition, i.e. generated as the result of Maximize Presupposition with another expression, and is not, for example, encoded in its lexical entry. We provide arguments for this in this section.

We first summarize the proposal of the anti-duality of English *all* as an implicated presupposition as presented in Percus 2006 and Sauerland 2008. In particular, we will show arguments from Sauerland [2008] where anti-duality carries the signature of an implicated presupposition, namely in its epistemic status and (crucially) its projection properties under universal quantifiers, which makes it incompatible with a mere lexical specification. We also provide the third observation that the inference can be suspended in contexts in which the duality of the domain is irrelevant, which is a more general

property of implicatures and implicated presuppositions. We show that all these facts hold for both English *all/every* and French *tous*.

The data below illustrate that the use of *all*, *every* and *tous* is odd when their domain is known to contain 1 individual, as in (14), or 2 individuals, as in (15), contrasting with a situation where the domain is known to contain more than 2 individuals, as in (16).

- (14) a. #Billy broke all his noses.
 - b. #Billy broke every nose of his.
 - c. #Billy s'est cassé tous les nez. Billy REFLAUX broke all the noses
- (15) a. #Billy broke all his legs.
 - b. #Billy broke every leg of his.
 - c. #Billy s'est cassé toutes les jambes. Billy REFLAUX broke all the legs
- (16) a. Billy broke all his fingers.
 - b. Billy broke every finger of his.
 - c. Billy s'est cassé tous les doigts. Billy REFLAUX broke all the fingers
- The English examples are said to be explained by the principle in (17), first proposed in Heim [1991] for indefinites and more generally by Sauerland [2002]:⁴

For the data we discuss in this paper, the simple account in (18) is however sufficient. We are aware

⁴More recent work in formal pragmatics has argued that MP should be subsumed under grammatical exhaustification, rather than tied to speech acts as in (18) [Marty, 2017]. Some of the relevant data involve antiduality. Specifically, Percus [2006] pointed out that (18) cannot account for antiduality in (17).

⁽¹⁷⁾ Everyone with exactly two students assigned the same exercise to both/#all of his students.

(18) Maximize Presupposition

Do not use ϕ in context c if ψ is an alternative to ϕ such that:

a. ψ has a stronger presupposition than ϕ .

b. ϕ and ψ are contextually equivalent in c.

Maximize Presupposition states that, given two alternatives with an identical at-issue content, a speaker should use the alternative that presupposes more. The anti-duality of all is generated via this principle as follows: all and both have the same at-issue content that states that a property in their scope is true of all elements in their restriction.
²⁴⁵ Comparing the presuppositions of all and both, both presupposes that there are two individuals, while all presupposes nothing. Therefore, if there are two individuals in the context of which a property is true, one must use both, making all infelicitous in such a context. This explains the contrast between (15) and (16), because legs generally come in twos, but not fingers. Similarly, the anti-singularity presupposition observed in (14) is
²⁵⁰ argued in Sauerland [2008] to arise from MP competition with the corresponding singular definite expression ('Billy broke his nose'), which has the same at-issue content as all but carries the presupposition that its domain contains only one individual.

The same mechanism applies for the anti-duality of *every*, assuming it also has the same at-issue content as *both*. Note that this story can only work if we also assume that number marking on the noun and verb are irrelevant for the possibility, since *every* calls for a singular complement, while *both* selects for a plural-marked complement.

The anti-duality of English *all/every* is straightforwardly explained by MP in their competition with *both*. How about French *tous*'s anti-duality? If French lacks a word for *both*, as mentioned in the introduction, we might expect its anti-duality to not arise as an implicated presupposition, but instead to be lexically encoded in the meaning of *tous*. We argue against this possibility, and show that the anti-duality of French *tous* exhibits the behavior of an implicated presupposition, in parallel with English *all*. We

focus on three signature characteristics from implicated presuppositions (the first two are from Sauerland 2008): a weak epistemic status, and the lack of universal projection in the scope of a universal quantifier, its suspension when the number of individuals in the domain is irrelevant.

First, (19) shows that the anti-dual inference of *every* and *tous* is epistemically weak: if there is ignorance about whether the domain contains two individuals, these quantifiers can be used (the French data here and throughout the paper is from two native speakers).

- 270 (19) Context: I don't know how many students there will be in my next class, there could be 2.
 - a. Every student in my next class will have to work hard.
 - b. Dans mon prochain cours, tous mes étudiants vont devoir travailler dur. in my next class all my students will have-to work hard

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The second characteristic feature of implicated presuppositions is that they need not project universally in the scope of a universal quantifier, in contrast to a typical presupposition [Chemla, 2009, Heim, 1983, Schlenker, 2008, a.o.]. Again, we see that French *tous* patterns with English *all* in this respect:

(20) Context: Several candidates applied. Some have written only one paper, others

of two accounts for Percus's observation (17), namely the dynamic account by Singh [2011] and the unexhaustification account by Elliott et al. [2022b], and both accounts are compatible with the proposals made in the present paper.

two, and the rest have written more than two.

- a. I checked, every candidate sent every paper of theirs.
- b. J'ai vérifié, chaque candidat a envoyé tous ses articles. I.AUX checked each candidate AUX sent all their articles

Contrast this with (21), where the dual presupposition of *both* and the uniqueness presupposition of the possessive pronoun *son* ('their') project universally:

- (21) Context: Several candidates applied. Some have written only one paper, others two, and the rest have written more than two.
 - a. #Every candidate sent both papers of theirs. \rightsquigarrow every candidate has exactly two papers
 - b. #Chaque candidat a envoyé son article. each candidate AUX sent their article \rightarrow every candidate has exactly one paper

These projection facts rule out lexical specification of *all*'s anti-duality: if it were a presupposition (e.g. one stating the domain of *all* is not known to be 2), we should expect it to behave like one and project universally from the scope of a universal quantifier.

Finally, we show that the anti-duality inference is suspendable when the number of individuals in the domain of the quantifier is irrelevant to the question under discussion.

²⁹⁵ This is expected given the general sensitivity of implicatures and implicated presuppositions to the QUD. We show below that *all* can be used in this case even when it is known that there are two individuals in the domain.

- (22) Context: I need a pencil to write something down, and I have two pencils on my desk, but both are broken.
 - a. Oh no, all my pencils are broken, I can't write.
 - b. Oh non, tous mes crayons sont cassés, je ne peux pas écrire. oh no all my pencils are broken I neg can neg write

Another case that makes this point is in (23), from Lauer [2016], which works in French as well.

- (23) A- Has Mary submitted the grades for all her students in her seminar?
 - B- How many people took it for credit?
 - A- [looks it up] Just two.

B- I see two grades. So she has submitted the grades for all her students.

- B- ... Donc elle a entré les notes pour tous ses élèves.
 - so she has submitted the grades for all her students

(minimally changed from Lauer 2016)

In (22) and (23) an utterance with the less-presupposing form (all) is felicitous even though the presupposition of the stronger competitor (both) is entailed in the context. Intuitively, the reason is that the salient overarching QUD only 'cares about' all vs. not-all (i.e., in (23), whether professors have submitted grades to all or not all of their students), with the domain size in each particular case (i.e., whether there are two or more students)
being irrelevant.

In sum, the facts above strongly suggest that the anti-dual meaning component of French *tous* is indeed an implicated presupposition.

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Proposal: Indirect Alternatives 4

We have put aside the possibility that the anti-duality of French tous is lexically encoded and established that it carries the signature of an implicated presupposition. Our proposal 320 will therefore maintain Chemla's original proposal that the anti-duality of tous is an implicated presupposition. However, since French does not have a word for 'both', we need to find a competitor to *tous* which carries a dual presupposition. Once this competitor is found, the use of tous is predicted, via Heim's MP in (18), to implicate anti-duality, as observed.

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We propose that the definite dual expression les deux NP VP ('the two NP VP') is an alternative to tous les NP VP ('all the NP VP'), albeit an atypical one, which we call an *indirect alternative.* We illustrate this novel concept in Figure 1. It is an alternative that is not generated directly by the grammar's basic alternative generation mechanism, but that is equivalent in meaning to a directly generated, but unpronounceable, alternative

330 (written between $\langle \rangle$ in Figure 1). In this case, we posit that in French, a *tous* expression has as a directly generated alternative a dual universal expression (with meaning 'both') that is blocked from pronunciation due to the presence of the unambiguous, equivalent, and at most as complex *les deux* expression, following a principle we call Avoid Ambiguity. This will therefore allow for *les deux* to enter in competition with the universal expression, 335

but not les trois ('the three') because there is no corresponding trial universal expression. In addition, an indirect alternative will be constrained to be as complex as an expression it is an alternative of. Les deux NP VP is not more complex than tous les NP VP, which means that it can act as an alternative to it. This complexity restriction will appropriately predict no anti-duality inferences for expressions other than the universal quantifier. For instance, which of the two is more complex than which, and therefore cannot act as an alternative to it (and there is no other expression in English equivalent in meaning to which of the two that is less complex than it).⁵



"les deux NP VP"

Figure 1: Indirect competition with tous les NP VP

We first show in section 4.1 that if *les deux NP VP* is generated as an alternative,

 $^{^{5}}$ We mention here an alternative formulation of the theory that makes the same predictions: tous les NP.DUAL VP is blocked by les deux NP VP following Avoid Ambiguity. But then we assume that the blocked expression can still be used as an alternative, even if it is not pronounceable. This formulation simplifies the algorithm in that we don't need to define the notion of "indirect alternative". However the predictions are different, and only further work will allow us to distinguish between the two theoretical options.

then MP is activated, due to the at-issue meaning equivalence between les deux NP VP 345 and tous les NP VP, and the former expression's stronger presupposition. In 4.2, we present the notion of indirect alternative, and in 4.3 show that les deux NP VP can be an indirect alternative to tous les NP VP as long as there is an equivalent unpronounceable alternative to tous les NP VP. In section 4.4, we define the nature of the unpronounceable dual universal expression, which allows for indirect competition with les deux NP VP. This 350

completes our proposal.

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In section 4.5, we discuss how an immediate prediction of the proposal is borne out: the possibility of saying tous les deux ('all the two'). In section 4.6, we offer a translation of this solution in a Meaning First framework, which provides a natural way to account for core concepts.

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4.1If 'the two' is an alternative to 'all the', then MP is licensed

In this section, we show that a sentence containing les deux NP and one containing tous les NP in the same position are contextually equivalent in a context where their presuppositions are satisfied, and only differ in their presupposed content, thus allowing for MP to apply.

