Self-Similarity and Quantificational Variability - Empirical Issues

Gertjan Postma
(Meertens Instituut)

Abstract
A configurational approach is given to quantificational variability, i.e. the fact that quantificational elements in natural language do not have a rigid quantificational value. A new perspective is given to the question why indefinite noun phrases may have existential, specific indefinite, and generic readings, but no interrogative readings, and why WH-words may have existential and interrogative readings, but no specific indefinite or generic readings. *Self-similarity*, a concept from mathematics and widely applied to natural-world phenomena, turns out to be applicable to natural language: its syntax and its semantics. Self-similar left-branches are linked to interrogative readings; self-similar right-branches are tied to existential readings. Repeated mixed left- and right-branching patterns in the middle filed are tied to specific indefinite readings. Self-similarity echoes Kayne's 1984 concept of connectedness of quantificational subtrees but its application is both wider and narrower than self-similarity. Indirectly, the depth of self-similarity contributes to the discussion on the status of recursivity in natural language.

1. The Phenomenon

Indefinite NPs have existential, specific indefinite, and generic readings. Heim (1982) explains such quantificational variability (QV) by assuming that indefinite NPs do not have a quantificational force of their own. An indefinite NPs is a variable. It receives interpretation from a quantifier that binds it. Indefinite NPs are, for instance, subject to unselective binding by quantificational temporal adverbs, such as *always*, *never*, *often*, *rarely*, etc. The clearest judgements are obtained with individual level (IL) predicates (in the sense of Carlson 1977) as in (1), which disfavors quantification over the tense variable.

(1)	a.	Pigs are often intelligent		high degree quantification: MOST PIGS
	b.	There were pigs on the road		existential quantification

The most salient reading in (1a) involves a quantification over pigs, not over events. Diesing (1992)'s Mapping Hypothesis holds the configuration responsible for the available quantification: when an indefinite NP, i.e. an open variable, sits within VP, which is the domain of existential closure, the NP obtains an existential reading (1b). Outside VP, other readings apply, as in (1a). A scrambled indefinite may adopt a specific-indefinite, a generic reading, a universal quantified reading (e.g. in donkey sentences), or be unselectively bound by

quantificational adverbs as in the example above, but they must have moved outside VP to acquire such readings. Diesing Mapping Hypothesis is in so far incomplete that it only describes when the existential reading is available, not what defines the other readings outside VP.[5]

WH items also display quantificational variability in many languages: they may typically vary between the interrogative and the existential reading (ignoring exclamatives and high-degree readings in this paper). QV with WH-items happens in Dutch, German, Latin, Chinese, Russian, Old English, just to mention some languages. Postma (1994) applies the open-variable approach to the QV in WH-elements in Dutch and German: within VP, a WH-item acquires an existential interpretation; when it moves out, other readings become available, for instance, when WH moves to the edge of the utterance, i.e. outside all domains of quantification, it must be bound by the hearer: an interrogative or question-answer structure emerges.

(2) a. Jan heeft snel **wat** opgeschreven (existential reading)
John has quickly QUEX up.written
'John has quickly written up something'

b. **Wat** heeft Jan snel opgeschreven (interrogative reading)
QUEX has John quickly up.written
'What has John written up quickly?'

Hengeveld, Iatridou & Roelofsen (2018), henceforth HIR, coin WH items that display QV "quexistentials" (abbreviated in glosses to QUEX), which term we will also use throughout this paper.

2. The problem: absent readings in quexistentials and indefinites

HIR challenge Postma's open-variable account of quexistentials. They wonder why WH-items in Dutch and German never adopt generic or specific-indefinite readings in the middle field, like indefinite NPs do. More specifically, why do quexistentials in Dutch and German never sit in the structural subject position and acquire a generic reading (3a), a specific indefinite reading (3b), or an unselective binding reading as in (3c)?

(3) a. **Wat over geschiedenis boeit hem zeer*
things about history interests him much
'History stuff interests him very much' (*generic reading)

b. **In Amsterdam gebeurt wat leuks vaak*
in Amsterdam happens what nice.GEN often
• 'Usually a nice thing happens in A.' (*specific indefinite reading)

[5] Diesing proposes a mechanism how generic readings in specTP come available: she proposes a VP-internal arbirtary PRO that is controlled and restricted by the VP-external subject. This only captures the generic reading, not the specific indefinite reading in the middle field.

• 'In A. usually something nice happens' (* ∃ -reading while outside VP)

c. *Wat verrast mij vaak*
what surprsies me often
• 'Something surprises me often' (*specific indefnite reading)
• 'Many things surprise me ' (*unselective binding)
• 'What does often surprise me?' (^{OK}question)

Dutch *wat* either remains VP-internally or moves to specCP, but intermediate positions in the middle field are not available. Why can't WH-items move to the middle field at all in Dutch? HIR take this as a "fatal problem" to the open-variable approach to WH: middle-field readings are systematically absent.

HIR's objection is certainly a challenge, but hopefully not a fatal one. For that would be rather unfortunate since a similar reproach of absent readings looms for the Heim-Diesing account to quantificational variability in indefinites: why are interrogative readings absent in fronted indefinites? If indefinites are open variables — why can't they be bound by a question operator?

(4) *Een man heb ik gezien*
a man have I seen
a. 'I have seen a (specific) man' (specific indefinite reading)
b. 'I have seen a man (and not a woman)' (contrastive focus reading(
c. *'Which man have I seen?' (question)

To block the interrogative reading of indefinites, Iatridou (pers. com.) assumes an abstract semantic feature on indefinites that marks which operator must evaluate the alternatives, as proposed in Chierchia & Liao (2015), a feature [– Σ] which is incompatible with the choice of alternatives created by focus/interrogation. This lexico-semantic approach is stipulative. Apart from the empirical problems (Giannakidou & Li 2016), the feature is difficult to situate in any lexical item, as bare plurals behave like indefinites, but no overt lexical element is present that can be held responsible for it and host it. This means that the problem must be solved by an abstract feature on a lexically null determiner. This is entirely within the toolbox of modern syntax and semantics but, being allowable, a similar stipulation can be made for WH. One could stipulate an (even slightly less) abstract feature on WH, e.g. Chierchia's [+Σ], that is incompatible with a semantic component associated with the middle field, for instance, the specific-indefinite familiarity/common-ground effect generated in the middle field. So it remains unclear why HIR do not completely abandon the open variable account for both indefinites and WH. They do not reject the open variable account for indefinites, but reject it for quexistentials.

