# Type-shifting and Scrambled Definites

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## Abstract

*We show that the difference between indefinites and definites with respect to their syntactic behaviour, in particular scrambling, follows from a difference in their semantics. In general, definites can be viewed as a special type of indefinites: they are restricted indefinites in all semantic types. This inherent restriction of definites makes them insensitive to processes of semantic incorporation. That is, merging an incorporating verb and a predicative definite is equivalent to merging an ordinary type of transitive verb and an ordinary type of definite. This will explain the phenomenon of optional scrambling for definites. Predicative indefinites are dependent on the verb for their interpretation, of which the adjacency requirement between the incorporating verb and the predicative indefinite is only a syntactic reflex.*

## 1 Introduction

The aim of this paper is to provide an explanation for a very striking and clear linguistic puzzle concerning the possible syntactic positions that a certain type of definite and indefinite objects may occupy in languages like Dutch and German. The definites and indefinites we are concentrating on look very similar and can be characterized as *weak*. Intuitively, they form a semantic unity together with a light verb. Yet, the definites can occur to either the left or the right of an adverb (henceforth, in scrambled or unscrambled position), whereas the indefinites may only occupy the unscrambled position: they have to be adjacent to the verb. The crucial difference is illustrated with respect to the minimal Dutch pairs in (1)-(3). Consider *de was doen* 'do the laundry' versus *een plas doen* 'take a piss' in (1):

(1) a. dat ik nog de was moet doen
that I still the laundry must do
"that I still have to do the laundry"

b. dat ik de was nog moet doen
that I the laundry still must do
"that I still have to do the laundry"

c. dat ik nog een plas moet doen
that I still a piss must do
"that I still have to take a piss"

d. *dat ik een plas nog moet doen
that I a piss still must do
"that I still have to take a piss"

Or *de bus nemen* 'take the bus' versus *een enkeltje nemen* 'get a single' in (2):

(2) a. dat ik altijd de bus neem
that I always the bus take
"that I always take the bus"

b. dat ik de bus altijd neem
that I the bus always take
"that I always take the bus"

c. dat ik altijd een enkeltje neem
that I always a single take
"that I always get a single"

d. *dat ik een enkeltje altijd neem
that I a single always take
"that I always get a single"

Or finally *de mazelen hebben* 'have the measles' versus *kinderen hebben* 'have children' in (3):

(3) a. dat ik ook de mazelen heb
that I also the measles have
"that I also have the measles"

b. dat ik de mazelen ook heb
that I the measles also have
"that I also have the measles"

c. dat ik ook kinderen heb
that I also children have
"that I also have children"

d. *dat ik kinderen ook heb
that I children also have
"that I also have children"

Current analyses of scrambling would not be able to account for the paradigm presented here, as we will point out in the next section. The fact that the definites in (1)-(3) behave exactly like other definites and unlike predicative indefinites, indicates that a proper analysis of scrambling should not be based on a difference in the (discourse) properties of the objects (properties such as familiarity, anaphoricity, topicality and/or focus). Instead, the explanation should be sought either in a syntactic difference between definites and indefinites, or in a semantic difference. We will argue in favour of the latter option and account for the scrambling differences between definites and indefinites within a semantic type-shifting perspective, elaborating on certain insights of Partee (1987), De Hoop (1992), Diesing and Jelinek (1995), and Van Geenhoven (1996). In Section 3 we will discuss the semantics of definites and indefinites and in Section 4 we present a solution to the puzzle by attributing the difference in syntactic behaviour between dependent definites and predicative indefinites to a difference in their semantics.

## 2 Scrambled definites

It has often been observed in the literature, that when a language allows for scrambling (which we will use as a descriptive term here for the occurrence of an object in a position to the left side of an adverb), definite and other strong NPs may freely scramble, whereas indefinite and other weak NPs are subject to certain restrictions. The data in (1)–(3) above are in accordance with this observation. The question that springs to mind is why the indefinites in (1)–(3) are not allowed to scramble. A related question is whether NPs that do scramble share a certain characteristic. That is, are there any properties of the object, the predicate, or the context, that actually trigger scrambling? Many recent approaches to scrambling phenomena argue that this is indeed the case, i.e., scrambling is not truly optional, it is *driven*.