(24)Tous les verres sont pleins. a. all the cups are full 'All the cups are full.'

discuss the collective reading below.

- b. Les deux verres sont pleins. the two cups are full 'The two cups are full.'
- We start with the definite numeral expression in (24-b). Numerals are typically as-365 sumed to indicate a lower bound (e.g., 'at least 2'), and achieve an exact number reading (e.g., 'exactly 2') through exhaustification of higher-number alternatives. We will skip this bulky step, and shortcut to deux ('two') having the meaning 'exactly 2'. Next, we adopt the familiar view of the definite article to be a maximality operator [Sharvy, 1980],
- taking the maximal sum of individuals present in the extension of its argument.⁶ We take the extension of a predicate to contain both atoms and pluralities, and denote the maximality operator using the σ operator, as in (25-b).

(25) a.
$$\llbracket (exactly) \text{ deux } \rrbracket = \lambda P.\lambda x. P(x) \land |\{y : atom(y) \land y \sqsubset x\}| = 2$$

b. $\llbracket \text{ les deux verres } \rrbracket = \sigma x. [cup(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2]$

We now make this compose with the VP sont pleins ('are full'). Since plein ('full') is 375 a distributive predicate, it must compose with the plural individual via a distributivity component. We introduce it as D in (26-a) as a universal quantifier over atomic individuals. A standard account distributes over contextual covers à la Schwarzschild 1996, however, it seems like distributivity over non-atomic covers is not available for definite descriptions with numerals, a fact which as far as we are aware has not been discussed 380 in the literature. Furthermore, for a domain of two individuals, either we have atomic quantification or a collective reading (no intermediate distributivity over covers), and we

⁶As far as we can see, our analysis is equally compatible with the maximal informativity based analysis of the definite determiner of von Fintel et al. [2014], but the empirical disadvantages of Sharvy's analysis compared to the maximal informativity based one do not cause any problems for the data we are considering.

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(26)

a. $[D \text{ sont pleins }] = \lambda x \cdot \forall z \cdot atom(z) \land z \sqsubset x \to full(z)$ b. [] les deux verres D sont pleins] =

$$\forall z.atom(z) \land z \sqsubset \sigma x.[cup(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2] \rightarrow full(z)$$

Now we turn to the semantics of the universal expression. We take French *tous* to be a universal quantifier over contextual covers of a definite plurality. This semantics is based on the selectional properties of *tous*, which can only compose with a noun phrase if ³⁹⁰ it is plural-marked, like in English, and via a definite article, unlike in English. We first consider a distributive reading over atoms.

(27) a. $\llbracket \text{tous } \rrbracket = \lambda x : \neg atom(x) . \lambda Q . \forall z.z \in C_x \to Q(z)$ $C_x \text{ is contextual cover of } x, \text{ i.e. it is a contextually-supplied set of subpluralities of } x \text{ whose grand join equals } x$

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- b. $\llbracket \text{tous}_{atom} \rrbracket = \lambda x : \neg atom(x) . \lambda Q. \forall z. atom(z) \land z \sqsubset x \to Q(z)$
- c. [[les verres]] = $\sigma x.cup(x)$
- d. [[tous les verres]] = $\lambda Q. \forall z.atom(z) \land z \sqsubset [\sigma x.cup(x)] \rightarrow Q(z)$
- e. $\llbracket \text{ sont pleins } \rrbracket = \lambda x.full(x)$
- f. [[tous les verres sont pleins]] = $\forall z.atom(z) \land z \sqsubset [\sigma x.cup(x)] \rightarrow full(z)$
- The at-issue meanings of the definite numeral expression in (26-b) and the *tous* expression in (27-d) are equivalent. (26-b) states that every atomic subpart of the maximal sum that makes *cup* true and has exactly 2 atoms is full. Ignoring the presuppositional component, the assertive component simply states that all cup atoms are full. This is equivalent to the meaning of (27-d). The presuppositional component of (27-d), introduced by the σ
- ⁴⁰⁵ operator, is that there is a maximal sum of cups. In (26-b), it is that there is a maximal sum of cups which contains exactly two atoms. This means that if the definite numeral expression in (26-b) can be generated as an alternative to the *tous* expression in (27-d), MP applies: (26-b) and (27-d) are contextually equivalent when presuppositions are satisfied, and (26-b) has a stronger presupposition than (27-d). Therefore, if the number of
- atoms is known to be exactly two, the presupposition of the definite numeral expression is satisfied, and the presuppositionally weaker *tous* expression is blocked.

Tous phrases are also compatible with collective predication (like English 'all'), as in the examples below.

(28) a. Toutes les fourmis ont soulevé le piano. all the ants have lifted the piano 'All the ants lifted the piano.'
b. Les deux fourmis ont soulevé le piano. the two ants have lifted the piano

'The two ants lifted the piano.'

The collective reading of *tous* is also anti-dual. We take collective readings of *tous* to arise from quantifying over the trivial singleton cover containing the whole plurality.

(29) a.
$$\llbracket \text{ toutes}_{coll} \rrbracket = \lambda x : \neg atom(x) . \lambda Q. \forall z \in C_0 : C_0 = \{x\} . Q(z) \equiv \lambda x . \lambda Q. Q(x)$$

b. $\llbracket \text{ toutes les fourmis} \rrbracket = \lambda Q. Q(\sigma x. ant(x))$
c. $\llbracket \text{ ont soulevé le piano} \rrbracket = \lambda x. lift-piano(x)$
d. $\llbracket \text{ toutes les fourmis ont soulevé le piano} \rrbracket = lift-piano(\sigma x. ant(x))$

This reading competes with the collective reading of the definite numeral:

425 (30) a. [[les deux fourmis]] =
$$\sigma x.[ant(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2]$$

b. [[les deux fourmis ont soulevé le piano]] = lift-piano $(\sigma x.[ant(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2]$

These readings are contextually equivalent, and differ only in their presuppositions, in the same way as above. The *tous* sentence presupposes the existence of a maximal sum of ants, and the definite numeral sentence presupposes the existence of a maximal sum of ants of exactly two individuals. Thus if the context entails there are exactly two ants, and the *les deux* sentence is generated as an alternative to the *tous* sentence, it must be used, by MP.

Tous sentences may also involve distributivity over intermediate contextual covers; we leave working out the relevant data and details to the reader.

One detail we have so far ignored is the difference in meaning typically observed between quantificational expressions and definite plural expressions. While plural definites are interpreted as 'quasi-universal', they are associated with two properties that distinguish them from universal quantification: non-maximality, namely exception tolerance, and homogeneity, referring to an apparent wide scope reading with respect to negation [Krifka, 1996, Malamud, 2012, Križ, 2015, Križ and Spector, 2021, Bar-Lev, 2018, 2021].

(31) a. Non-maximality:

	•
	J'ai lu les livres sur la liste.
	I read the books on the list.
	\rightsquigarrow compatible with not reading one or two books on the list.
b	Homogeneity:
	Je n'ai pas lu les livres sur la liste.
	I didn't read the books on the list.
	\rightsquigarrow I read no or almost no books on the list.
A universa	al quantifier which contains a plural definite, like English <i>all</i> an

⁴⁵⁰ A universal quantifier which contains a plural definite, like English *all* and French *tous*, is known to erase these two properties [Link, 1983, Dowty, 1987, Brisson, 1998, Malamud, 2012, Križ, 2015]: in its presence, neither homogeneity nor non-maximality are observed.

(32)	a.	Non-maximality removal by <i>tous/all</i> :
		J'ai lu tous les livres sur la liste.
455		I read all the books on the list.
		\rightsquigarrow not compatible with not reading one or two books on the list.
	b.	Homogeneity removal by tous/all:
		Je n'ai pas lu tous les livres sur la liste.
		I didn't read all the books on the list.

 \rightsquigarrow I read some books on the list.

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In the semantics provided above, these properties are ignored. We therefore need to question whether the meaning equivalence between the *tous* expression and the definite numeral expression persists once we account for these properties. We may not need to worry: indeed, we are comparing the meaning of a *tous* expression not with a plain plural

- definite, but with a plural definite containing a numeral. And there are reasons to believe that a numeral may also remove homogeneity and non-maximality. Definites numeral expressions have not received much attention in the literature; as far as we know, the only detailed discussion of them is in Križ [2015]. Križ reports that the presence of a numeral appears to remove non-maximality, as shown in (33-a), but he tentatively claims that
- 470 it doesn't remove homogeneity in English. However, he reports a possible contrast with

French, where definite numerals don't seem to conserve their homogeneity. According to our own judgments,⁷ there might also be a contrast between the two languages, although the data is very subtle, and it seems like there is at least one parse in both languages compatible with homogeneity removal (with the role of prosody unclear).

a. Non-maximality removal by a numeral: J'ai lu les deux/dix livres sur la liste. I read the two/ten books on the list.
→ not compatible with not reading one or two books on the list.
b. Homogeneity removal by a numeral?

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Je n'ai pas lu les deux/dix livres sur la liste.
I didn't read the two/ten books on the list.
→ compatible with reading some books on the list.
✓ J'en ai lu que un/cinq.
?√I only read one/five.

The facts with non-maximality removal appear to be quite robust, and should be enough to make the claim that a definite numeral expression is contextually equivalent to a quantified expression, when these are unembedded. As for homogeneity removal, 485 we will rely on the French facts, which are those we need to make our point.⁸ There is a clear contrast between a plain definite plural and one with a numeral, where the one with a numeral has a non-homogeneous reading $(\neg > N)$ available. This homogeneity removal, however, appears less robust than the one with tous, in that an apparent wide scope reading of the numeral $(N > \neg)$ still appears to be available. One could argue 490 that homogeneity removal with tous is particularly clear because of the presence of a scalar implicature (due to tous competing with quelques ('some')) incompatible with the homogeneous reading, which the definite numeral lacks. Either way, we would like to emphasize the crucial point for our purposes, namely that there exists a non-homogeneous parse of the definite numeral. This matters in a sentence where a quantifier expression like 495 tous les verres scopes below negation, as in (34), and still has an anti-duality inference. This inference would rest on the non-homogeneous parse of the definite numeral expression les deux verres scoping below negation, as in (35).

(34)	a.	Pas tous les verres sont pleins.	
		not all the cups are full	
		'Not all the cups are full.'	$odd \ if \ only \ 2 \ cups$
	b.	Les deux verres ne sont pas pleins.	
		the two cups neg are neg full	
		'The two cups are not full.'	$\checkmark \neg > 2$

4.2 Indirect alternatives: definitions

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In this section we define the notion of *indirect alternative*, that depends on the existence of *unpronounceable alternatives*. We leave the possibilities of what counts as an unpronounceable alternative to section 4.4, and in this section simply assume that it exists.