Significantly, one cannot split off the missing readings in indefinites and the missing readings in quexistentials, as they form one system of interpretation, as I show in Postma (2019) for Ancient Greek τις. But evidence is also traceable in Dutch and English. It comes from the fact that indefinite NPs do acquire an interrogative reading in multiple questions as in (5).

(5) (context: A and B are passing their office building with a flag half-mast)
a. A: - Is er een medewerker/iemand overleden?
$Q_{y/n}$ is there a colleague/anybody died
'Did a colleague/anybody die?'
b. B1: Ja (= 'yes, a colleague died')
'Yes'
c. B2: Ja, Piet (= 'yes, Peter died')
'Yes, Peter'

The question in (5a) contains a question operator in specCP (Dutch is a strict-V2 language) in addition to an indefinite NP *een medewerker* 'a colleague' in the structural subject position. There are two possible ways to answer the question: firstly, with a simple 'yes' or 'no', i.e. the question is interpreted as a simple polarity question, as in (5b). Secondly, one can also answer with a multiple answer as in (5c) with a polarity 'yes' and a filler of the subject. We take the second answer as a response to an underlying structure in which the question operator unselectively binds both the Davidsonian event variable and the subject.[6] This structure is parallel to a multiple argument question in (6).

(6) a. A: Wie heeft wat in het gastenboek geschreven?
who has what in the guest book written
b. B1: John (= John was written something in the guest book)
B2: John a compliment, and Peter a question
= John wrote a complement in the guest book, and Peter a question

This construal with interrogation is parallel to the well-known and well-discussed case of quantificational construal of interrogation and universal quantification. An further argument comes from the ambiguity in (7), where the universal quantifier can have narrow or wide scope

[6] Sabine Iatridou (p.c.) objects that B2 is not necessarily an answer but might be a pragmatic response, since it is independent of the question status of A.

(i) A: Er is iemand overleden A: Somebody died
B: Ja, Piet. B: Yes, Peter

Fortunately, there are languages that separate the two situations, e.g. Brazilian Portuguese, which has a formal syntactic way of answering 'yes' by repeating the bare inflected verb. This formal answer is possible with the unselectively interrogative binding, but not with statements.

(ii) A: Veio alguem? A: Alguem veio.
B: Veio, o João. B: *Veio, o João / Veio mesmo, o João

with respect to the interrogation operator (Karttunen 1977, Kempson & Cormack 1981, May 1990:48). The scope ambiguity causes two different responses, of which the list reading in B2 corresponds to the universal quantifier *every* taking wide scope over the interrogation, which then additionally binds the indefinite *one* unselectively.

(7) A: What did everyone want?
B1: Everyone wanted to go to the movies — response to $Q_y \forall_x$ [x wanted y]
B2: Peter wanted this, Charles wanted that, … — response to $\forall_x Q_{xy}$ [x wanted y]

In the B2 reading, one can observe that Q_y unselectively binds the subject variable x, notated by Q_{xy}. If the parallel between (5) and (7) holds water, the interrogative reading of indefinites forces us to take quantificational variability of indefinites and quantificational variability in WH elements as one problem. Any severing off one of these cases misses a generalization. In this paper, we sketch a potential solution for the missing readings of QUEX in Dutch and German. in addition to that, it also provides an answer to the question why interrogative readings are absent cross-linguistically in fronted indefinite NPs as in (4c).

There is another doubt on HIR's hypothetical semantic features [±existential at birth], and/or [±compatibility with sets of alternatives], that is kept responsible for the "missing readings". What has been described as quantificational variability is, in fact, *positional variability*, or rather, if positional variability is taken for granted in view of the general nature of «Move α», a **restriction** on positional variability. For it is not so much a certain reading that is not available upon quantificational variability, but rather a certain syntactic *position* is banned and — as a result — all the readings that come available through that position. So, it is not simply the specific indefinite reading that is unavailable to Dutch *wat*, but also the generic reading and the $\forall$ reading, i.e. all readings that are associated with the middle field. Similarly, it is not the interrogative reading that is precluded from indefinite NPs in English, but all readings associated with the CP-system: interrogative, exclamative reading, bound reading by an antecedent ("relative pronoun").

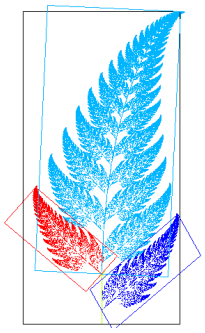
(8) *Excluded readings of some lexical items with quantificational variability*

Variable item	Du *wat*, Germ *was*	- Du *iets*, HG *etwas* - indefinite NPs
Missing readings	• specific indefinite • generic reading • universal quantif. (in donkey sentences)	• interrogative • exclamative • relative pronoun
Excluded Domain	Middle field (TP)	CP

Never is just one of the readings selected under exclusion of the others in that very domain. This points to a *positional* account, i.e. a syntactic account in the spirit of Diesing's Mapping Hypothesis. A strictly configurational account will be the subject of the next section.

3. Self-similarity

In mathematics, an object is called *self-similar* whenever parts of the object are scaled copies of the whole. Though recursive geometrical sub-structures have been known in mathematics for centuries (e.g. Fibonacci 1202), self-similar patterns in the natural world only received systematic attention after Mandelbrot's seminal work "The fractal geometry of nature" in 1982. Only after that book was it realized that self-similarity is a recurrent phenomenon in the nature around us — and in us. We give an example of the fern leave structure below without further comment.



Self-similarity can also be observed in semantics. The basic quantifiers, ALL, NO, AN (universal, negation, and existential quantification) can be uniquely characterized by the polarity properties (negative and positive polarity)[7] in the restrictor and scope (Zwarts 1986). Every subdomain of a negative polarity domain is a negative polarity domain (and often recursively encoded as such by lexical strategies, e.g. NPIs).[8] Likewise, any part of a positive polarity domain is a positive polarity domain. In other words, the entailment properties are self-similar in the tripartite structure of the basic quantifiers. Let us first try to make this acceptable to the reader's mind by showing the consequences to some well-known syntactic problems (Quantifier Raising (QR), Antecedent Contained Deletion (ACD), and Scope Reconstruction) and then apply it to quantificational variability.