Diesing and Jelinek (1995) claim that scrambling of definites is semantically driven. (In)definites are taken to be NPs of type $e$ and $(e, t)$ that introduce free variables. Variables can get an existential interpretation in unscrambled (VP-internal) position, thanks to a default existential closure operator that is postulated at the VP-level. According to Diesing and Jelinek, definite NPs which receive a referential interpretation have to be in scrambled position. Otherwise, they would get bound by the default existential closure operator. This then would be a violation of a novelty condition (cf. Heim 1982) that requires variables bound by existential closure to be new in the discourse. So, in languages like German and Dutch, referential definite NPs are predicted to obligatorily scramble in order to get out of the scope of the existential closure operator. Crucially, however, this prediction is not borne out. Referential definites do not obligatorily scramble. The sentences that Diesing and Jelinek claim to be ill-formed are in fact perfectly well-formed:

(4) weil ich selten die Katze streichle
since I seldom the cat pet
"since I seldom pet the cat"

(5) weil ich nicht das Rosamunde-Quartett gespielt habe
since I not the Rosamunde Quartet played have
"since I haven't played the Rosamunde Quartet"

Diesing and Jelinek predict the sentences in (4) and (5) to be ungrammatical. They actually mark the sentences with the grammaticality indication '*?'. Yet, the sentences in (4) and (5) are not ill-formed at all, not even slightly. This means that the scrambling theory of Diesing and

Jelinek which is supposed to cover indefinites as well as definites of a non-quantificational type (since existential closure is only applied to free variables, it does not affect quantificational NPs) cannot account for the clear differences between definites and indefinites with respect to scrambling.

With respect to the puzzle presented in the introduction above, one might argue that the definites in (1)-(3) are of a special kind and need not be familiar. Clearly, *de bus* 'the bus' in (2) does not have to be introduced in the discourse before and it is not like 'the sun' either, a definite which denotes one and the same individual through contexts. The bus-type of definite is actually hardly referential. Therefore, the definites in (1)-(3) are not especially problematic for Diesing and Jelinek's analysis. What is however problematic for their analysis, is that definites that are indeed referential or even anaphoric (i.e., definitely related to the previous discourse) do not obligatorily scramble either, as is illustrated below:

(6) Paul heeft een kat die de laatste tijd een gespannen indruk maakt
"Paul has a cat that seems to be under stress, recently"

a. Misschien komt dat omdat Paul zelden de kat aait
maybe comes that because Paul seldom the cat pets
"That's maybe because Paul hardly ever pets the cat"

b. Misschien komt dat omdat Paul de kat zelden aait
maybe comes that because Paul the cat seldom pets
"That's maybe because Paul hardly ever pets the cat"

To sum up, all types of definites, the highly referential and anaphoric ones as well as the weak ones and everything in between, freely scramble. That is, definites may either occupy the scrambled or the unscrambled position relative to an adverb, and there does not seem to be a property of either the definite itself or the context in general that forces or prohibits scrambling. Anaphoric, referential, familiar, topical definites like the one in (6) do not have to scramble (*contra* Diesing and Jelinek 1995, a.o.), whereas non- topical, non-specific, non-anaphorically destressed, non- contrastively focused definites may scramble (*contra* De Hoop 1992, Choi 1996, Neeleman and Reinhart, to appear, a.o.). The conclusion that is important for the purpose of this paper is that scrambling is truly optional for all definites.

## 3 Semantics of definites

We would like to claim that the differences in scrambling behaviour between definites and indefinites is due to two interrelated semantical features:

i) definites can be independent of their semantic context in a way indefinites cannot;

ii) definites are naturally viewed as having type $e$ while indefinites are not.

To sustain this claim, we give a quick overview of the semantics of (in)definites in type $e$ ('referential'), type $(et)$ ('predicative'), and type $((et)t)$ ('quantificational'). Here we start from the seminal paper Partee (1987), adding new observations as we go along.

**Type** $e$ As is well-known, referential definites have a natural interpretation in type $e$. Let $P$ be a property holding of a single entity, then the meaning of 'the $P$' can be given as $\iota(P)$. Here, $\iota$ is the partial function of type $((et)e)$, which returns the element of its argument *provided* this element is a singleton:

$$\iota(X) = d, \text{ if } X = \{d\} \text{ for some } d.$$

For instance, the VP in (7a) has (7b) as its semantics:

(7) a. de bus nemen
the bus take
'to take the bus'
b. $\lambda x.\text{nemen}(x, \iota y.\text{bus}(y))$

with *bus* denoting a singleton.

Partee suggests that a similar shift from $(e,t)$ to $e$ is available for indefinites if these are viewed as 'novel' variables, in the sense of DRT. However, variables are *syntactic* rather than semantic entities, and are therefore unsuitable as ingredient of the required shift.[1] In seeking a semantic analogue of this idea, the use of choice functions seems the closest one can get (see Meyer-Viol 1995 for an overview and development). But then one has to represent dependencies that are absent in the case of referential definites. For instance, the semantics of (8a) is (8b):

(8) a. een enkeltje nemen
a single take
'to get a single'
b. $\lambda x.\text{nemen}(x, \varepsilon y(\text{nemen}(x,y) \ \& \ \text{bus}(y)))$

Here, $\varepsilon$ means a choice from its argument *provided* this set is non-empty. Note that this choice should be from the singles $x$ gets; it cannot be just any single. By contrast, $\iota$ can be applied *independently* of the verb; for each $y$ in (7b) there is a unique bus regardless of whether $x$ takes this bus or not. Due to the dependence, indefinites are not simply of type $e$ but rather of type $(e,e)$. Moreover, to specify the meaning of an indefinite in type $(e,e)$ requires the use of the verb, and is hence non-compositional. For this reason we do not consider this option any further but follow Partee, who holds that indefinites live more naturally in the predicative type $(et)$ (cf. Van Geenhoven's semantics in Section 4).