We adopt the standard alternative generation mechanism proposed by Katzir [2007],

 $^{^7 {\}rm Judgments}$ are of the first author, native speaker of French and English, and of the third author, native speaker of French.

⁸Nina Haslinger, p.c., questions homogeneity removal by numerals in general. She suggests other ways of allowing for a *les deux* sentence to compete with a *tous* sentence in relevant cases. For instance, we may allow for MP to apply before negation is introduced. Or, in contexts in which *tous/all* is licensed, the QUD must be such that the definite plural has a maximal reading. Since the whole topic is of yet poorly understood, we leave a final account of this competition for the future.

where alternatives are obtained from deleting constituents, or replacing a constituent with a lexical item of the same syntactic category. We cite the whole definition below (this merges definitions (18), (19), (20) and (41) of Katzir's (2007) paper).

- (35) A structural alternative of a parse tree ϕ is a parse tree ψ obtained from ϕ by a finite series of deletions (removing edges and nodes), contractions (removing an edge and identifying its end nodes), and replacements of constituents in ϕ with lexical items of the same syntactic category or subtrees of ϕ . [Katzir, 2007]
- The notion 'of the same syntactic category' is crucial for our purposes: this restriction entails that *les n NP*, for any numeral *n*, is not generated as an alternative to *tous les* NP because *tous*, a quantifier, is not replaceable by *les*, a determiner, and *les* is not replaceable by a numeral. So *tous les NP* cannot have *les n NP*, for any *n*, as a structural alternative. Thus, *les deux NP* is not directly generated as an alternative by the Katzirian ⁵²⁰ algorithm.

Instead, we propose that we can generate it as an indirect alternative via an unpronounceable alternative. An unpronounceable alternative, defined in (36), is a linguistic object directly generated as an alternative which has a meaning but is not mapped to any phonological representation, and thus cannot be uttered. We assume that French has an unpronounceable dual universal alternative. The reason why it is unpronounceable will

be addressed in section 4.4.2.

(ii)

(36) An **unpronounceable alternative** is an expression obtained from the grammar's alternative generation mechanism, but cannot be pronounced.

We assume that direct competition with an unpronounceable alternative is impossible. ⁵³⁰ However, competition is licensed with a pronounceable expression equivalent in meaning to it, an indirect alternative. We define the notion of indirect alternative below.

- (37) A pronounceable parse tree I is an indirect alternative of a parse tree S iff there is an unpronounceable alternative S_X of S such that:
 (i) [[I]] ≡ [[S_X]], and
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 $I \preccurlyeq S$:= I has at most as many nodes as S.

Both the Katzirian alternative and the indirect alternative is defined to be at most as complex, in some way, as the expression it is an alternative to. However, the notions of complexity used in the two definitions are not the same. Katzir's notion of complexity, which is directly integrated into the definition of structural alternatives, only allows comparison between parse trees that are related by the Katzirian algorithm. This means that the Katzirian complexity of an expression cannot be compared to that of an indirect alternative, which is by definition not related in a Katzirian way. Thus we appeal to a more general notion of complexity, which is number of nodes in the tree, and which is applicable to comparing any two parse trees.

⁵⁴⁵ We discuss possible overgeneration issues of this notion of complexity in the following section.

4.3 'The two' satisfies the complexity limit for indirect alternatives

Now we show that *les deux NP VP* is a good candidate for being an indirect alternative to *tous les NP VP*, because it is at most as complex as it, i.e., has at most as many nodes as it. *Les deux NP* and *tous les NP* have identical complexity, with (at least) three overt

terminal nodes each (each a syntactic head). Then they both merge in identical fashion with the VP.

- Thus, the complexity requirement for *les deux NP VP* being an indirect alternative to *tous les NP VP* is satisfied. This means that it is an indirect alternative to it if there is an unpronounceable expression that is directly generated as an alternative to *tous les NP VP*, and equivalent in meaning to *les deux NP VP*. The nature of this unpronounceable alternative is the topic of the upcoming section 4.4.
- This complexity requirement accurately blocks other NP-containing expressions from having indirect dual alternatives. For instance, there is no expression in English or French equivalent to 'which of the two NP', simpler than 'which (of the) NP'. So, even if 'which of the two NP' is equivalent in meaning to an unpronounceable dual alternative, there is no indirect alternative licensing competition, and no anti-duality is derived. The same reasoning applies to other expressions that do not exhibit anti-duality such as 'each NP', 'one NP', 'the NP'. We continue the discussion of anti-duality, or lack thereof, with other quantifiers and cross-linguistically, in section 5.

However, as is, this notion of complexity might overgenerate (as pointed out to us by Yasutada Sudo, p.c.). In particular, it might admit a sentence such as "At the current time, which oak tree is visible?", to have an anti-duality inference via the expression "Which of the two oak trees is visible now?" which has less syntactic nodes, and thus satisfies the complexity requirement for indirect alternatives. First, one might question whether 'at the current time' is exactly equivalent in meaning to 'now'. An immediate difference one can intuit is that 'at the current time' appears to refer to a wider interval than 'now' (compare 'we need it now' vs. 'we need it at the current time'). So more generally, it may be exceedingly difficult to find an expression of the type containing *which* that is more complex than one containing *which of the two*, as it would rely on an exact meaning equivalence between two expressions of different complexities. We leave this as an open question.

We may also propose a solution to such overgeneration in which the requirement for 580 indirect alternatives applies not just at the end of the derivation, but also at certain intermediate points in the derivation (a natural point to implement this requirement would be at each phase boundary). For instance, one such point would be at any CP level. Then, if $XP_1 CP_1$ has as an indirect alternative $XP_2 CP_2$, then CP_1 must have as an alternative, direct or indirect, CP_2 (and possibly also XP_1 must have as an alternative 585 XP_2). If CP is such a level, we must also seriously consider smaller constituents argued to be phases. Above, we argued for the whole sentence les deux NP VP being an indirect alternative to tous les NP VP. This is because les deux NP, of type e, cannot be equivalent to tous les NP, of type $\langle e, et \rangle$. If the requirement for indirect alternatives must apply at smaller constituents than the CP, e.g. the vP, then we need to make the DP les deux 590 NP an indirect alternative to the QP tous les NP. We can do this simply by type-lifting the meaning of les deux NP from type e to type $\langle et, t \rangle$, which makes it equivalent in meaning to tous les NP.⁹ A full proposal for the exact timing of indirect alternative

 $^{^{9}}$ A possible remaining worry is the case of floating quantifiers. Indeed, when *tous* is floated, as in (39), it maintains its anti-duality inference.

⁽³⁹⁾ Les verres sont tous pleins. the glasses are all full

generation for future work (and may be considered together with the timing of direct ⁵⁹⁵ alternative generation, which is itself an open question).

4.4 The unpronounceable dual alternative to tous les NP

The data on French *tous*'s anti-duality reveals that language makes the concept 'two' important in some sense. This observation corroborates data in various domains in which duality is lexicalized, but not triality, etc. For instance, *both* is lexicalized in English, but not something equivalent to 'all the 3'. Languages have dual pronouns, but many fewer have trial pronouns.¹⁰ Thus, there is on the one hand an intuition that the number '2' is conceptually more prominent in some way than any other higher numeral, and on the other this prominence is grammaticalized, as there are reflexes in language that show this. Following Chemla's (2007) insight, we propose that a universal dual number concept DUAL is integrated in the grammar of every language, and that this core concept is responsible for the presence of a dual universal alternative to the French universal quantifier *tous*.

In this section, we propose the existence of a dual universal expression tous les DUAL NP, built from a core number concept DUAL, to be an unpronounceable alternative to tous les PL NP, which licenses competition with the indirect alternative les deux NP.

610 4.4.1 The core concept DUAL

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We propose that there exist *core concepts*, which include the core concept DUAL, which are universally present in the lexicon of any language. We assume that core concepts are either phonologically null or non-null, and in the latter case they can be phonologically realized together with another operator. For example, in English, we assume that DUAL in the restrictor of a universal quantifier is realized as *both*. In French, DUAL has no phonological realization in the restrictor of a universal quantifier.

We assume that the core concept DUAL is available alongside the number concepts plural and singular (presumably also core concepts, but we have no immediate evidence for this hypothesis, nor current need to entertain it), and can thus combine with any NP. As a consequence, in a language where dual is unpronounced, a string containing a plural-marked NP is ambiguous between a plural and a dual interpretation. This will be

possible in the scope of a universal quantifier as well, allowing the structure *tous les* DUAL *NP* to be generated.

This proposal can be aligned with that of Harbour [2014], who proposes that the dual arises from the interaction of primitive number features [-atomic] and [+minimal]. We depart from Harbour and subsequent authors in assuming that the dual is universally present, meaning that both [atomic] and [minimal] features are present in all languages, despite not being morphologically expressed. Their universality is thus often invisible, but is revealed in some corners of grammar, such as with the anti-duality of *tous* in French. See

the appendix (section 8) for an implementation of the following proposal using Harbour's features. In this section, we simply assume that universal number features include SG, PL and DUAL.

^{&#}x27;The glasses are all full.'

We adopt an analysis of floating quantifiers à la Sportiche [1988], in which the DP in preverbal position originates low, together with the quantifier. Then, we assume that the indirect alternative requirement applies before this movement takes place.

¹⁰Other numbers can be lexicalized, e.g. *thrice*, *dozen*, etc, but are much rarer than lexicalizations of the dual.

4.4.2 Blocking the dual universal expression

We propose an economy principle that blocks this dual universal structure from pronunciation because of the presence of an unambiguous string equivalent in meaning to it (once it combines with a VP), and at most as complex as it: *les deux NP*. This principle, which we call 'Avoid Ambiguity', defined in (40), encodes the preference to express a given meaning using an unambiguous string (compatible with only one logical form) rather than an ambiguous string (compatible with more than one logical form). We also encode a complexity requirement in (40), were the unambiguous string must be at most

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encode a complexity requirement in (40), were the unambiguous string must be at most as complex as the ambiguous string, which in reality might be a result of the interaction with an independent pressure favoring less complex expressions.

(40) **Avoid Ambiguity:** if a string S is ambiguous between two parses P1 and P2, and there is a string S' with a parse P1' whose meaning is equivalent to P1, but no parse P2' equivalent to P2, and S' is structurally at most as complex as S, then P1 is blocked from being pronounced (i.e. string S cannot realize parse P1).