3.1 Self-similarity and quantifier raising (QR)

There are several considerations that evidence the existence of self-similarity in natural language. In the first place, it explains the need of Quantifier Raising (May 1985) of strong

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[7] We prefer the terms negative and positive polarity domains instead of downward en upward entailing (which are only defined in propositions) in order to generalize over other sentence types such as questions, exclamatives, etc. The WH-quantifier consist of NPI domains in both restrictor and scope.

[8] For instance (i):

(i) Every boy who has (**ever**) met a girl who has (**ever**) been to Boston, is happy

To the extent that self-smiliarity is disrupted as in (ii), it can be shown that the non-self-similar domain undergoes prepositional fronting.

(ii) Every boy who ha (ever) met [the girl that has (*ever) been to Boston]

For x= [the girl that has (*ever) been to Boston], it holds that [every boy who ha (ever) met x]

quantifiers: QR moves a downward restrictor out of an upward domain. To see how, consider the tri-partite structure Q[A][B]: the sentence *John bought every book*. In this quantified structure, *every* is the quantifier Q, *book* is the restrictor [A], but what is it scope, [B]? Suppose that it is not ø and a syntactic constituent. Then *every book* must be part of its scope "at birth" and must move out of it, simply to disentangle restrictor and scope and to realize the different entailment properties of universal quantification in restrictor and scope. Now, observe that QR only occurs if a conflict in polarity looms in [A] and [B] in the tripartite structure Q[A][B], where Q[A] in included in [B] syntactically "at birth". In this way, self-similarity explains the paradigm in (9). In the VP-deletion contexts in (9a-c) QR is obligatorily present to bleed the infinite regress in VP-copying. However, bleeding infinite regress cannot be the trigger of QR, because it would render (9de) grammatical, which they are not.

(9)	Constructions with Q[A][B]		[A]	[B]
a.	John bought every book Mary did.	+polarity conflict	–	+
b.	John read most books that Peter did	+polarity conflict	–	+
c.	John read exactly those books I did	+polarity conflict?	–	+
d.	*John read few books that Peter did	–polarity conflict	–	–
e.	*John read no book that Peter did	–polarity conflict	–	–
f.	??John read a book that Peter did	–polarity conflict	+	+

Resolution of infinite regress of VP substitution patterns with polarity contrast in [A] and [B] of the quantifier, cf (9a-c). In sum, by the projection principle, Q[A] is at birth contained in [B]. We take this state of affairs by taking the need for self-similarity as the trigger of movement of the Q[A] part, i.e. QR, not scope nor infinite regress.

A second piece of evidence for self-similarity as a trigger for QR is the fact that it explains why QR is clause bound, even in fully transparent contexts: i.e. why long-distance QR is ruled out contrary to what it seems at first glance in view of (10), taken from Fox (1999, (3)).

(10) a. [At least one soldier]$_1$ seems (to Napoleon) [t_1 to be likely to die in every battle].
$\exists > \forall$, $\forall > \exists$

b. [At least one soldier]$_1$ seems to himself$_1$ [t_1 to be likely to die in every battle].
$\exists > \forall$, $*\forall > \exists$

While (10a) is ambiguous, (10b) is not. Under the assumption of the existence of QR, one would be tempted to attribute this scope ambiguity to QR of *every*. However, if QR of the universally quantified NP would be the cause of the ambiguity in (10a), (10b) should be ambiguous as well, which it is not: only the improbable narrow-scope reading survives in which soldiers die repeatedly. Fox convincingly argues that the scope ambiguity is using the A-chain of [*at least*

one soldier]: the ambiguity comes about through *scope reconstruction* of the displaced NP [*one soldier*] to its base position. This is allowed in (10a) but blocked in (10b) because of the reflexive, that must be bound (Binding Principle A). Though Fox's account is sound and correct, he is vague a *reason* why long-distance QR of *every battle* is excluded.[9] Self-similarity provides this reason.[10] If self-similarity is a ruling device and the only ruling device of QR, there is never a trigger for long-distance QR, since short-distance displacement just above the lowest predicate already makes the construction self-similar. In other words, self-similarity accounts for the short-distance nature of QR together with arguments of economy. Scope-taking as a trigger gives the wrong predictions.[11] Therefore, it does not come as a surprise that QR occurs irrespective of the presence of other scopal elements, as the paradigm of Antecedent-Contained Deletion in (9) above already shows.

Finally, self-similarity explains why WH contexts does not bleed Principle C while QR in ACD does (Fox 1999: 185). Consider the pair in (11) with their structures in (12).

(11) a. You have introduced **him** to everyone **John** wanted to
b. *Which argument that John is a genius, did you tell him t ?
(12) a You have [everyone **John** wanted to [VP]] have -ED [$_{VP}$ introduce **him** to -]
b. *Which [argument that John is a genius] did you tell him [$_{NP}$ argument that John is a genius]

As one can extract form the contrast in (11), ACD obviates Principle C: although the R-expression *John* is c-commanded by *him* at SS, there is no Principle C violation since the phrase [everyone John wanted to] undergoes covert QR. This covert movement can be deduced from the fact that the construction is interpretable, i.e. copying of the deleted VP under recoverability (Fox's parallelism). In contrast with this, WH movement does not bleed Principle C.[12] Fox argues that some parts of the WH phrase, more specifically the restrictor of the WH-quantifier [$_{NP}$argument that John is a genius] reconstructs to its base position. The reason for the distinct behaviour is, according to Fox, ECONOMY: While in the QR structure a reconstructed copy of the restrictor leads to infinite regress, no such considerations hold in the WH-moved structure

[9] Fox refers to Fox (1995b, appendix) which attributes the clause-boundedness to the domain over which ECONOMY is calculated. It is unclear what counts as a domain of calculation, the clause as he assumes in Fox (op. cit.), any finite clause (skipping non-finite clauses), or a smaller domain (VP).
[10] As Sabine Iatridou (p.c.) remarks, QR is also needed for type reasons. While type is an important factor, we will see that type-reasonsing does not provide us with the correct grammaticality distribution.
[11] In fact, there is ACD resolution without inverse scope:
(i) No boy read every book that Mary did
(ii) Exactly 5 boys read no book that Mary did
I thank Sabine Iatridou for this observation.
[12] WH-movement does not obviate Principle C, only late merge of adjuncts does.

in (10). Fox makes the assumption that ECONOMY operates on a *selection set*, which is reduced in the case when infinite regress looms. Hence, ECONOMY must choose from two options in WH (12'), but only from one possibility in the case of QR (11').