**Type** $(et)$ The predicative meaning of an (in)definite NP is of type $(et)$; it is the denotation of its nominal. In the case of definites this denotation

[1]Cf. also Van Benthem's warning in Partee 1987, footnote 19.

should be a singleton, and it should be non-empty in the case of indefinites. Clearly, for singleton properties $P$, the predicative meaning of a definite is essentially the same as its referential meaning:

$P = \{d\}$ iff $\iota(P) = d$

for any $d$. In Partee's terminology, the predicative definite in type $(et)$ can be obtained by applying the total injective function

$$ident \equiv \lambda x \lambda y.x = y$$

of type $(e(et))$ to $\iota(P)$:

$$P = ident(\iota(P)) = \lambda y.\iota(P) = y \ .$$

In set notation: $P = \{\iota(P)\}$. Conversely, the partial, surjective $\iota$ turns a predicative meaning of definites into a referential one.

Note that at this level definites can be seen as 'restricted' indefinites; singletons are of course special instances of non-empty sets. The same is true for the quantificational treatment of (in)definites, but to see this requires a short excursus into quantification theory.

**Quantifiers**

The idea that definites are 'restricted' indefinites can be visualized in an appealing way by means of the tree of numbers. To this end, we first recall the notion of a logical quantifier.

**Definition 1** A logical quantifier is a functor $\mathbf{D}$ which assigns to each non-empty domain $E$ a two place relation among sets:

$$\mathbf{D}_E \in \wp(\wp(E) \times \wp(E))$$

which satisfies three constraints:

- Conservativity (CONS): $\mathbf{D}_E AB$ iff $\mathbf{D}_E AA \cap B$;
- Extension (EXT): $\mathbf{D}_E AB$ iff $\mathbf{D}_{E'} AB$, for all $A, B \subseteq E \subseteq E'$;
- Isomorphy (ISOM): for all bijections $\pi$ from $E$ onto $E'$, $\mathbf{D}_E AB$ iff $\mathbf{D}_{E'} \pi[A]\pi[B]$.

**Fact 1** *Conservativity and extension is equivalent to universality (UNIV):*

$$\mathbf{D}_E AB \textit{ iff } \mathbf{D}_A AA \cap B.$$

For UNIV $\mathbf{D}$ the first argument truly 'sets the stage'. Formally, this means that we may forget about the domain $E$: $\mathbf{D}AB$ iff for some $E$ $\mathbf{D}_E AB$; cf. Van Benthem 1986, Westerståhl 1985.

**Fact 2** *On finite models, a logical quantifier* $\mathbf{D}$ *can be identified with a relation* $\mathbf{d}$ *among natural numbers:*

$$\mathbf{d}|A - B||A \cap B| \textit{ iff } \mathbf{D}AB.$$

*Hence, quantifiers become subsets in the tree of numbers in Figure 1. Cf. Van Benthem 1984.* □

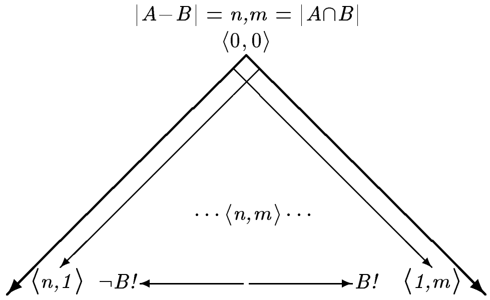


FIGURE 1 *Tree of Numbers*

**Quantificational indefinites**

Note that in general a quantificational proposition $\mathbf{Q}AB$ depends on (the size of) two sets: $A-B$ and $A \cap B$, not just on $A \cap B$! Yet, some quantifiers, the so-called intersectives, only depend on $A \cap B$. This insight can be defined in several equivalent ways.