The string 'tous les NP' is ambiguous between a plural reading tous les PL NP and a dual reading tous les DUAL NP. Tous les DUAL NP VP is equivalent in meaning to the expression les deux NP VP (as we are about to show), which is not more complex than it. Therefore, according to (40), the parse tous les DUAL NP VP cannot be pronounced.

We now show the meaning equivalence between tous les DUAL NP VP and les deux NP VP. We propose that the number concept DUAL has the semantics equivalent to 'exactly 2'.¹¹

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(41) a. $\llbracket \text{ DUAL } \rrbracket = \lambda P \cdot \lambda x \cdot P(x) \land |\{y : atom(y) \land y \sqsubset x\}| = 2$

b. [[les DUAL verres]] = $\sigma x.[cup(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2]$

c. $\llbracket \text{ tous les DUAL verres } \rrbracket = \lambda Q. \forall z. z \sqsubset [\sigma x. cup(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2] \rightarrow Q(z)$

We compose this dual universal quantifier with the predicate *sont pleins* ('are full') (whose semantics, as assumed earlier in (26-a), contains a distributivity component).

$$\begin{array}{l} \text{(42)} \quad \left[\left[\text{ tous les DUAL verres sont pleins } \right] \right] = \\ \forall z.z \sqsubset \left[\sigma x.cup(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2 \right] \rightarrow \left[\forall y.atom(y) \land y \sqsubset z \rightarrow full(y) \right] \\ \equiv \forall z.atom(z) \land z \sqsubset \left[\sigma x.cup(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2 \right] \rightarrow full(z) \end{array}$$

We can see that this meaning is equivalent to the one generated by the definite numeral expression, which we already derived in (26-b), repeated below (modulo interaction with homogeneity, which we decided should not play a role in this case, as discussed in that section).

(43) $[\![les deux verres sont pleins]\!] = \\ \forall z.atom(z) \land z \sqsubset \sigma x.[cup(x) \land |\{y|atom(y) \land y \sqsubset x\}| = 2] \rightarrow full(z)$

We note a potential empirical problem with (40): what if we have a string S with parse P1 and P2, and a string S' with parse P1' and P3, where [P1] = [P1'], but [P2] and [P3] are independent. Such a case might be exemplified, as brought up by an anonymous

¹¹The result would have been identical, in this case, if DUAL had had a lower bound semantics, as is sometimes proposed for numerals. However, we assume here an exact semantics for DUAL, in order to align it with a proposal à la Harbour sketched in section 8, in which we reduce DUAL to a feature bundle whose semantics will be 'exactly 2'.

reviewer, of an determinerless language which exhibits ambiguity between definite and indefinite NPs (and also does not have word for *both*): 'all NP VP' will be ambiguous between a dual and a plural reading, which might inherit definiteness from universal quantification, while 'two NP VP' will be ambiguous between a definite and an indefinite (dual) reading. In this case, the Avoid Ambiguity principle faces a conundrum: it should block P1 of S, because S' is not ambiguous between [P1]] and [[P2]], or P1' of S', because S is not ambiguous between [[P1]] and [[P3]]? We do not know what happens empirically in such a language, and thus we leave such cases for future research.

- ⁶⁸⁰ There are other cases of potentially problematic predictions of (40), as pointed out by Y. Sudo, p.c.: the sentence "Everyone didn't come on time" has a scope ambiguity, and the "every ¿ not" reading is taken to be equivalent with the unambiguous sentence "No one came on time": why isn't the wide scope reading of *everyone* blocked? We believe that the two readings of the former sentence are differentiated by prosody. We also question,
- ⁶⁸⁵ following our intuitions, the exact meaning equivalence between "everyone...not" and "noone", for instance in that "everyone" presupposes the existence of specific individuals, but "no-one" doesn't. Exploring it fully is beyond the scope of this paper. Another case is that the sentence "I move the cup on the shelf" can be disambiguated towards one interpretation by using a directional preposition "I move the cup onto the shelf": but
- are on and onto really completely equivalent? This comes back to the question discussed earlier in section 4.3 about whether full synonymy is ever observed in language. We could otherwise consider a modification of (40) where the ambiguity may be of a particular type, e.g. two parses that differ by silent operators. Deciding on the best formulation of (40) requires a full project's worth of work that is beyond the scope of this paper.

695 4.4.3 Indirect competition licensed

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Tous les DUAL NP VP is a Katzirian alternative to tous les PL NP VP, where PL is replaced by DUAL. However, as we showed above, tous les DUAL NP VP is blocked from pronunciation. Therefore competition with it is not licensed, but competition with the indirect alternative les deux NP VP is, since it is equivalent in meaning to tous les DUAL NP VP, as shown above, and at most as complex as tous les NP VP.

As a result, the anti-duality of French tous les NP ('all the NP') comes from MP in the indirect competition with les deux NP ('the two NP') via the conceptual alternative tous les DUAL NP (after combining with the rest of the sentence).

We have given a solution that relies on the existence of core concepts, which, even when blocked from pronunciation, can play a role in alternative generation, if an indirect alternative is present.

4.5 A borne out prediction: tous les deux

Based on the current assumptions, the analysis makes a prediction: the numeral deux ('two') can be in the restrictor of tous.

Recall that the dual universal alternative 'tous les DUAL NP' is blocked due to its phonological identity with a structure with different meaning, namely, 'tous les NP', and the availability of a semantically equivalent unambiguous structure, namely, 'les deux NP'.

Now, we can also have a structure 'tous les DUAL deux enfants'. The spellout of this ⁷¹⁵ structure is unambiguous. Therefore it shouldn't be blocked, and we thus predict the numeral to be in the restrictor of *tous*. This is what we observe, in some cases, as shown below.

(44)	a.	Tous les deux sont venus.
		all the two are came
		'Both came.'
	b.	{Les enfants, Ils} sont tous les deux venus.
		the children they are all the two came
		'{The children, they} both came.'

Note that this is mainly observed when the noun is elided, or in a floating quantifier position. When the noun is not elided, the use of numerals is highly restricted. This is the case not only for *deux* but for any numeral. For instance, sentences such as (45) are ill-formed.

- (45) a. *Tous les deux enfants sont venus. all the two children are came
 - b. *Tous les trois/dix enfants sont venus.
 - all the three/ten children are came

As pointed out by a reviewer however, a few examples of the type *tous les deux NP* –even though marked– can be found online. Crucially, such examples involve either *deux* or other numerals, and are equally marked.¹²

Thus, the fact that *deux* is highly marked when the noun is not elided is due to an independent constraint on numerals being generally disallowed in the scope of *tous*. The reason behind this intriguing phenomenon is beyond the scope of this paper.

Note that in English, *all two* is ungrammatical (compare to *all three* which is not). This is predicted if *both* is a lexicalization of *all* and the dual concept, which blocks any other realization of it.

4.6 Indirect alternatives in the Meaning First approach

In this section, we maintain the idea of competing with a core concept, but switch to a Meaning First approach [Sauerland and Alexiadou, 2020], in which such objects can be naturally incorporated into the ontology.

The Meaning First approach contrasts with a standard syntax-first Y-model in postulating that language results from the compression of structured thoughts into phonological representations as shown in Figure 2, where thought structures are universal, and recoverable pieces of thought need not be phonologically realized.

(46) a. Toutes les deux tours sont recouvertes d'un chatior pointu d'une forme de pyramide all the two towers are covered of-a tented.roof pointy of-the shape of pyramid octogonale. octagonal

'Both towers are covered by a tented roof in the shape of an octogonal pyramid.'

b. Il existait des raisons plausibles de soupçonner tous les dix suspects de faire partie there existed of the reasons plausible of suspect all the ten suspects of do part d'un groupe criminel organisé.

of-a group crime organized

'There were plausible grounds for suspecting all ten suspects of being part of an organized crime group.'

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 $^{^{12}}$ See e.g., (46-a) which includes the numeral deux and (46-b) which includes the numeral dix 'ten'.

Thought Structure	\longrightarrow Compression	Articulation
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Figure 2: Meaning First architecture of grammar [Sauerland and Alexiadou, 2020]

- The Meaning First architecture assumes the existence of a set of primitive concepts from which conceptual representations are built and proposes furthermore that some of these primimites are universal. We can thus say that the 'core concept' DUAL is one of these universal primitives, and can freely combine with other concepts as part of the combinatorial system of conceptual objects that feeds language.
- The Meaning First architecture assumes furthermore that there is a competition similar to scalar implicature computation or exhaustification at the thought level. For our present purposes, we state this mechanism in (47). Specifically, we assume that alternatives are generated at the thought level, but that they can only feed into competition mechanisms if they can be articulated by a form that is not more complex than the articulation of the present utterance.
 - (47) **Thought competition:** A thought T will compete with an alternative thought T' if there exists a compressed form (phonological form) of a thought C(T'') such that $C(T'') \preccurlyeq C(T)$ (under some notion of complexity adapted to compressed forms), and $T'' \equiv T'$.
- Furthermore we assume by adapting Katzir's (2007) notion of complexity to (47) that a thought structure always has as an alternative a thought structure that differs from it by a primitive concept (either added, removed, or replaced with another). Let T be a thought of a universal quantificational claim over subparts of a plurality, which would be compressed into 'all the Ps Q'. T^* is an alternative to T where the core concept DUAL was added (via predicate modification) to its restrictor, where DUAL is a property of pluralities which counts its atoms and returns true if there are exactly 2.

$$\begin{array}{ll} (48) & \text{a.} & T = \forall y \sqsubset \sigma x \ . \ P(x) \to Q(y) \\ & \text{b.} & T^* = \forall y \sqsubset \sigma x \ . \ \text{DUAL}(x) \land P(x) \to Q(y) \end{array}$$

As shown in section 4.4.1, T^* is equivalent to the meaning of *les deux Ps Q* (i.e., to the thought which compresses into this phonological form). Therefore competition between T and T^* is licensed. Consequently, the anti-duality of *tous* is predicted.

5 Anti-Duality and its Absence with Other Quantifiers

In this section, we further discuss the second one of the puzzles for Chemla's (2007) proposal that we mentioned in the introduction. The puzzle is that the presence of a lexicalized dual quantifier in one language does not predict anti-duality of corresponding non-dual quantifiers across languages, contrary to what one might expect given French anti-dual *tous*.

5.1 Lack of anti-duality of which, some, each

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We first look at languages like Icelandic and Japanese, which express duality with quantifiers other than *all*—namely *some*, *which*, and *each*—where neither English nor French express duality. We furthermore observe that the non-dual counterparts to those quantifiers in Icelandic and Japanese are anti-dual. But this anti-duality is not observed in

English and French *some*, *which*, and *each*, which do not have dual counterparts. We initially discuss *which*-phrases, presenting the gist of our argument, and will return to other quantifiers later in this section.