(11') Selection set, in case of ACD
a. Q[A] …. [$_B$ … t …$_B$]
b. ~~Q[A] …. [$_B$ … [A] …$_B$]~~ (removed from the set by infinite regress)

(12') Selection set, in case of WH-movement
a. WH[A] …. [$_B$ … t …$_B$]
b. WH[A] …. [$_B$ … [A] …$_B$]

This correctly accounts for the contrast in (9). However, Fox forgets to consider why Principle C is not able to restrict the selection set on which ECONOMY operates, just as "avoidance of infinite regress" does. So why does Principle C does not create a selection set in (13)?

(13) Selection set, in case of WH-movement
a. WH[A] …. [$_B$ … t …$_B$]
b. ~~WH[A] …. [$_B$ … [A] …$_B$]~~ (removed by Principle C)

This would leave the WH-construction with a simple trace as the only option. In sum, why does Principle C just functions as a powerless post-hoc evaluator, while "avoidance of infinite regress" functions as a syntax-ruling principle? In fact, there is no basis for such an enhanced syntactic activity of "avoidance of infinite regress", as we can see from (9de) where avoidance of infinite regress does not lead to grammaticality.

Self-similarity — operating on Fox's reconstruction analysis — gives the correct predictions in these cases without further stipulations. Let us see how. Notice that WH has equal polarity in restrictor and scope, just as negation does: both domains license NPIs. As a consequence, under self-similarity, there is no blocking of reconstructing [A] in the case of WH which have the same polarity, while there is blocking of reconstruction of the restrictor [A] in the case of universal quantifiers and in general all quantifier that allow ACD: the restrictor is downward while the scope is upward. Self-similarity gives the correct *selection set* on which Economy can make its selection. So we rephrase Fox's patterns in (14).

(14) <u>Fox (1999), rephrased in terms of self-similarity</u>
ACD: block of restrictor reconstruction because ALL[A][B] = ALL[–][+] and reconstruction of A=[–] into B=[+] would violate self-similarity.
WH: no block of restrictor reconstruction because WH[A][B] = WH[–][–] and reconstruction of A=[–] into B=[–] does not violate self-similarity.

We see that self-similarity can account for a range of phenomena in quantifier behaviour. So

we conclude that it is advantageous to explore self-similarity as a design rule of natural language. In the next section, we will therefore, investigate its value in the domain of quantificational variability, in particular in WH-items.

There is a difference between QR and WH: while self-similarity is a trigger to move the downward restrictor out of the upward scope, there is no such reason for WH-movement, since both restrictor and scope are downward. So there must be another trigger for movement. Instead of abandoning self-similarity as a designing force for WH, we will explore the designing force of self-similarity in the domain of syntactic configurations.

3.2. Self-similarity in syntax

In this section we find out to what extent a *syntactic* correlate to these entailment properties exists and to what extent we can generalize self-similarity to other quantifiers and operators. Consider the NP *een man* 'a man' in the following well-known alternation.

(15)	a.	Er kwam een man de kamer binnen there came a man the roon into	(existential, <e>)
	b.	Een man kwam de kamer binnen A man came the room into 'A man entered the room.'	(specific indefinite, <<e,t>, t>)

In (15a), *een man* receives an existential interpretation, in (15b) a specific indefinite interpretation, which is a generalized quantifier (Zwarts 1986). Type-shifting proceeds under syntactic movement (e.g. scrambling, A-bar movement). Scrambling, and A-bar movement in general, can be seen as an operation that transforms a configuration in which a predicate takes an element as its argument, into a configuration in which a generalized quantifier takes the predicate as its argument. We see a transform from the function application $F_{<e,t>}$ (e) into $G_{<<e,t>,\,t>}$ ($F_{<e,t>}$) by type-shifting the NP $_{<e>}$ to a generalized quantifier $G_{<<e,t>,\,t>}$ under syntactic movement.

There is evidence that there are DP-internal reflexes of this type shifting. In other words, the internal structure of the DP changes upon scrambling, or rather the reverse: the DP-internal change triggers the DP-external change in the VP. Take Portuguese:

(16)	a.	Aconteceu [alguma [$_{NP}$ coisa]] 'something happened'	<e>
	b.	[coisa$_i$ alguma [$_{NP}$ t_i]] aconteceu nothing happened	<<e,t>, t>
	c.	*Aconteceu [coisa$_i$ alguma [$_{NP}$ t_i]]	
	d.	Não aconteceu [coisa$_i$ alguma [$_{NP}$ t_i]] there did not happen anything	

While *alguma coisa* in (16a) is an existential quantifier, creating — or being inserted in — an upward context (16a), the DP-internal scrambled DP *coisa alguma* creates a downward context — or is inserted in one, cf. (16b). It must sit under a negative quantifier or operator, or else it must move up to a quantifier position and is type-shifted to a generalized quantifier that creates the downward context in restrictor and scope. In the literature, this behaviour is called *quantificational variability* (QV), and is widely observed in quantificational items.

A similar DP-internal movement in correlation with quantificational variability can be observed in the Dutch pair in (17). We observe a WH word and a dependent adjective *lekker* 'tasty' + a genitive marker -s.