**Definition 2** A quantifier is *intersective* iff it is conservative and co-conservative:

$$\mathbf{D}AB \textit{ iff } \mathbf{D}A \cap BB.$$

iff it is conservative and *symmetric*:

$$\mathbf{D}AB \textit{ iff } \mathbf{D}BA.$$

iff it is invariant under identical intersections:

$$A \cap B = A' \cap B' \textit{ implies: } \mathbf{D}AB \text{ iff } \mathbf{D}A'B'.$$

Keenan (1987) proposes to identify indefinite quantifiers with the intersectives. They should be exactly the ones which occur felicitously in existential sentences:[2]

(9) There are just two/*most students at the party

When viewed as subsets of Van Benthem's tree, intersective quantifiers are extremely well-behaved; see Figure 2. Indeed, on finite domains intersectives as a relation between numbers is fully determined by its element on the righthand spine. They are essentially one- instead of two-dimensional quantifiers, since they can be written as $\langle P \rangle AB$, with $P \subseteq \omega$ a *set* of natural numbers, and: $\langle P \rangle AB$ iff $|A \cap B| \in P$.[3] For example, a singleton $\{n\}$

[2]What about the sentence: 'There are two of the three students at the party.' (Perhaps this sentence is double Dutch, but the real Dutch *Er zijn twee van de drie studenten op het feest* is fine.) A sentence 'two of the three AB' has meaning $|A \cap B| = 2 \wedge |A| = 3$. Like *most* this depends on $|A - B|$ and $|A \cap B|$ and is hence non-intersective. To retain Keenan's proposal, one should treat '$|A| = 3$' as a presupposition and require intersectivity only if it is satisfied.

[3]Thus it is clear that there are uncountably many intersective determiners ($\wp(\omega)$ is uncountable). A quick cardinality argument shows that most intersective quantifiers are

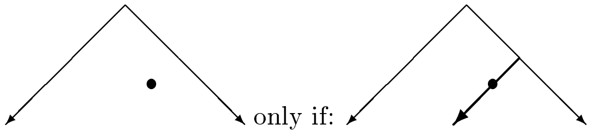


FIGURE 2 *Invariance of indefinites*

gives *just n*. Also, the *upward closed* sets $P$ with: if $k \in P$ and $n \geq k$, then $n \in P$, are all of the form $\{n \in \omega : m \leq n\}$ for some minimal $m$, which corresponds to *at least m*. Given the above invariance, it is clear that the following theorem holds:

**Theorem 3** *The intersectives are precisely the left-oriented zebra's in Van Benthem's tree; see Figure 3.* □

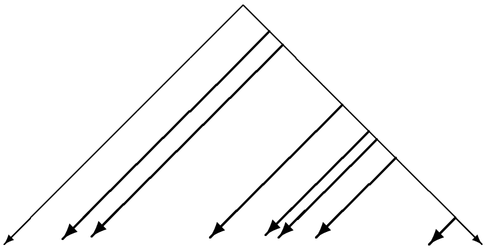

FIGURE 3 *Indefinites as left-oriented zebra's*

### Quantificational definites

Above we observed that definites are in a sense 'restricted' indefinites. Indeed, for $P \subseteq \omega$ the definite can be defined by $[P]AB$, which holds iff: $\langle P\rangle AB$ and $|A - B| = 0$. Alternatively:

$$[P]A := \{B : A \subseteq B \wedge |A| \in P\},$$

which gives definites as the *principal filters* in Barwise and Cooper (1981). For example, $[\{n\}]A$ is *the n A*, and $[P]A$, for upward closed $P$, is *the n or more A*, and so forth and so further... Definites, too, are strictly one-dimensional.

**Theorem 4** *In Van Benthem's tree, definites are just the spines of left-oriented zebra's; see Figure 4* □

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non-first-order definable, because there are only countably many of those. Some of the non-first-order definable intersectives are easily expressed in natural language; e.g., *an even number of*. It seems that at most the countably many *recursive* subsets of $\omega$ are realized in daily language, and perhaps even just a proper subset of those. Cf. also Van Benthem 1986.

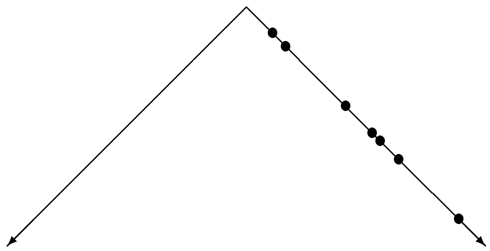

FIGURE 4 *Definites as spines of zebra's*

We trust the reader is familiar with how type-shifting relates the quantificational denotations with the referential and predicative ones (but see Section 5).