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5.1.1 No indirect alternatives for *which* phrases

Recall from Section 2 that, in both Icelandic and Japanese, the dual marked *which*-phrase must be used when the domain of the *which*-phrase has exactly two elements, shown in (49) and (50), repeated from (6) and (7). The number-general *which*-phrase in (b) can in both languages only be used if the domain of the *which*-phrase has three or more elements.

- (49) ICELANDIC, repeated from (6)
 - a. Á hvor-um handlegg-num brotna-i hún? on which.DUAL-DAT arm-DAT.DEF break.INT-PST she 'Which arm did she break?'
 - b. ?À hvaa handlegg brotna-i hún? on which arm.DAT broke.INT-PST she

795 (50) JAPANESE, repeated from $(7)^{13}$

- a. Taroo-wa dotti-no ude-o o-tta-no? Taro-TOP IND.DUAL-GEN arm-NOM break-past-Q 'Which arm did Taro break?'
- b. #Taroo-wa dono ude-o o-tta-no? Taro-TOP IND arm-ACC break-past-Q

The data points in (53) and (54) show that the number-general form of *which* must ⁸⁰⁰ be used with domains of numerosity greater than two in both Icelandic and Japanese.

- (53) ICELANDIC
 - a. *Á hvor-um fingr-i brotna-i hún? on which.DUAL-DAT finger-DAT broke.INT-PST she
 b. Á hvaa fingr-i brotna-i hún? on which finger-dat broke.INT-PST she

(51) Eki-wa **dotti**-desu-ka? station-TOP which.direction-copula-Q 'Which direction is the station?'

This is presumably due to the fact that *dotti* in its direction sense is not the same lexical item as *dotti* translated as plain 'which', and it simply does not have a lexicalized dual variant. Further support for a lexical separation between the directional and non-directional senses of *dotti* is that the pronominal version *dore* of *dotti* does not have a directional use. (52) can be used only to ask which building is the station, not which direction the station is.

(52) Eki-wa dore-desu-ka? station-TOP IND-COPULA-Q 'Which one is the station?'

¹³Note that (50)a has a genitive marker whereas (50)b does not, possibly casting doubt that they are equivalent with respect to their structural complexity. Following Kuno [1973] we assume that the lack of genitive case marker with (50)b is due to Haplology triggering deletion of the case marker. This means that *dono* in (50)b is underlyingly *dono-GEN* and is thus just as complex as *dotti-no*.

Another comment about the Japanese data, pointed out by Yasutada Sudo (p.c.), is that dotti (as well as its formal variant dotira) do not exhibit a duality presupposition when used with directions: For example, (51) is acceptable in a situation where the road splits three-ways:

'Which finger did she break?'

805 (54) JAPANESE

- a. #Taroo-no dotti-no yubi-ga oreta-no? Taro-GEN IND-DUAL-GEN finger-NOM broke-Q
- b. Taroo-no dono yubi-ga oreta-no? Taro-GEN IND finger-NOM broke-Q 'Which of Taro's fingers broke?'

The number-general *which*-phrases in English and French, on the other hand, can be used also if the domain of the *which*-phrase has two elements as shown by (55) and (56).

- (55) ENGLISH, repeated from (10) Which arm hurts you?
- (56) FRENCH, repeated from (11) Quel bras te fait mal? which arm you cause pain 'Which arm hurts you?'

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The absence of anti-duality in English and French is not predicted by a simple proposal in which DUAL is a non-lexicalized core concept with no additional stipulations, as in the ones suggested by Chemla [2007] or developed by Aravind [2018]. If this core concept exists, we expect that the dual *which* words in Icelandic and Japanese are formed by combining this DUAL concept and the WHICH operator. If this is possible in Icelandic and Japanese, this combination should also be possible in other languages like French and English that don't lexicalize dual *which*. We therefore should have in those languages unpronounceable dual alternatives which would lead to anti-duality on *which* and *each* by MP. However this is not what we observe.

We show how the account we proposed in section 4 predicts the absence of anti-duality for English and French *which*-phrases and other relevant cases. We maintain that dual *which* is indeed an alternative in those languages, but that there is no other expression that blocks its pronounciation as it would be predicted by the Avoid Ambiguity principle in (40) (and consequently stands in for it as an indirect alternative as defined in (37)). In other words, we assume that dual *which* is pronounceable as a simple *which* phrase,

which is ambiguous between a dual and a plural meaning.

We note that there are at least two meanings one might ascribe to the combination of the DUAL morpheme and a quantifier, namely, duality could apply to either the domain of a quantifier or to its verifier. We define these two interpretations of number marking on a quantifier formally in (57), where we assume that a morpheme M with an interpretation M of type $\langle e, t \rangle$ is a number morpheme if $\forall x, y \in D_e$. $\#x = \#y \to M(x) = M(y)$.

- (57) For a number-morpheme M occurring with a quantificational noun phrase in a structure T = '[Q NP]-M S', we distinguish:
 - a. domain application of M: The interpretation of T is equivalent to the application of M to the referent of 'the NP' conjoined with the interpretation of 'Q(NP)(S)'.¹⁴
 - b. verifier application of M: The interpretation of T is equivalent to the application of M to the referent of 'the [NP and S]' conjoined with the interpretation of 'Q(NP)(S)'.

⁸⁴⁵ Both of these meanings are attested cross-linguistically. Therefore both should be considered as possible alternatives available to competition with their non-dual counterparts.

First, consider domain duality. Both Icelandic *hvor* and Japanese *dotti* exhibit domain duality. This follows from the datum in (49) and (50) as the domain of *which* is the set
of two arms, but the expected answer is about a singular arm. Why do we not observe domain anti-duality with *which*-questions in English? In English, one way to express domain duality in a question is to use partitive of and the numeral *two* as in (59).

(59) Which of the two arms hurts you?

But (59) is more complex than (the dual reading of) (55), thus the dual reading of English
which is not blocked from pronounciation by the Avoid Ambiguity principle in (40). The same holds for any other way of expressing a dual meaning equivalent to (59) that we can think of: 'Which of your left and right arm hurts you?', 'Does your left or right arm hurt you?' and 'Which arm of two hurts you?'. Therefore, in English in French, we do not have any expression that can stand in for the dual reading of English which to block it
from pronounciation and make its plural reading unambiguously anti-dual by MP as an indirect alternative.

Let us now discuss verifier duality. With plural marking, verifier plurality is attested with plural marking on interrogative pronouns in several languages including English, Farsi, Spanish, Hungarian, Greek, and German [Maldonado, 2020, Elliott et al., 2022a,

- Alonso-Ovalle and Rouillard, 2023]. Consider the English plural *which*-phrase in (60). Domain plurality would be satisfied if the addressee has multiple fingernails. But the effect of plurality in (60) is stronger – it is interpreted as a presupposition of the question that the addressee painted a plurality of their fingernails.
 - (60) Which fingernails of yours did you paint?
- These are also languages which obligatorily mark plurality on nominals; there are languages that have obligatory dual marking, like Slovenian. We consequently observe verifier duality on *which* phrases.
 - (61) Kater-a računalnik-a sta pokvarjen-a? which-DUAL computer-DUAL are.DUAL broken-DUAL? 'Which two computers are broken?'
- Although this meaning is available in Slovenian, no anti-duality is predicted in counterparts with non-dual marking languages because no indirect alternative exists. Two ways to express the verifier duality interpretation in English are given in (62), but both of these are based on more complex structures than (55), and therefore do not block the dual meaning from being pronounced.

¹⁴A question arises as to the compositionality of this meaning: in the case of all the DUAL NP, the meaning of DUAL applies the NP meaning. But in cases of which phrases and existential quantifiers, applying DUAL to the NP does not yield the right meaning. One possibility is that every quantificational phrase has a syntactically represented restrictor argument, at which DUAL can apply, whether it is pronounced or not. So a 'which' phrase has the structure in (58-a) with a choice of spellouts in (58-b) and (58-c). To obtain domain application of M, it appears in the restrictor, as shown below.

⁽⁵⁸⁾ a. Structure: Which [one cup] [of the DUAL cups] is full?

b. Spellout 1: Which (one) cup of the DUAL cups is full?

c. Spellout 2: Which one cup of the DUAL cups is full?

880 (62)

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- Which two fingernails of yours did you paint?
- b. Which pair of fingernails of yours did you paint?

5.1.2 Each, one

a.

The account carries over to the case of dual marking on existential and universal distributive quantifiers. The attested cases of anti-duality from Japanese (63) and (64) involve domain duality, so we start with that (note that in all Japanese cases we look at, namely *which, each* and *one*, they are built from the dual 'indeterminate' pronoun *dotti*).

(63) Repeated from (8)

- a. Taroo-wa dotti-no ude-mo o-tta. Taro-TOP IND.DUAL-GEN arm-MO break-PAST 'Taro broke each of his arms.'
- b. #Taroo-wa dono ude-mo o-tta. Taro-TOP IND arm-MO break-PAST

(64) Repeated from (9)

- a. Taroo-wa dotti-no ude-ka-o o-tta. Taro-TOP IND.DUAL-GEN arm-KA-ACC break-PAST 'Taro broke one of his arms.'
- b. #Taroo-wa dono ude-ka-o o-tta. Taro-TOP IND arm-KA-ACC break-PAST
- ⁸⁹⁵ But as with *which* above, English requires a partitive structure to express domain duality, and no simple enough expression exists that could express domain duality and block the dual readings of *one* and *each*. The best candidates below are more complex than their number-general counterparts.
 - (65) Taro broke one / each of the two arms.
- Verifier duality, on the other hand, is actually observed with existential one or a in English. But in this case, the English numeral two and the plural form are generated as direct alternatives, and excluded via scalar implicature, which is fully consistent with our proposal. Finally, the type of meaning that would predict verifier (anti)-duality for each feels unnatural, at least in English. Verifier duality for each finger broke would be equivalent to 'the broken fingers are 2 and each finger broke', which entails there being 2 fingers, and is equivalent in this case to domain duality at least in unembedded cases. The most natural dual expression in English is thus 'each of the two fingers broke', and the problem is the same as with domain duality.
- In sum, we have shown that our account predicts correctly that despite the presence of dual-marked quantifiers other than *both* in Icelandic and Japanese, there are no antiduality inferences with quantifiers other than *all* and *every* in English. Such a prediction is only possible given the need for at most as complex equivalent expressions to block the dual meanings from pronounciation and stand in for them as indirect alternatives to license MP competition.