(17)	a.	Je hebt [wat lekkers] gegeten. you have WH.NEUT tasty.GEN eaten 'you ate something tasty.'	existential reading
	b.	[Wat voor lekkers] heb je gegeten? WH.NEUT COMP tasty. GEN have you eten 'what kind of tasty things have you eaten?'	interrogative reading
	c.	*[Wat lekkers] heb je gegeten?	*interrogative
	d.	*Je hebt [wat voor lekkers] gegeten.	*existential[13]

In (17a) we have an existential *wat* + A construction in an existential reading. There is an existential quantification over entities. In (17b) this constituent has been fronted to specCP. To make it grammatical, *voor* must be added. This is the well-known *wat-voor* construction, discussed in Den Besten (1981), Bennis (1995), Postma (1996), Bennis, Corver & Den Dikken (1998), and elsewhere. It concerns an interrogation over kinds, not on entities. Bennis (1995) analyzes *voor* as a complementizer within the noun phrase. For a recent overview, I refer to Broekhuis *et al.* (2012-16). Significantly, if *voor* is present, only the interrogative reading is available; if *voor* is absent, only the existential reading is allowed (17cd). If Bennis is correct, it follows that *wat* is in specCP within the noun phrase in (17b), i.e. on a left-branch. Moreover, the entire constituent *wat voor lekkers* sits in a specCP itself. This makes (17b) to a self-similar construction as to its syntax: a pattern repeats itself at a lower level. Henceforth we will denote left-branches with (0) and right-branches with (2).[14] We then characterize the interrogative *wat-voor* construction as $(0)_v(0)_n$, in which the first brackets represent the left-branch in the extended VP domain, and the second bracket the left-branch in the extended NP domain.

[13] Echo reading of WH is available under strong focus on *wat*.

[14] We use left and right as if it were English, i.e. we use left and right as specifier versus complement in an X-bar framework. We refer to Postma (2020b) why we use (0) for left-branches and (2) for right-branches.

What about the existential construction in (17b)? Notice that all authors analyze *wat* to have moved to the edge of the noun phrase in the *wat-voor* construction, evidenced by the so-called *wat-voor* split (Den Besten for Dutch, Leu 2007 for German), given in (18). In the *wat-voor* split construction, the constituent is not pied-piped by the WH word on its way to specCP. This WH-movement reduces to standard cyclic movement from CP to CP (Chomsky 1981).

(18) a. [$_{CP}$ **wat** heb jij [$_{CP}$ ~~**wat**~~ voor [~~**wat**~~ lekkers]] gegeten]?

If so, it is reasonable to assume that no movement has occurred in the existential constrruction in (17a), i.e. we have the structure in (18b).

(18) b. [$_{CP}$ jij hebt [$_{CP}$ - ø [$_{DP}$ wat lekkers]] gegeten]?

In fact, parallel to the V2 effect in the verbal domain, there is a Position-2 effect (P2) in the nominal domain. If we assume that the CP layer is always present in strict-V2 languages, we conclude that *wat* in *wat lekkers* sits on the right-branch with respect to the CP in the extended NP domain. Moreover, it also sits in a typical right-branch in the verbal domain.[15] We may characterize the structure as $(2)_v(2)_n$, which is, once again, self-similar. In sum, we have both in (17a) and (17b) self-similar structures, be it of different branching type. In (17a) we have a quantification over entities, in (17b) we have a quantification over kinds. Apparently, type-shifting has occurred. Notice that the ungrammatical cases in (17cd) lack self-similarity, $(0)_v(2)_n$ and $(2)_v(0)_n$ respectively. In view of these patterns, and in view of the growing literature on parallelism of DP-internal WH-movement and sentential WH-movement (Heck 2009, Demirok 2019, Richards 2019), let us generalize to (19).

(19) <u>Self-similarity in syntax</u>
In a tripartite structure Q[A][B] (where Q may be silent), the path towards the open variable is self-similar

The generalization in (19) echoes the proposal in Kayne (1984) with respect to the cases with a simple quantifier variable binding, which must be *connected*. However, (19) makes new predictions for the intermediate cases, to which we will turn to in a minute.

Another well-known case of QV is the double reading of bare WH-items as given in (20): they can have an existential and interrogative reading (Postma 1994).

[15] Left and right are in the traditional sense as specifier and complement, i.e. as if Dutch has the same structure as English modulo order.

(20)		existential	interrogative	
	a.	Es ist **was.**∃ passiert	**was.Q** ist passiert?	(German)
	a.	Er gebeurde **wat.**∃	**wat.Q** gebeurde er?	(Dutch)
		'something happened'	'what happened?'	

Interesting, Modern Greek (Horrocks & Stravou 1987) and Ancient Greek (Postma 2019) provides evidence that there is DP-internal movement of the QUEX *tis* 'who/somebody'.

(21)	a.	…V [theoon **tis**]	existential
		….. gods.GEN QUEX	
		'one of the gods / a god'	
	b.	[**tís** theoon] V…..	interrogative
		QUEX gods.GEN V	
		'who of the gods?, which god?'	
	c.	**tís** mèn ….. theoon	interrogative (cf. *wat-voor* split)
		QUEX COMP gods.GEN	
		'who of the gods, which god'	

We refer to these studies for more data. We see that a DP-internal movement of QUEX turns an existential (a weak quantifier) into an interrogative (a strong interrogative with an exhaustive reading), cf. Giannakidou & Li (2016).[16] Let us, therefore, assume a similar process of type-shifting from an existential reading to the generalized quantifier that underlies interrogation (request for exhaustivity) and its syntactic correlate in the transformation from *wat.*$_{\exists}$ to *wat.*$_{Q}$. So we assume (22), fully parallel to (18) and (21). We will identify XP later.

(22)	a.	wat.$_{\exists}$	[$_{DP}$ - D° [$_{XP}$ wat]]	*wat* is sitting on a right-branch
	b.	wat.$_{Q}$	[$_{DP}$ wat D° [$_{XP}$ t_i]]	*wat* is sitting on a left-branch

Notice that self-similarity requires that the constituent-as-a-whole in (22a) must be inserted on a right-branch in VP, while the constituent-as-a-whole in (22b) must be merged on a left-branch (specCP). Only then, there is self-similarity in these two structures: in the case of the existential reading (a right branch sitting on a right-branch) and in the case of the interrogative reading (a variable on a left-branch sitting on a left-branch). The bare Dutch pronouns does not provide direct supporting empirical evidence for (22), but as soon we add more material, a noun or an adjective, the type-asymmetry shows up, cf. the *wat-voor* construction in (17). Moreover, the theoretical consequences are attractive, as we will see.