## 4 The puzzle solved

In this section we will provide an explanation for the difference between indefinites and definites that get a weak reading as in the examples (1)–(3) above. Although the definites in (1)–(3) can intuitively be characterized as predicative, just like their indefinite counterparts, they differ in syntactic behaviour: the definites can scramble whereas the indefinites cannot. There is another difference between indefinites and definites cross-linguistically: in many languages that show morphological or syntactic noun incorporation, the incorporated noun cannot be definite or interpreted as definite. The following example shows this for West Greenlandic (Van Geenhoven 1996):

(10) Kaage-lior-p-u-t [West Greenlandic]
cake-make-IND-[-TR]-3PL
They made cake/a cake/cakes/*the cake

The weak or predicative reading of indefinites is argued to follow from the semantic type these NPs have by a number of authors. For example, Van Geenhoven argues that West Greenlandic incorporated nouns are of type $(e, t)$. These predicates are incorporated or absorbed by an incorporating verb, and as such introduce a restriction on the individuals that the verb applies to. Their existential interpretation comes with the lexical semantics of the verb (following Carlson 1977). Van Geenhoven defends the view that West Greenlandic incorporated nouns are base generated in verb adjacent position. A semantically incorporated expression does not have to be realized as a syntactic morpheme: it can also be realized as a syntactic phrase bearing weak case (cf. De Hoop 1992). Compare Van Geenhoven's examples:

(11) a. Angunguu-p aalisagaq neri-v-a-a
A.-ERG fish.ABS eat-IND-[+TR]-3SG.3SG
"Angunguaq ate the/a particular fish"

b. Angunguaq neri-v-u-q
A.ABS eat-IND-[-TR]-3SG
"Angunguaq was eating"

c. Angunguaq aalisakka-mik neri-v-u-q
A.ABS fish-INST.SG eat-IND-[-TR]-3SG
"Angunguaq ate fish"

The transitive verb in (11a) is intransitivized in (11b) and (11c): in (11b) there is no object, in (11c) it bears weak (instrumental) case. Van Geenhoven argues that in West Greenlandic an instrumental object and the absence of object agreement are syntactic markers of the process of semantic incorporation (whereas noun incorporation is a morphological realization of this semantic process).

Van Geenhoven extends her analysis of semantic incorporation to the semantic and syntactic properties of indefinites in languages like German and Dutch. A (pseudo-)transitive verb like *eat* can combine with quantificational as well as predicative NPs in Dutch and German. This means that the verb can have two different semantic types, which seems to be in accordance with the fact that the corresponding verb in West Greenlandic can take two different morpho-syntactic forms (see (11) above). Either it is interpreted as an ordinary two-place relation between individuals or it is interpreted as an incorporating verb that combines with a predicative NP. As an illustration, (12a) represents the meaning of the non-incorporating predicate *eat*, and (12b) of its incorporating counterpart:

(12) a. $\lambda y \lambda x[\mathrm{eat}(x, y)]$
b. $\lambda P \exists y \lambda x[P(y) \ \& \ \mathrm{eat}(x, y)]$

So an incorporating verb is the result of a shift from type $(e(et))$ to type $((e,t)(e,t))$ as follows:

$$inc(R^{(e(et))}) \equiv \lambda P^{(e,t)} \lambda x^e . \exists y^e [P(y) \ \& \ R(x)(y)].$$

Note that this shift must be restricted, since not all verbs allow for a predicative interpretation of an indefinite object (see also Diesing 1992 for discussion). Not surprisingly, an incorporating verb and a predicative indefinite have to be adjacent to each other in order to allow for the process of semantic incorporation (cf. Van Geenhoven 1996). Therefore, the scrambled indefinites in (1)–(3) give rise to ill-formedness. Other indefinites may scramble, but in those cases it can be argued that they are not dependent on the verb for their existential interpretation. They have the type of a generalized quantifier (cf. De Hoop 1992), which is the semantic type for indefinites that get a generic, partitive or referential reading as well as of those that function as objects of non-incorporating predicates. In other words, an indefinite that shifts to a quantificational type is not semantically incorporated and hence may scramble:

(13) a. dat Paul twee koekjes al opgegeten heeft
that Paul two cookies already eaten has
"that Paul has already eaten two (of the) cookies"

We assume that the indefinites in (1)-(3) must be semantically incorporated. This is due to the light (non-contrastive) character of the verbs under consideration, that do not allow for a strong, quantificational reading of the indefinite objects (cf. De Hoop 1992).[4] Predicative indefinites are semantically dependent on the verb for their existential interpretation. The observed adjacency requirement between the verb and the indefinite is a syntactic reflex of this process of semantic incorporation.

Before we return to the problem of dependent definites, let us pay some attention to monotone decreasing indefinites. Given that monotone decreasing indefinites do not license discourse anaphora, the common conclusion in DRT (e.g., Kamp and Reyle 1993) is that these NPs are always of the quantificational type, just like NPs such as *every fish*. If monotone decreasing NPs would always be quantificational, however, we could not be able to account for the fact that they behave like other indefinites in the following context:

(14) a. dat Fred ook geen kinderen heeft
that Fred indeed no children has
"that Fred doesn't have children either"

b. *dat Fred geen kinderen ook heeft
that Fred no children indeed has
"that Fred doesn't have children either"