915 5.2 (Lack of) anti-duality with no

English has a dual negative existential quantifier *neither*, and corresponding dual NPI *either*. Their presence seems to induce an anti-duality inference in the non-dual counterparts no(ne) and *any*.

- (66) a. (i) {#No side(s), Neither side} of this sheet of paper has/have been used.¹⁵
 - (ii) {#None, neither} of the sides of this sheet of paper has been used.
 - A: Which of the two did you pick?
 - B: $\{\#None, Neither\}.$
 - c. I didn't tell {#any, either} of our parents.
 - d. {#None, neither} of the two (children) spoke.

In contrast, negative quantifiers in French do not seem to carry anti-duality. The French counterparts of the no(ne) examples in (66) are much better, as shown in (67).

- (67) a. (i) Aucun côté de cette feuille n'a été utilisé.
 no side of this paper neg=has been used
 '{#No, Neither} side of this sheet of paper has been used.'
 - (ii) Aucun des côtés de cette feuille a été utilisé.
 no of the sides of this paper has been used
 '{#None, neither} of the sides of this sheet of paper has been used.'
 - b. A: Lequel des deux as-tu choisi? the.which of two have-you picked 'Which of the two did you pick?'
 - B: J'en ai choisi aucun. I=part have picked none 'I picked neither.'
 - c. Je ne l'ai dit à aucun de nos parents. I neg it.have said to none of our parents 'I didn't tell either of our parents.'
 - d. Aucun des deux (enfants) a parlé.
 none of.the two (children) has spoken
 'Neither (lit. 'none') of the two (children) spoke.'
- Note: in French, all examples are fine, but we have identified an intuition that there is pressure to specify the domain with 'aucun', but this seems to not be specific to two individuals.

German is also of interest at this point because like French it lacks a dual negative existential, while it has a dual universal *beide* ('both') like English. Like in French, the negative indefinite in German is fully acceptable with a dual domain as (68) illustrates. This shows that the antiduality of negative indefinites in English is due to the presence of the lexical item *neither*.

- (68) Keine der Seiten kann gewinnen. none.SG the.GEN sides can.SG win 'Neither (lit. *no*) of the the sides can win.'
- This data is explained by our analysis. Indeed, while there is a dual conceptual alternative generated by applying DUAL to the domain of the quantifier, via domain application as in (57), there is no unambiguous expression equivalent in meaning to it that is at most as complex. The smallest expressions with this meaning are *aucun des deux* ('none of the two'), or *ni l'un ni l'autre* ('neither one nor the other'), which are more complex than *aucun*.

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b.

¹⁵We note the intriguing observation that when the domain is known to be small and/or made up of specific individuals (further work required to determined this), the singular-marked negative generalized quantifier ("no side") is markedly better than a plural marked one ("no sides" or "none of the sides").

5.3No anti-duality with the, some

We have so far looked at quantifiers that have dual counterparts across languages. We can also test our predictions for other cases, namely definite descriptions and *some* phrases.

Predicting that definite descriptions are not anti-dual is an important point for our theory, as they host a similar syntactic environment to all/tous phrases, which contain a 960 plural definite, and thus are expected to combine with DUAL in a similar way (in possible contrast with existential or distributive quantifiers which require the dual morpheme to combine in some non-trivial way to yield domain duality). Below are the plural and dual structures for plural-marked definites in French.

- (69)a. 965
 - les PL parents b. [les DUAL parents]

Again, there is no unambiguous expression equivalent to (69-b) that will block that one from pronounciation and act as an indirect alternative to (69-a).

Another important case to discuss is *some*, as it could be argued to predict an antiduality inference (Y. Sudo, p.c.). for bringing this up. Indeed, Some NP.DUAL VP might 970 be blocked by the equally complex and unambiguous Two NP VP. It then acts as an indirect alternative to Some NP.PL VP, which obtains the enriched meaning 'some NP VP but not exactly 2' via scalar implicature. Here, however, we argue that Two NP VP is not equivalent in meaning to Some NP.DUAL VP: in the former case, the sentence

has an 'at least 2' type of meaning, while in the latter, it has an 'exactly 2' type of 975 meaning. So this means that the two are equivalent only after computing a 'not three' implicature to the 'two' expression. This may be ruled out either by disallowing indirect alternatives to contain exhaustification operators (this would fall out naturally from a theory in which exhaustification does not happen in the semantics), or simply by having the exhaust operator make the sentence with the numeral too complex to block the dual 980 reading of the *some* sentence.

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Always: anti-dual in English but not in French 5.4

Perhaps the most promising data that provides support for the analysis of indirect alternatives has to do with the temporal quantifier *always* and its difference in meaning in English and French.

In English, *always* seems to be anti-dual when it quantifies over individual times (Y. Sudo, p.c.) (albeit possibly less so than *all*).

a. #She came twice to visit us, and she always brought us flowers. (70)

- She came twice to visit us, and both times she brought us flowers. b.
- She came three times to visit us, and she always brought us flowers. c.

The dual version of *always* is *both times*, which at first glance appears to be more complex. However, we simply assume that *always* can be decomposed into *all* and *ways*, thus making it as complex as both times. This allows both times to act as an alternative to always and trigger anti-duality.

- Interestingly, the French word for 'always' *toujours* does not seem to carry the same 995 anti-duality effect as its English counterpart.
 - (71)Elle est venue deux fois nous rendre visite, et elle nous a toujours apporté a. des fleurs.

Elle est venue trois fois nous rendre visite, et elle nous a toujours apporté b. des fleurs.

Toujours also has a transparent morphemic decomposition as tous ('all') and jours ('days'). However, there is no expression for both times, the closest being les deux fois. However, les deux fois is more complex than toujours. Therefore the dual meaning of *toujours* is not blocked.

There is perhaps a sense in which the anti-duality of English *always* is not as clear-cut

as that of all. And some French speakers have some reservations about toujours in the

"Let us speak plainly, Dubois; your master is insane, is he not?"

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above sentence (others don't). A more thorough quantitative analysis might be needed to establish a clear contrast between the two languages. In the meantime, we show an excerpt from "Césarine Dietrich" by George Sand, translated into English by Edward Stanwood, which shows a use of *toujours* that is non-anti-dual, which is not kept in the 1010 English translation.

Tranchons le mot, Dubois; votre maître est fou?

Eh bien! oui, sans doute, mais il l'a

(72)

1015

toujours guéri. a

ves no

well

has **always** cured

"Well yes, undoubtedly; but he has been so twice before, and was cured" ('always cured' in the French original)

déjà

doubt but he it has already been two times and he

été

deux fois, et

il

This contrast between *always* and *toujours* is particularly telling because of their morphological makeup containing all and tous. The indirect alternative theory provides a very natural explanation for why tous is anti-dual but not toujours, and for why both all 1020 and *always* are.

6 Alternative explanations

In the previous section, we proposed a solution for the anti-duality of *tous* using the novel notion of indirect alternative. In this section, we present possible proposals for alternative solutions that may appear to the reader simpler, but we ultimately deem 1025 them less theoretically desirable than the indirect alternative solution.

In section 6.1, we entertain a solution in which BOTH is the core concept, instead of just DUAL. In 6.2, we entertain the possibility that les deux NP is directly generated as an alternative, which means that *les trois* NP also is, and so on, and find another way of blocking competition with les n NP for n > 2.

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6.1 Not DUAL but BOTH is the core concept

Instead of considering DUAL as the core concept underlying tous's anti-duality, we might consider BOTH instead. One advantage of this alternative proposal is that many facts fall out immediately. First, it directly explains why French tous is anti-dual. We can simply assume that any expression can compete with one in which a lexical item has been 1035 replaced with a core concept of the same semantic type. So tous is replaced with the nonlexicalized concept BOTH, similarly to where in English *all* is replaced with lexicalized *both*. and then MP applies in a standard way. It also directly explains why universal quantifiers are anti-dual, but not other expressions. In other words, it sets apart all_{DUAL} (i.e., both),

the dual version of all, from $each_{DUAL}$, $which_{DUAL}$, one_{DUAL} , the_{DUAL} . So it explains why 1040 French tous is anti-dual, but not each, which, one, the (in French or English).

The anti-duality observed in the Japanese and Icelandic counterparts to these expressions could be simply explained with recourse to traditional Katzirian structural alternatives feeding MP, which we expect to exist regardless of whether core concepts play a part in those expressions. The lack of anti-duality of these counterparts in French and English is due to the fact that there are no dual expressions simple enough to be Katzirian

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alternatives.

There would thus be no need to posit indirect alternatives, which we initially proposed to restrict anti-duality effects with other quantifiers. Note that it is nevertheless compatible to have BOTH as a core concept and require an indirect alternative to license competition with it, if we want to maintain the idea that an alternative needs phonological support.

One first point of skepticism about this solution is that both from a conceptual and an empirical point of view, the primacy of the dual concept seems to extend beyond universal quantification, as already discussed in section 2. Conceptually, there are many reasons to think that the number 2 is primitive, as it is very salient in human experience, perhaps most saliently observed in the axial symmetry of human bodies. It is not obvious, however, why both should be conceptually more salient than each of the two or which of the two. Empirically, duality has been observed cross-linguistically in the lexicalization

- of pronouns on the one hand, and in that of quantificational expressions like Japanese 1060 and Icelandic, which shows that the importance of the dual concept can be lexicalized. However, one may object to this argument in observing that *both* is lexicalized much more often than other dual quantifiers (as far as we can tell; this should be of course checked).
- Another point of contention is that it might seem theoretically undesirable for BOTH to be a core concept, as it appears to be more complex from a logical point of view. 1065 Indeed, BOTH can be derived from the concepts ALL and DUAL, but ALL and DUAL cannot be obviously derived from BOTH. Since ALL and DUAL underlie operators that are otherwise needed in language (in addition to being highly salient, high frequency and highly lexicalized), it might be costly to store BOTH as an additional operator, when it instead can be so easily derived. 1070

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Finally, an empirical argument against this view that BOTH is a core concept is that there are languages including French that allow the combination of all and two in some configurations, as we saw in section 4.5. If BOTH were a core concept, we shouldn't expect this to happen.

6.2'The n NP' are directly generated alternatives to 'all the NP' 1075

We now consider the possibility for the definite numeral phrase les deux NP to be directly generated as an alternative to tous les NP. We discuss what is needed to allow it to be an alternative, and how to block overgeneration from competition with les n NP for n > 2.

Under a standard Katzirian notion of alternatives [Katzir, 2007], as defined in (35), les deux NP cannot be generated as an alternative to tous les NP. We could modify the 1080 Katzirian definition to replace constituents that are not necessarily of the same syntactic category.