Let us now investigate the case with an "intermediate" movement of a WH-item to

[16] Dutch *wat* is a weak quantificational item to be compared with Chinese *shenme* and Greek *kanenan*, which are, according to Giannakidou & Li (2016), *referentially vague*, in contrast to English *any* which is exhaustive. Note that Du *wat* German *was* lack polarity in contrast to *shenme* and *kanenan*. So the weakness of Dutch existential *wat* and German *was* is beyond any doubt.

specTP. Notice that specTP is a left-branch, while -- at least in strict V2-languages -- it sits on the right branch with respect to C. In terms of our formal notation, it is $(20)_v$ in the extended VP domain. Now suppose we only had the structures /*was*. ∃ / and /*was*.Q/ to our disposal. It would either end up as an ultimate right-branch sitting on a mixed branch, in bracket notation $(02)_v(2)_n$, or an ultimate left-branch sitting on a mixed branch, in bracket notation $(20)_v(0)_n$. If self-similarity is a requirement on variable interpretation, the structure would not be interpreted. We can only rescue an open variable reading in the "mixed" specTP-position by also creating a "mixed" structure in the nominal domain, i.e. by merging an extra layer above the *wat*.Q, as in (23). This is done in German and Middle Dutch by merging the morpheme *et-/iet-* on top of the indefinite (Jaspers, Van Craenenbroeck & Vanden Wyngaard 2016: their (62/63)). They identify these structures as having the morpheme in DP on top of a non-identified XP. It is in function and structure to be compared to English *some* in *something* and *someone*.

(23)									
	etwas.$_{mix}$	[$_{DP}$ *et-*	[$_{XP}$ *was*	X°	[$_{NP}$	t_i	]]]	High German
	ietwat.$_{mix}$	[$_{DP}$ *iet-*	[$_{XP}$ *wat*	X°	[$_{NP}$	t_i	]]]	Middle Dutch
	someone.$_{mix}$	[$_{DP}$ *some*	[$_{XP}$ *one*	X°	[$_{NP}$	t_i	]]]	English
	iets.$_{mix}$ / wes.$_{mix}$	[$_{DP}$ *iet-*	[$_{XP}$ pro/*we*	['s]$_{X°}$	[$_{NP}$	t_i	]]]	Modern/Middle Dutch

If *some*/*et-*/*iet* is merged as a D-head on top of the XP, it makes the nominal path to QUEX a structure in bracket notation: $(20)_n$. The full structure is, hence, in bracket notation $(20)_v(20)_n$, which is self-similar. Modern Dutch does not have such a separate morpheme anymore, but an independent lexeme *iets* 'something' which is contracted from older Dutch *iet-wes* (WNT, s.v. *iets*), with *wes* a genitive WH-item. Middle Dutch *wes*/*wis*, as alternant of interrogative *wat*, was typically used when selected from outside its projection, e.g. in embedded interrogatives.[17] If we move the constituent *etwas*/*ietwat* to specTP, a self-similar structure emerges, at least in strict V2 languages: a mixed DP structure in a mixed sentential structure: a specific indefinite reading emerges. In general, open variable structures in the middle field show a complex type self-similarity of rank two.

Another example of an ill-formed structure is when QUEX remains on a right-branch but shows internal movement. This happens with R-pronominalisation, as exemplified in (24). It replaces a pronoun by a locative pronoun under insertion in a left-branch. R-pronominalization is optional, except for the weak pronoun/clitic *'t* which requires to be R-pronominalized to *er*.

[17] (ii) Dat si ne wiste **wis** beginnen (Middle Dutch)
that she neg knew what.GEN start.inf…

(24) a. *op dat* 'on that' => *daarop* 'thereon'
b. **op het* 'on it' => *erop*
c. *op niets* 'on nothing' => *nergens* op
d. *op iets* 'on something' => *ergens op*
e. *op alles* 'on everything' => *overal op*
f. *op wat* 'on what' => *waarop*

Significantly, the process is impossible with the existential reading of *wat*.

(25) Teun zit steeds over wat/*waarover na te denken
Teun sits steadily about what/whereabout PRT to think
'Teun is reflecting all the time about something'

This is not because the R-pronoun *waar* is not a QUEX in Dutch, as similar facts hold for German: while [*für was*] 'for what' and *wo* 'where' is a QUEX, the R-pronominalization [*wo für*] cannot.[18] We understand the ungrammaticality in (25) as an existential right-branch occupied by a constituent whose DP-internally moved QUEX to a left-branch. This is a $(2)_v(0)_n$ configuration, which lacks self-similarity. In the CP domain, the structure is, once again, exactly the reverse, as can be inspected from (26).

(26) a. een probleem dat/wat we niet kennen
a problem that/what we not know
'a problem we do not know'
b. *een probleem van **wat** de oplossing we niet kennen
c. *een probleem van **wat** we de oplossing ~~van wat~~ niet kennen
d. *een probleem de oplossing van **wat** we niet kennen
e. een probleem **waar**van we de oplossing niet kennen
f. een probleem **waar**van de oplossing we niet kennen
g. *een probleem de oplossing **waar**van we niet kennen
'a problem we do not know the solution of'

De underlying structure in (26b-g) is [the solution of WH]. There are three movements involved: 1. DP-internal movement of [of WH] to edge of the DP, 2. movement to the edge of the clausal domain (with or without pied-piping), 3. PP-internal movement in [of WH] → [WH of]. Only the structures where all three movements occur is grammatical, i.e. $(0)_v(0)_n(0)_p$.[19] For further reference and empirical confirmation or refutation, we make this explicit in (27a-k).

[18] Grimm's DWB only mentions one marginal case of *wodurch* lit. whereby in indefinite use: "by something'.

[19] This covers the Edge Generalization in Heck (2009) or the Edge Constraint in Demirok (2019). Richards 2019 rephrases it into his hypothesis of *contiguity-prominence*, which he derives it from minimalist feature checking.

(27) Grammatical cases of QUEX with self-similarity and ungrammatical cases without it.

a.	$(0)_v(0)_n$	interrogative	wat voor boeken zijn duur?
b.	$(2)_v(2)_n$	existential	ik las wat
c.	$(20)_v(20)_n$	specific indefinite	wat van Vermeer is duur, maar wat van Hals niet
d.	$(0)_v(2)_n$	ungrammatical	*wat boeken zijn duur?
e.	$(2)_v(0)_n$	ungrammatical	*ik heb wat voor boeken
f.	$(02)_v(02)_n$	?	—
g.	$(22)_v(22)_n$	existential	ik las wat boeken
h.	$(20)_v(0)_n$	ungrammatical	*QUEX in middle field ("missing reading")
i.	$(20)_v(2)_n$	ungrammatical	*QUEX in middle field ("missing reading")
j.	$(0)_v(0)_n(0)_p$	relativization	relative clauses with R-pronominalization
k.	$(2)_v(2)_n(2)_p$	existential	existentials without R-pronominalization

Notice that this paradigm only holds for the Dutch QUEX *wat*, not for the inherent interrogative pronoun *wie* 'who', which might violate the Edge Constraint.