Van Geenhoven (1996) does not treat monotone decreasing indefinite NPs, but De Swart (1997) proposes that apart from a local existential closure operation for NPs of type $(e,t)$ that are derived from monotone increasing NPs, we also need a local universal closure operation for NPs of type $(e,t)$ that are derived from monotone decreasing indefinites. The weak interpretation of the indefinite monotone decreasing NP in (26) can now follow from the $(e,t)$-type of the NP that restricts the individuals that the verb applies to. Universal closure is possible for predicate NPs derived from monotone decreasing NPs. Along the lines of Van Geenhoven (1996), we can represent the meaning of the verb in this case as in (15b):

(15) a. Ik eet geen vis
I eat no fish
"I don't eat fish"

[4] In some cases, such a light verb can become contrastive nevertheless. Anita Mittwoch (p.c.) noted that w.r.t. a sentence such as (2c), one can come up with a context in which single tickets are hardly ever sold. Therefore, whenever there are single tickets available, I will take the opportunity to get one. In such a context we get a kind of generic reading for the object while the verb becomes contrastive. Hence, scrambling becomes possible: *omdat ik een enkeltje altijd NEEM* 'since I always take a single ticket (whenever the opportunity offers).'

b. $\lambda P \lambda x \forall y[P(y) \rightarrow \neg \text{eat}(x,y)]$

De Swart's local closure operations capture the generalization that weak interpretations of indefinites always involve the closure of a set of individuals which corresponds with the predicative use of the NP. The choice between an existential and a universal closure operation is made on the basis of the minimality/maximality property of the predicatively used NP, which is derived from the monotonicity properties of its underlying generalized quantifier denotation. Thus, we can account for the fact that weak monotone decreasing NPs behave like other predicative indefinites, but unlike definites, with respect to semantic incorporation.[5]

We have seen that indefinites can morphologically incorporate in certain languages whereas definites cannot. The problem is that definites do have weak interpretations, however, such as the ones in (1)–(3) above. That might indicate that the definites in (1)–(3) semantically incorporate after all. But even in these cases they freely scramble, just like other definites, which suggests that their predicative interpretation does not correspond to a predicative type. Van Geenhoven (1996) argues that definites can only be understood as predicates of 'familiar' variables, whereas the internal argument's variable of a semantically incorporating verb is always 'novel'. In the case of *do the laundry take the bus* and *have the measles*, however, this can hardly be the explanation, since *the laundry*, *the bus*, and *the measles* in these configurations do normally not refer to familiar discourse referents.

In the previous section we pointed out that definites can be conceived of as restricted indefinites. This is illustrated in (16) for the predicative type of indefinites and definites:

(16) a. $\lambda x[\text{man}(x)]$

b. $\lambda x[\text{man}(x) \ \& \ \forall y(\text{man}(y) \rightarrow x = y)]$

This difference between indefinites and definites actually allows us to account for their difference in syntactic behavior with respect to semantic incorporation and scrambling. While indefinites are dependent on the predicate for their existential interpretation, following Van Geenhoven (1996)

[5]Above we have observed that incorporating verbs can be seen to result from the shift *inc* from type $(e,(e,t))$ to type $((e,t),(e,t))$. Following up on this observation, we notice that De Swart's local closure is one corner in a square of opposition (cf. Löbner 1987). This square is generated by means of external and internal negations from type $((e,t),(e,t))$ to type $((e,t),(e,t))$, respectively denoted by $\neg^*$ and $\sim^*$:

- $inc(R^{(e(et))}) \equiv \lambda P^{(e,t)} \lambda x^e.\exists y^e[P(y) \ \& \ R(x)(y)]$.
- $\neg^* inc(R^{(e(et))}) \equiv \lambda P^{(e,t)} \lambda x^e.\neg(inc(R^{(e(et))})(P)(x))$
  $\equiv \lambda P^{(e,t)} \lambda x^e.\neg\exists y^e[P(y) \ \& \ R(x)(y)]$. (External negation: 'geen'.)
- $\sim^* inc(R^{(e(et))}) \equiv inc(\lambda x \lambda y.\neg R(x)(y))$
  $\equiv \lambda P^{(e,t)} \lambda x^e.\exists y^e[P(y) \ \& \ \neg R(x)(y)]$. (Internal negation: 'een niet', 'niet elke'.)
- $dual(inc(R^{(e(et))})) \equiv \neg^* \sim^* inc(R^{(e(et))})$
  $\equiv \lambda P^{(e,t)} \lambda x^e.\forall y^e[P(y) \rightarrow R(x)(y)]$ (Dual: 'elke'.)

De Swart's local closure is of course equivalent to the external negation $\neg^* inc(R^{(e(et))})$.

and De Swart (1997), definites are not. The uniqueness condition of definites is part of the semantics of the definite itself in all its types. It is strongly related to the view that a definite NP denotes in type $e$: it refers to an object of the kind indicated by its nominal. Hence, the $\iota$-operation that can be used to shift the type of a predicative definite in type $(e,t)$ to type $e$ is *not* dependent on the verb. Since the $\iota$-operation is only defined in case the uniqueness restriction is fulfilled, it can be taken for granted that when I say I will take the bus, there will be one unique bus from where I am to where I want to go at a certain time.