(73)A category-free structural alternative of a parse tree ϕ is a parse tree ψ obtained from ϕ by deleting constituents, or replacing constituents with lexical items, not necessarily of the same syntactic category, as long as the result is well-formed.

As a result, we can replace the universal quantifier with the definite determiner, and the definite determiner with the numeral. In this way, *les deux NP* can act as a structural alternative to *tous les NP*.

Allowing les deux NP ('the two NP') to be directly generated as an alternative to tous les NP ('all the NP') gives the right result for tous: we have shown in section 4.1 that if les deux NP is generated as an alternative to tous les NP, MP can apply and derive anti-duality. However, as noted in the original formulation of our puzzle, this solution overgenerates. The issue we run into is that if we admit les deux NP to be an alternative to tous les NP, there is no way of blocking les trois NP ('the three NP') from being one too. Therefore one incorrectly predicts tous les NP to be odd when the domain of individuals is known to be exactly 3. And so on for all n, predicting that tous les NP is only possible

with domains whose size is unknown or infinite, which is empirically incorrect.

The Katzirian algorithm itself, as it is stated or in its modified form in (73), specifies no way of blocking only a subset of alternatives that are of the same syntactic complexity. In other words, it cannot both allow *les 2 NP* to act as an alternative to *tous les NP* and block *les n NP* for n > 2. If we are to allow all these alternatives to compete with *tous les NP*, and MP applies to all, we end up with the strange inference that the number of individuals in the restrictor of the quantifier is unknown or infinite. This inference is of course generally not attested.

One possibility is to generate these alternatives les n NP, and then prune all the non-salient alternatives, which might the case for n > 2.

It is not unexpected that 2 is more salient than 3 or any higher number. However, it is unclear why (i) 2 seems to be almost always salient and (ii) 3 seems to be never salient. For instance, the following two contexts minimally differ in the number of objects present, which seems to control for saliency. Yet only in the 2-object context is *all* infelicitous.

(74)	a.	Context 1: we see 3 cups, they are empty.	All the cups are empty.
	b.	Context 2: we see 2 cups, they are empty.	#All the cups are empty.

It might be that saliency can also be conceptually based, and 2 exceeds the saliency threshold, making it prunable only with contextual support (see section X), while 3 (and all numbers above) has a low enough conceptual saliency that it is always pruned. The latter point is especially tenuous. Even when we try to increase the saliency of 3 in whatever way possible, which usually forces the alternative to be taken into account, an anti-trial (or anti-*n*ial) inference does not seem to be derived. Below are our attempts.

1120 (75) a. Look, we have 3 cups here, one for each child. But they are all empty!

- b. My tripod has all of its legs broken.
- c. All sides of this triangle are under 2cm long.
- d. All sides of this square are under 2cm long.
- e. All my fingers are broken.
- ¹¹²⁵ While these examples are all grammatical and felicitous, there does seem nevertheless to be some slight effect of the number 3 being possibly borderline. It seems however unlikely that this is due to pruning because of the lack of saliency of the number 3 in the above examples, given how salient it is. It seems more likely to be an effect of *including* a non-structurally derived alternative but contextually salient alternative (note that some of the examples above have *all* combining with a bare NP, and cannot therefore have as

Katzirian alternatives 'the n NP' anyways).

Another possible solution is to stipulate a restriction on possible meanings that arise

from MP, which include those of the type generated here, namely forcing the domain of the quantifier to be obligatorily unknown or infinite. We would have to propose a principle that would block application of MP in a minimal non-arbitrary way. Assuming all numerals n > 2 are of equal saliency, blocking any number of alternatives built from numerals means blocking all alternatives built from them. Then, we can postulate that n = 2 has higher saliency, and therefore we don't need to block the alternative built

from it. Note that such a move is somewhat reminiscent of exhaustification operators designed to avoid contradictions. One problem with this solution is that the alternative 'the 3' difficulty has the same saliency as 'the 3^{333} ', or 'the *n*' for any *n* too high to be pronounced. If there are ways around such issues, they will introduce additional stipulations, weakening the plausibility of such a solution. There is enough ground for skepticism here to explore other solutions that don't rely on as many stipulations.

1145 7 Conclusion

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In this paper, we have proposed an analysis for the long-standing puzzle observed by Chemla [2007] for the anti-duality of universal quantifier *tous* in French, arising even though French has no word for *both*.

Chemla [2007] had suggested that this alternative to *tous* may involve either (i) the complex expression *les deux* ('the two'), or (ii) a core concept which need not be realized by linguistic material. In this paper, we argue that neither of these suggestions is enough alone to explain the puzzle and immediately related data. Option (i) does not explain why *les trois* ('the three') (and so on) is not an alternative to *tous* as well (as noted by Chemla). Option (ii), if we follow the natural assumption that the dual is a core concept, overgenerates anti-duality in expressions that don't exhibit it.

In this paper, we proposed a solution that incorporates a bit of both suggestions. There is a core concept DUAL that plays a role in an alternative to *tous*, but competition with the dual alternative is licensed only it can be 'replaced' by an indirect alternative, i.e., a pronounceable expression in the language that is semantically equivalent to it.

- This paper contributes to the debate about the existence of conceptual alternatives, which are alternatives not supported by linguistic material. The anti-duality of French tous is cited in Buccola et al. [2018] as a main example of a linguistic phenomenon where a conceptual alternative is needed. In this paper, we add some nuance to this claim. We show that a pure conceptual alternative, namely one that does not correspond in any use to a pronounceable expression, is blocked from competition. Instead, a conceptual
- alternative, which in this paper corresponds to a linguistic expression that cannot be pronounced, can play a role in competition, if, but only if, there is an expression that is equivalent in meaning and can be pronounced. This result raises the conjecture that at least some kind of overt expression is needed for pragmatic competition, at least between alternatives for MP, to arise.

Our result has, we think, implications for the structure of grammar. Namely as discussed in 4.6, our finding is most easily captured within a view of grammar where concepts are available independently of their pronunciation such as the Meaning First architecture [Sauerland and Alexiadou, 2020], but their availability as alternatives depends on them being expressible without additional effort.

This new notion of alternative might explain further problematic cases for a standard account. As noted by a reviewer, how the typical 'not all' implicature obtained with *some* arises in French is mysterious, because the *all* expression is more complex than the *some* expression, as shown below (in English this is less of an immediate issue, since the *all*

expression does not come with a definite article obligatorily; note however a difference in 1180 meaning might make it a problem for English anyways).

(76)	a.	Quelques étudiants sont venus.
		some students have come
		Some students came.
	1	$(T) + \frac{1}{2} $

Tous *(les) étudiants sont venus. b. all the students have come All (the) students came.

1185

We might be able to solve this case by proposing that there is a conceptual universal alternative that does not have a direct exponent in French, but that is equivalent in meaning to the definite plural expression (in its maximal reading), in (77).

(77)Les étudiants sont venus. the students have come 1190 The students came.

> The definite expression is now equally complex to (76-a), and can thus act as an indirect alternative to it.

8 Appendix: Implementation using Harbour's system

In this section, we embed the solution we proposed within system from Harbour [2014], 1195 namely, instead of having SG, PL and DUAL as number features, we have $[\pm atomic]$ and $[\pm \text{minimal}].$

In this section we assume that a dual meaning is universally available from the interaction of the number features [+minimal] and [-atomic], proposed by Harbour [2014] to derive the meaning of the dual. The presence of these features will generate dual 1200 universal expressions very much in the same way as the dual core concept DUAL. It will be generated as a Katzirian alternative to the plural expression, and then, following the same assumptions introduced for our proposal in 4, it will be unpronounceable, and license competition with the definite numeral expression 'the two', deriving the anti-dual implicated presupposition.

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Harbour [2014] Harbour [2014] argues that the dual meaning falls out along with singular and plural from the interaction of two features: $[\pm \text{atomic}]$ and $[\pm \text{minimal}]$, whose meaning is defined as the following:

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 $\llbracket [+\text{atomic}] \rrbracket = \lambda P \cdot \lambda x \cdot P(x) \wedge atom(x)$ (78)a. $\llbracket [+\text{minimal}] \rrbracket = \lambda P \cdot \lambda x \cdot P(x) \land \neg \exists y (P(y) \land y \sqsubset x)$ b.

The minus version of these features, for Harbour [2014], is the negation of these concepts. Harbour [2014] proposes that these features compose with the meaning of a noun phrase by function application.

 $[+\min a]]([+atomic]][N])$ (79)

The interaction of these two features derives singular, dual and plural meanings, as shown 1215 in the table below.

The derivations leading to each of these meanings are shown below:

	$[\pm atomic]$ $[\pm minimal]$		
	[+atomic] [+minimal]	ingular	-
	[-atomic] [+minimal]	ual	
	[-atomic] $[-minimal]$	lural	
	$\llbracket [+\text{minimal}] \ \llbracket (\llbracket [+\text{atomic}] \ \llbracket (\llbracket nP \rrbracket))$	D) a.	(
$\mathbf{singular}$	$= \lambda x.\llbracket \mathbf{n}\mathbf{P} \rrbracket(x) \land atom(x) \land \neg \exists y.atom(y) \land \llbracket \mathbf{n}\mathbf{P} \rrbracket(y) \land y \sqsubset x$		
	$\llbracket [+\text{minimal}] \ \llbracket (\llbracket [-\text{atomic}] \ \rrbracket (\llbracket nP \rrbracket))$	b.	
dual	$= \lambda x.\llbracket \mathbf{n}\mathbf{P} \rrbracket(x) \land \neg atom(x) \land \neg \exists y. \neg atom(y) \land \llbracket \mathbf{n}\mathbf{P} \rrbracket(y) \land y \sqsubset x$		
	$\llbracket [-\text{minimal}] \ \llbracket (\llbracket [-\text{atomic}] \ \rrbracket (\llbracket [nP]]))$	с.	
plural	$= \lambda x.\llbracket \mathbf{n}\mathbf{P} \rrbracket(x) \land \neg atom(x) \land \exists y. \neg atom(y) \land \llbracket \mathbf{n}\mathbf{P} \rrbracket(y) \land y \sqsubset x$		
	$\llbracket [-\text{minimal}] \ \llbracket (\llbracket +\text{atomic}] \ \rrbracket (\llbracket nP \rrbracket))$	d.	
contradiction	$= \lambda x.\llbracket \mathbf{nP} \rrbracket(x) \land atom(x) \land \exists y.atom(y) \land \llbracket \mathbf{nP} \rrbracket(y) \land y \sqsubset x$		

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We can thus see in (80-b) how combining [-atomic] and [+minimal], we get a number specification of 2.