We will not discuss the projection rules of configuration and reading (i.e. a Generalized Mapping Hypothesis), i.e. we do not discuss the *reason* why it is the specific indefinite reading that shows up upon $(20)_v(20)_n$. In this mainly syntactic study, we focus on the grammaticality of the *syntactic patterns*. Furthermore, in the ideal case, our approach should say why the self-similar structure in (26f) is ill-formed, or rather does not occur. Unfortunately, there is no reason to rule it out within the present formalism. We leave this case for further research.

4. The missing reading in indefinites

We are now approaching the crucial insight in the missing readings of indefinites. As Heim and Diesing have shown, indefinites show quantificational variability: they can have existential, specific indefinite readings, and generic readings, but they lack interrogative readings. Only readings available in VP (existential) and readings available in the middle field (specific indefinite, generic) are possible, but no readings that are tied to the CP domain (questions, embedded questions, (free) relative pronouns). As we have seen in the previous section, we can construe an indefinite syntactic entity by adjoining a morpheme which we label SOME on top of QUEX, e.g. German *et*/*je*/*irgend*, Dutch *ie*- on top of the QUEX DP: German *wer, was, wo,* English *thing*, *body*, *one*. Let us assume that English *something* and their Dutch and German counterparts are composed, i.e. *some* + *thing*, just like ordinary noun phrases like *some house*. The question then is where SOME is and where THING is. THING and its counterparts in English and in German are grammaticalized nouns. Following Roberts & Rousou (2003), we assume they are reinterpreted in a functional projection above NP. Let us assume, that (some)*thing*, (some)*one*, (irgend)*was* lexicalize NUM. We will also analyze Dutch *wat* as NUM, in view of the colocation *drie of wat boeken* lit. /three or what books/ 'some three books'

and *een stuk of wat boeken* lit. /a piece or what books/ 'some books' etc. Let us further assume that SOME is inserted in DP. This seems the minimal hypothesis.

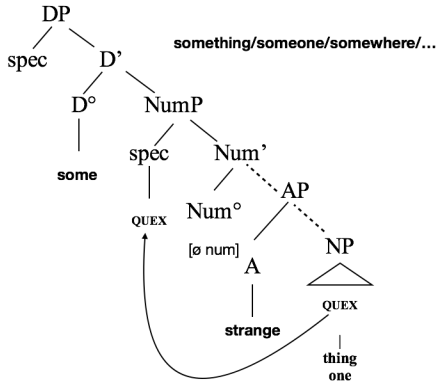
(28) $[_{DP}$ SOME $[\ldots.\ [_{NumP}$ QUEX $]]]$ indefinite pronoun
$[_{DP}$ SOME $[\ldots.\ [_{NumP}$ three $[_{NP}$ houses $]]]]$ indefinite NP

It is not clear to me, where the open variable resides in regular singular indefinite NPs (probably it is zero as in plural NPs), so we concentrate on the indefinite pronouns. It seems reasonable to assume that HG *man(d)* in *je-mand* and *wo* in *irgend-wo* 'somewhere' as well as English *one/what/where/thing* are bleached NPs, i.e. they are incompatible with number.[20] It is not immediately clear if they are inserted in Num or move to Num, the counterpart of specTP in the verbal domain. Let us assume German *man(d)* and English *one* does or at least can, just as the generic pronoun HG *man* 'one', English *one*. So we conclude that a grammaticalization step in (29) is involved under movement and subsequent reanalysis (Zamparelli 1995, Roberts & Roussou 2003, Roberts 2007: 145).

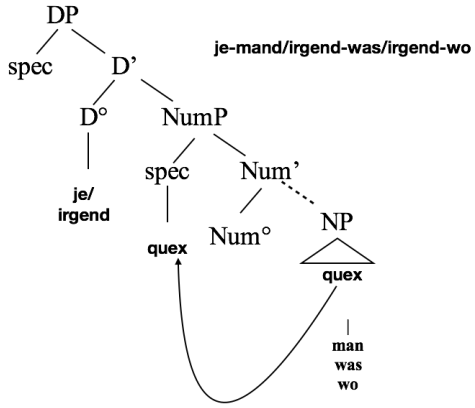
(29) <u>Grammaticalization by DP-internal movement and reanalysis as Num</u>
/some nice thing/ → /some-thing nice/

The true QUEX undergo this movement obligatorily, visualized in (30a).

(30) a.



b.



So QUEX is interpreted in specNumP. Let us characterize its path. Notice that it is on a right branch with respect to D and on a left-branch with respect to Num. This is a mixed structure of the type $(20)_n$. The HG counterpart, e.g. *irgend-was*, is given in (30b). Now, if the entire constituent would move to specCP, e.g. for interrogation, exclamation, etc., the resulting structure will be $(0)_v(20)_n$, which is not self-similar. This captures the fact that indefinites do

[20] See also Munaro (1985) for Italian *cosa* 'what, something' and *cossa* 'what' in North-Italian dialects.

not move to specCP for interpretation. It is, however, possible to move indefinites to the middle field, which is $(20)_v$: specific indefinite and generic readings become available, as in German generic *man*, English *one*, but also in the form of indefinite NPs.

It has been argued that noun phrases have a projection that is similar to the CP in the verbal domain. Some identify it with DP (Alexiadou 2001:32), but most authors assume an independent CP (Bennis, Corver & Den Dikken 1998), which reserves the referential function to DP, to be compared with to the event-referentiality in TP.[21] Now, it must be noticed that there is also fronting of the quantifier type in noun phrases (Jaspers et al. 2015:12), as illustrated in the English sentences in (31).