Following the strategy in Partee and Rooth (1983) to interpret an NP in as simple a type as is possible, definite NPs have their basic denotation in type $e$ (e.g., as specified by means of the $\iota$-operation). As a consequence, they combine with non-incorporating verbs as usual:

(17) de vis eten
'eat the fish'
$\lambda x.\text{eat}(x, \iota y.\text{fish}(y))$

But shifting its referential meaning to the corresponding singleton predicate, it combines with the incorporating verb, too.

(18) de vis eten
'eat the fish'
$\lambda x.\exists y[\text{eat}(x,y)\ \&\ \text{fish}(y)]$

Moreover, since *fish* is supposed to be a singleton, (17) and (18) have the same meaning:

$$\lambda x.\text{eat}(x, \iota y.\text{fish}(y)) = \lambda x.\exists y[\text{eat}(x,y)\ \&\ \text{fish}(y)].$$

By contrast, indefinite NPs in object position do not have a natural denation in type $e$; they start to live predicatively in type $(e,t)$. These predicative NPs cannot combine with non-incorporating verbs at all. This explains why definites scramble more freely than predicative indefinites.

## 5 Generalizing to dependent (in)definites

The discussion up till now was restricted to independent definites, which denote uniquely regardless of the linguistic context. The explanation for dependent definites—as in (19) where each linguist may take a different bus,—is a little more complicated. It will lead us to consider a parameterized version of the Partee triangle for definites.

(19) dat twee linguisten de bus nemen
that two linguists the bus take
'that two linguists take the bus'

We hold that dependent definites are still *in*dependent of the verb in a way indefinites are not. It is just the nominal *bus* which is functionally dependent on the *linguists*, so we need not construe this dependency by considering the entire VP. E.g., for quantificational definites one has:

$$[\text{two } x : \text{linguists}][\text{the } y : \text{bus}(x, y)](\text{take}(x, y))$$

As a consequence, an explanation of why dependent definites scramble as freely as independent ones could come from a parameterized version of the Partee triangle for definites, where the parameters indicate the elements on which the definite depends. We now introduce this triangle, and show how it can be used to give the desired explanation.

Since a definite may depend on *any* finite number of elements, dependent definites live in several systematically related types. To make this precise, we define an auxiliary notion:

**Definition 3** Let $\alpha$ be a type. The type $\alpha_n$ is defined recursively by:

$$\alpha_0 \equiv \alpha, \text{ and } \alpha_{n+1} \equiv (e, \alpha_n).$$

That is, an object of type $\alpha_n$ takes $n$ elements of type $e$ to return an object of type $\alpha$.

A dependent definite lives in a type $(e)_n$, $n$ a natural number. It is a function $f^n$, such that for every sequence of objects $\vec{x}$ of length $n$, $f(\vec{x})$ is the unique object of the kind given by its nominal. For example, the dependent definite *the bus* in (19) denotes a function of type $e^1 \equiv (e, e)$, which applied to an argument $x$ gives the bus assigned to $x$.[6] A convenient way to specify this meaning uses a generalized $\iota$-operator that shifts the graph of an $n$-ary function—i.e., an object of type $(e, t)_n$ coding a set of $n + 1$-tuples,—to the function in type $e_n$ itself:

$$\iota(F) = \lambda x_1^e, \ldots, x_n^e.F^*(x_1, \ldots, x_n)$$

This shift presumes that $F$ is a functional relation in type $(et)_n$. If so, $F^*(x_1^e, \ldots, x_n^e)$ denotes the function value of $F$. For instance, the meaning of (19) in terms of this operator becomes:

$$[\text{two } x : \text{linguists}](\text{take}(x, \iota(\text{bus})(x)))$$

The nominal *bus* in (19) denotes the graph of a 1-place function (type $(e, t)_1$). This function assigns a unique bus to each element, whence $\iota(\text{bus})(x)$, which results from applying the function $\iota(\text{bus})$ of type $(e, e)$ to the variable $x$ of type $e$, is the bus assigned to $x$.

This $\iota$-operator generalizes the familiar one as follows. By convention, a zero place function is an element; therefore the graph of such a function is a singleton. The $\iota$-operator lowers this graph to the function value, i.e, the element.

Along similar lines, the entire Partee triangle for definites can be generalized to types $e_n$, $(e, t)_n$, and $((e, t)t)_n$; see figure 5.

The shifts in the triangle are defined as follows:

[6] Strictly speaking one should use *partial* functions, which may be undefined for certain arguments. We ignore this aspect here, since it is clear how it could be handled.