Updated assumptions: Trivial semantics and exhaustification We depart from Harbour [2014] in assuming that the semantics of the minus version of the features is trivial. 1230

(81) a.
$$\llbracket [+atomic] \rrbracket = \lambda P.\lambda x.P(x) \wedge atom(x)$$

b. $\llbracket [-atomic] \rrbracket = \lambda P.\lambda x.P(x)$
(82) a. $\llbracket [+minimal] \rrbracket = \lambda P.\lambda x.P(x) \wedge \neg \exists y (P(y) \wedge y \sqsubset x)$
b. $\llbracket [-minimal] \rrbracket = \lambda P.\lambda x.P(x)$

_ _

If this shift to trivial semantics for the negative features is not done, the anti-duality of 1235 tous cannot be derived as an implicated presupposition (instead, it will be encoded into any use of tous, regardless of the environment in which it appears). Furthermore, it has been shown that the plural itself has implicated presuppositional properties [Sauerland et al., 2005]; these can only be achieved if the meaning of the plural is unmarked, which means that the meaning of [-atomic] and [-minimal] must be left unmarked. 1240

We will assume that the semantic inferences observed with the minus version of the features arise through exhaustification of alternatives, which include the plus version of the features (84). Furthermore, we will allow for a version of the exhaustification operator EXH to locally apply to a property, as proposed in Mayr 2015, Sauerland and Bobaljik 2022.

(83)
$$\llbracket \text{EXH}_{Alt} \rrbracket^w \equiv \lambda P \cdot \lambda x \cdot P(x)(w) \land \lambda Q \in Alt \cdot \neg Q(x)(w) \lor \forall x \cdot P(x) \to Q(x)$$

This will ensure, crucially, that when [+minimal] applies to [-atomic], the dual reading is derived. We show below how the dual and plural readings are derived (the singular is derived as before, since the meanings of the plus features are left unchanged).

1250 (84) a. Alt([-atomic])={[+atomic],[-atomic]}
b. Alt([-minimal])={[+minimal], [-minimal]}
(85) a.
$$\llbracket EXH [-atomic] nP \rrbracket \equiv \lambda x. \llbracket nP \rrbracket (x) \land \neg (\llbracket nP \rrbracket (x) \land atom(x))$$

 $\equiv \lambda x. \llbracket nP \rrbracket (x) \land \neg atom(x)$
b. $\llbracket [+minimal] EXH [-atomic] nP \rrbracket$
 $\equiv \lambda x. \llbracket nP \rrbracket (x) \land \neg atom(x) \land \neg \exists y. \neg atom(y) \land \llbracket nP \rrbracket (y) \land y \sqsubset x$ dual

c. $\llbracket \text{EXH} [-\text{minimal}] \text{EXH} [-\text{atomic}] \text{nP} \rrbracket$ $\equiv \lambda x. \llbracket \text{nP} \rrbracket(x) \land \neg atom(x) \land \neg (\llbracket \text{nP} \rrbracket(x) \land \neg atom(x) \land \neg \exists y. \neg atom(y) \land \llbracket \text{nP} \rrbracket(y) \land$ $y \sqsubset x)$ $\equiv \lambda x. \llbracket \text{nP} \rrbracket(x) \land \neg atom(x) \land \exists y. \neg atom(y) \land \llbracket \text{nP} \rrbracket(y) \land y \sqsubset x$ plural

1260 When [-minimal] combines with [+atomic], EXH derives a contradiction.

Finally, the action of the EXH operator needs to be appropriately constrained in order to capture the implicated presupposition facts. To do so, we assume that EXH is optional in non-upward-entailing environments.

The structure of a DP and universal number features Following Martí [2020], languages can be categorized into which bundles of features contrast with each other morphologically. For example, English is "[±atomic]" language, because it marks the contrast between [+atomic] (singular) and [-atomic] (plural). English contrasts with Turkish, which marks the [±minimal] contrast instead. While these two systems converge in simple cases, the difference in morphology between these two language types is observed when the noun phrases combine with numerals: in English type languages, these are plural marked, while in Turkish type languages, they are not.

We depart from Martí's system in assuming that both [\pm atomic] and [\pm minimal] features are present universally in DP structures, but that languages may not encode the featural contrasts morphologically.¹⁶ This entails, for instance, that in English, a plural marked noun phrase will be ambiguous between a dual meaning ([-atomic] [+minimal]) and a plural meaning ([-atomic] [-minimal]), since the [\pm minimal] distinction is not morphologically marked. Only in very particular instances will their effect be seen. We propose that one particular instance is the anti-duality of *all*.

We assume, following Martí [2020], that a DP always has a number projection Numline berP, which hosts the [\pm atomic] and [\pm minimal] features.

(86)

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Numerals are hosted in a numeral projection, below the number projection.

¹⁶The universalist assumption for number features works only if the negative versions of the features have trivial semantics. This is relevant for languages like Turkish, which morphologically realize the $[\pm minimal]$ features. This means that [+minimal]-marked nouns, i.e. with singular marking, will be ambiguous between having [+atomic] and [-atomic] features. If [-atomic] had contentful semantics, then we should expect singular marked nouns to be ambiguous between singular and dual meaning, which is not observed. If instead we assume that the minus version are vacuous, [-atomic] is vacuous, therefore the combination of [+minimal] and [-atomic] simply gives a singular reading. A puzzle from this remains: what if EXH applies to [-atomic] in Turkish? The combination [+minimal] EXH [-atomic] yields a dual reading, yet is morphologically marked for singular. In order to avoid this problem, we might propose that two structures that correspond to the same string cannot be alternatives to each other (here, the two strings are vacuous, corresponding to the unrealized $[\pm atomic]$ features). Unless, of course, there is an indirect alternative available. This move has possibly undesirable predictions for anti-duality in Turkish, however, that we decide not to address here.



In French, a universal quantifier expression contains a definite DP. For the expression tous les verres ('all the cups'), we assume the following structure:



Deriving *tous*'s anti-duality Let's consider a string containing *tous*. It can correspond to several different structures, including the following two crucial ones, where (89-a) corresponds to the (unspecified) plural, and (89-b) corresponds to the dual.¹⁷

The dual expression in (89-b), after combining with a VP, is equivalent in meaning to *les deux NP VP*. We repeat its meaning in (90-a), from (85-b). By design, this semantics is equivalent to 'exactly 2', as shown in (90-b) (we use NP instead of Martí's nP for consistency).

1295

(90)	a.	$\llbracket + \text{minimal} \text{ EXH } [-\text{atomic}] \text{ NP } \rrbracket$
		$\equiv \lambda x.\llbracket \operatorname{NP} \rrbracket(x) \land \neg atom(x) \land \neg \exists y. \neg atom(y) \land \llbracket \operatorname{NP} \rrbracket(y) \land y \sqsubset x$
	b.	$\neg \exists y. \neg atom(y) \land \llbracket \mathbf{nP} \rrbracket(y) \land y \sqsubset x \equiv \forall y. \llbracket \mathbf{nP} \rrbracket(y) \land y \sqsubset x \to atom(y)$
		$\equiv \lambda x.\{y: \llbracket \mathbf{nP} \rrbracket(y) \land y \sqsubseteq x \land atom(y)\} = 2$

¹⁷A string containing *tous* is in principle ambiguous between the following parses, built from [-atomic] (which morphologically marks plural) and either [+minimal] and [-minimal], and all combinations of EXH (applying non-vacuously right after – features). Since the restrictor of *tous* is DE, EXH is optional.

(88) a.	(i)	tous les [-minimal] [-atomic] NP	unspecified for number
	(ii)	tous les [-minimal] EXH [-atomic] NP	non-singular
	(iii)	tous les EXH [-minimal] [-atomic] NP	non-singular
b.	(iv)	tous les EXH [-minimal] EXH [-atomic] NP	non-dual, non-singular
	(i)	tous les [+minimal] [-atomic] NP	singular
	(ii)	tous les $[+minimal]$ EXH $[-atomic]$ NP	dual

(88-b-i) is blocked by the Avoid Ambiguity principle in (40): there is an unambiguous string 'the NP' equivalent to (88-b-i), and at most as complex. In fact, the anti-singularity inference of *tous* presumably arises via indirect competition with 'the NP' in a similar way to anti-duality. As for the parses in (88-a), they all entail the plural (and additional inferences can be derived via MP for the weaker parses). Some or all of (ii)-(iv) may be blocked, a possibility we don't address here.

¹³⁰⁰ We can therefore equate the meaning of this feature bundle to that of the core concept DUAL we proposed in section 4.4.1. In that section, we showed that *tous les* DUAL *NP VP* is equivalent to *les deux NP VP*. Therefore, we also have meaning equivalence between *tous les* [+minimal] EXH [-atomic] *NP VP* and *les deux NP VP*.

(91) $\llbracket \text{tous les } [+\text{minimal}] \text{ EXH } [-\text{atomic}] \text{ NP VP} \rrbracket \equiv \llbracket \text{tous les DUAL NP VP} \rrbracket$ ¹³⁰⁵ $\equiv \llbracket \text{les deux NP VP} \rrbracket$

Thus, by the same Avoid Ambiguity principle from (40) that tous les DUAL NP VP was blocked, tous les [+minimal] EXH [-atomic] NP VP is also blocked. That is because it corresponds to a string that is ambiguous with another parse, and is equivalent in meaning and at most as complex as the unambiguous string les deux NP VP.¹⁸

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Furthermore, we assume that *tous les* [+minimal] EXH [-atomic] NP VP can be generated as an alternative to *tous les* [-minimal] [-atomic] NP VP. This requires allowing EXH to be added into alternatives, which admittedly isn't ideal.

Thus, we derive tous les [+minimal] EXH [-atomic] NP VP as an alternative. However, since it is blocked, direct competition with it is not licensed, but les deux NP VP

satisfies the requirements for an indirect alternative, being equivalent in meaning to tous les [+minimal] EXH [-atomic] NP VP and at most as complex as tous les [-minimal] [-atomic] NP VP, and therefore MP can apply. This derives the anti-duality of tous les [-minimal] [-atomic] NP VP.

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¹⁸While this string is ambiguous between two different featural combinations [-minimal] [-atomic] and [+minimal] EXH [-atomic], the two parses are equivalent in meaning (this may actually induce blocking of one parse, but this blocking would be invisible here). So the string itself is semantically unambiguous, and Avoid Ambiguity in (40) can apply.

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