(31) a. how big a mistake (from: a how big mistake)
b. too ugly a word (from: a too ugly word)
c. many a problem
d. *[how big], [too ugly] a word
e. [how many] a time[22]
f. $[_{CP}$ how ugly [a]$_C$ $[_{DP}$ $[_{AP}$ ~~how ugly~~] D $[_{NP}$ word]]]
g. $[_{CP}$ what [an]$_C$ $[_{DP}$ $[_{AP}$ ~~what~~ ugly] D $[_{NP}$ word]]]

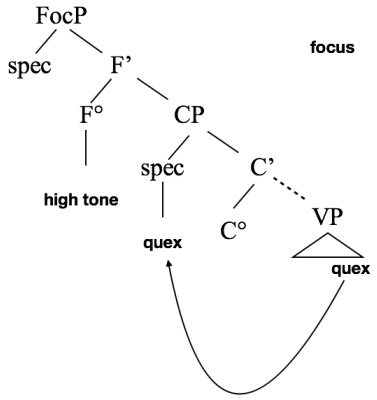
In (31a), a WH-adjective phrase (AP) is moved to a position in front of the indefinite article, i.e. higher up than D, in (31b) a degree-AP is moved. In (31c) a numerical quantifier undergoes a similar movement. We can identify the landings sites, because these movements are incompatible whenever the quantifier features reside in distinct constituents (31d), but allowable whenever the two features reside in one constituent (31e). We identify it with CP (Bennis *et al.*, op. cit.). There is variation in pied-piping just as in the verbal domain: *how* triggers pied-piping of the adjective (31f), while *what* does not (31g). If this analysis is correct, the strict adjacency of the fronted quantificational expression and the indefinite article *a(n)*, suggests *a(n)* has moved from its insertion point D to C, and the quantified structures in (31) are parallel to do-support structures in the sentential domain.

Based on these data from English and data from Greek given above in (21), we conclude that there is DP-internal quantifier movement. It justifies the application to the Dutch QUEX structures in (22). For, if QUEX undergoes a similar movement within DP, we expect different readings of QUEX because of open variable status of *wat* in Dutch.

Let us finally look into the second point on criticsm in HIR (2019): movement of an

[21] Pesetsky & Torrego (2001) assume that DP corresponds to CP in the verbal domain, but then hypothesize a lower proejction RP which hosts the article. This is in fact a notational variant of our labeling of a CP on top of DP, with DP hosting the referential index.
[22] The occurrence of the construction seems to be decreasing (Google ngram viewer search: how many a *).

indefinite NP to specCP under focus. While Dutch QUEX *wat* disallows for specific indefinite readings, it does allow for it under contrastive focus. What happens here is that there is a higher FocP on top of CP (Cinque 1999, Cinque & Rizzi 2008). If we retain general movement to specCP, a self-similar structure is created:



(32)

This structure is of the type $(20)_v$ which is self-similar with the DP-internal structure $(20)_n$ in (30). We charaterize the configurtaion as $(20)_v(20)_n$. This captures HIR's focus effect. If, on the other hand, the dummy noun does not undergo DP-internal movement, it resides on a right-branch. It is $(22)_n$. Such a DP can only sit on a right-branch in the extended VP domain for self-similarity: a VP-internal interpretation is possible (existential closure). This is charaterized as $(22)_v(22)_n$.

7. Self-similarity and recursion

If self-similar structures are as much present in human language as they are in the rest of the nature around us, language must be recursive. This is in itself a welcome conclusion, but it does raise the question of the locus of this recursion in the grammar. In derivational models of language, recursion has been captured in rewriting rules or recursive merge (minimalism), but also in representational models of cross-categorial parallelism (X-bar theory, subject across categories, cross-categorial functional superstructure of VP and DP, structure preservation of transformations etc.) the concept of recursion was present, albeit in an templatic way. In bare phrase structure grammars, the language-internal similarities and cross-categorial patterns cannot explicitly stated anymore, but must (ideally) derive from similarities in grammatical processes (e.g. the existence of uninterpretable features and strategies of feature probing (EPP)), though the actual execution of this program has virtually been left pro memori.[23] Self-similarity

[23] A remarkable exception is the study by Pesetsky & Torrego (2001), who assume uninterpretable tense features to be active in both the extended VP domain and in DP. It correctly derives self-similarity in WH structures discussed in that paper.

closes the gap created by bare phase structure. Self-similarity does not impose parallels in the building plans of the various categories, but require a recurrent pattern in an actual instance of these categories. If self-similarity turns indeed out to be a recurrent property of natural language, the question emerges if it is a surface phenomenon and should be derived from deeper laws and principles, or can be simply stated as is done in this first attempt.

Like Kayne's connectedness, the present theory is hybrid between representation and derivation as it concerns configurational patterns that results form derivational recursive processes.

In the above treatment of self-similar structures, it emerges that self-similarity of the left-branching type (typically in CP) is easy to attain, as well as self-similarity of the purely right-branching type (typically in VP). In those cases, three levels of recursion were found. Self similarity in the middle field is more complex and always concerns a mixture of directionality. Only a single level of recursion was found. It recalls the situation in early generative theory, where context-free grammars covered the empirical data easily to they extent they were also covered by regular grammars, be they right- or left-recursive, but were found to be problematic with respect to center-embedding, which exceeds the productive force of regular grammars. Only simple levels of recursion were empirically found in natural language (Reich 1969). Center-embedding typically concerns the middle field. Though considered grammatical from a formal point of view, center-embedded recursion turned out to be problematic for interpretation and hence was found virtually absent from the actual produced set of sentences.

Conclusion

Self-similarity, the recursive isomorphism of a structure with subsets of it, is a ruling force in syntax and semantics. In this respect, natural language is a natural object just as many other objects in nature, like snowflakes, or patterns on the wings of butterflies (Koster 2016:376). We conclude that self-similarity gives a promising theoretical account of various empirical facts of quantificational variability. It explains why QUEX receive interpretation in VP and specCP, but not in TP, while indefinites receive an interpretation in the VP and the middle field but not in the utmost sentence periphery (specCP): no interrogative interpretation is available. It does not give an account of the type of reading projects on what pattern. It is in this stage unclear if this is simply Saussurian arbitrariness or should be derived from more basic principles.[24]

[24] We mention Postma (1995), which is an attempt to restore compositionality in the Heim-Diesing approach.

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