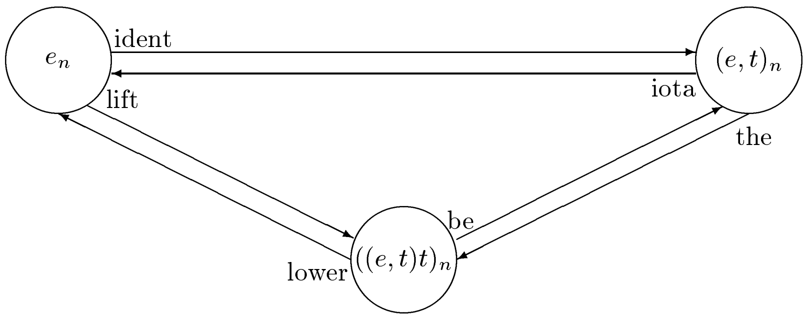


FIGURE 5 *Partee triangle for definites*

**Ident** from type $e_n$ to type $(e,t)_n$:

$$ident(f^{e_n}) = \lambda x_1^e, \ldots, x_n^e \lambda y^e.f(x_1)\ldots(x_n) = y.$$

**Iota** from type $(e,t)_n$ to type $e_n$:

$$\iota(F^{(e,t)_n}) = \lambda x_1^e, \ldots, x_n^e.F^*(x_1)\ldots(x_n).$$

*provided* $F$ is a functional relation in type $(et)_n$; $F^*(x_1^e, \ldots, x_n^e)$ denotes the function value of $F$.

**The** from type $(e,t)_n$ to $((e,t)t)_n$ is a parameterized version of the quantifier 'the'.

$$the(F^{(e,t)_n}) \equiv \lambda x_1^e, \ldots, x_n^e \lambda X^{(e,t)}.\forall y^e(F(x_1)\ldots(x_n)(y) \rightarrow X(y)).$$

For definites the shift is partial, since they require $F(x_1)\ldots(x_n)$ to be a singleton for each $x_1, \ldots, x_n$.

**Be** from type $((e,t)t)_n$ to type $(e,t)_n$:

$$be(Q^{((et)t)_n}) \equiv \lambda x_1^e, \ldots, x_n^e \lambda y^e.Q(x_1)\ldots(x_n)(\lambda z.z = y).$$

**Lift** from type $(e,t)_n$ to type $((e,t)t)_n$:

$$lift(f^{(e)_n}) \equiv \lambda x_1^e, \ldots, x_n^e \lambda X^{(e,t)}.X(f(x_1)\ldots(x_n)).$$

**Lower** from type $((e,t)t)_n$ to $(e)_n$ is best given as the composition of the shifts *be* and *iota*:

$$lower(Q^{((e,t)t)_n}) \equiv \iota(be(Q)).$$

This gives the required

$$Q(x_1)\ldots(x_n) = \lambda X^{(e,t)}.X(lower(Q)(x_1)\ldots(x_n))$$

*provided* $Q(x_1)\ldots(x_n)$ is an ultrafilter generated by a single element.

The Partee triangle and its generalized shifts indicate how to explain the free scrambling behaviour of definites also for the dependent case. As soon as the parameters of a definite are set, we obtain its familiar denotations in type $e$ and $(e,t)$. These combine with the incorporating and non-incorporating verb meanings as before to yield synonyms; e.g.:

$$\lambda x.\text{take}(x, \iota(\text{bus})(x)) = \lambda x \exists y[\text{take}(x, y) \ \& \ \text{bus}(x, y)]$$

if *bus* is a functional noun. But the corresponding dependent indefinite lives in type $(e, t)_n$ (i.e., the parameterized predicative reading); hence it cannot combine with a non-incorporating verb in the way required.

## 6 Conclusion

In this paper we offered an explanation for a difference in Dutch between predicative indefinites that have to be adjacent to the verb on the one hand and definites that freely scramble on the other. The difference is especially striking in the case of dependent definites such as *the bus* in examples such as *Two linguists take the bus* which are intuitively very similar to predicative indefinites such as *a single* in *Two linguists get a single*. Yet, we argued that although this type of definite is dependent on other elements, such as the *linguists* in the above example, they are independent of the verb in a way predicative indefinites cannot be. We argued that whereas the predicative use of indefinites lives naturally in type $(e, t)$, definites have their basic denotation in type $e$ as specified by means of the *iota*-operation. A predicative indefinite is dependent on the predicate for its existential interpretation, of which the adjacency requirement between the verb and the object in languages like Dutch is a syntactic reflex. A functionally dependent definite is still independent of the verb, however. As soon as its parameters are set, it combines with incorporating and non-incorporating verb meanings, just like its independent counterparts. That is, merging an incorporating verb and a predicative type of definite is shown to be equivalent to merging a non-incorporating verb and a referential type of definite. This can be used to explain the free scrambling behaviour of (in)dependent definites.

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