Coercion vs. Indeterminacy in Opaque Verbs

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0. Introduction

This paper is about the semantic analysis of *opaque* verbs such as **seek** and **owe**, which allow for unspecific readings of their indefinite objects.[1] One may be looking for a good car without there being any car that one is looking for; or, one may be looking for a good car in that a specific car exists that one is looking for. It thus appears that there are two interpretations of these verbs – a specific and an unspecific one – and one may wonder how they are related. The present paper is a contribution to this question.

1. History

1.1 Paris. The Time of the Holy Inquisition

Opaque verbs differ in their semantic behaviour from ordinary verbs. This phenomenon was already known to the medieval logician Buridanus:

> I posit the case that for a good service you performed for me, I promised you a good horse. […] And since I owe you this, until I have paid that concerning the payment of which I have obligated myself […], you could rightly take action against me to bring about payment to you of a horse, which you could not do if I did not owe you. […] But the opposite is argued in a difficult way. [Buridanus (1966 [1350]): 137]

The following modern version of the opposite argument is less verbose than the original:

> Let us then have our horse-coper arguing again. 'If I owe you a horse, then I owe you something. And if I owe you something, then there is something I owe you. And this can only be a thoroughbred of mine: you aren't going to say that in virtue of what I said there's something else I owe you. Very well, then: by your claim, there's one of my thoroughbreds I owe you. Please tell me which one it is.' [Geach (1965: 430]

The two arguments are based on two different ways of reading the sentence under debate (1) – an obvious, unspecific interpretation and a somewhat remote[2], specific one.

(1) **I owe you a horse.**

1.2 Harvard. The McCarthy Era

While Buridanus had no solution to offer – indeed, he discussed the puzzle under the heading *Insolubilia* – Quine, making the same observation with verbs like **seek**, came up with an ingenious explanation:[3]

(2) **Ernest is seeking a lion.**

According to Quine, the puzzle has two sources. The first is a general structural ambiguity found in propositional attitude reports and related constructions where indefinites, which express existential quantification, may or may not logically outscope the attitude verb under which they are embedded. Thus, e.g., (3a) is ambiguous with the readings (3b) and (3c):

(3a) **Tom believes that someone denounced Catiline.**
(b) **Tom believes that someone is such that he denounced Catiline.**
(c) **Someone is such that Tom believes that he denounced Catiline.**

This ambiguity conspires with the lexical meaning of the opaque verb **seek** (or **owe**, as the case may be) which superficially behaves like a transitive verb but must be interpreted as abbreviating a propositional attitude, as confirmed by the paraphrase **try to find** (or **must give**). Hence paraphrasing (2) as (4a) makes the sentence susceptible to the variable scope effect:

(4a) **Ernest is trying for it to be the case that Ernest finds a lion.**
(b) **Ernest is trying for it to be the case that a lion is such that Ernest finds it.**
(c) **A lion is such that Ernest is trying for it to be the case that Ernest finds it.**

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1 This should be taken as the definition of *opacity* that is used in this paper; hence my use of the term differs from Quine's, who uses it in the sense of *intensional*. It should be noted that, although indefinites are criterial for opacity (in my sense of the term), they are not the only noun phrases that behave exceptionally when serving as objects to opaque verbs. However, for the purpose of the present investigation, it suffices to consider (singular) indefinite objects.

2 The remoteness of the specific reading seems to be a lexical idiosyncrasy of the verb **owe**. With other opaque verbs, including **seek**, specific readings come quite naturally. I will return to this phenomenon in Section 6.

3 Cf. Quine (1960: 151–156); the key idea already appears in Quine (1956), written around 1952. To be fair, Buridanus did make a tentative attempt to solve the puzzle; Geach (1965) offers a modern reconstruction and some criticism.

The two ingredients in Quine's analysis of opacity, then, are:

Q1 ***LEXICAL DECOMPOSITION***
Sentences with opaque verbs abbreviate propositional attitude reports.

Q2 ***SCOPAL VARIABILITY***
As always in attitude reports, the indefinite [object] may take different scopes.

Apart from analyzing the two interpretations of an opaque verb as a case of structural ambiguity, Quine's analysis also explains why sentences with opaque predicates differ from those with ordinary, *transparent* predicates in two further respects:

- The object position is *not quantificational*.
- The object position is *intensional*.

The first point concerns the observation that an indefinite in the object position of an opaque verb cannot be read as being existentially quantified: taken unspecifically, (1) does not imply that there is a horse, as little as (2) implies that lions exist. The explanation is quite simple: although the indefinite does express existential quantification, its being under the scope of an attitude predicate generally prevents it from projecting its existential impact to the whole sentence.

The second point highlights the fact that, on the unspecific interpretation, substitution of co-extensional indefinites does not always preserve truth values: Ernest may be looking for a twenty-year old lion without being looking for a twenty-year old circus lion, even though all lions of that age may happen to be circus lions. Again, the explanation is straightforward: the scope of an attitude predicate is an intensional position.

1.3 California. Summer of Love

Montague, using techniques of higher-order modal logic, turned Quine's account of opacity into a surface-compositional analysis[4], the starting point of which is a possible worlds adaptation of Quine's paraphrase formulated in intensional type theory; under the assumption that **try-for-it-to-be-the-case-that** denotes a binary relation between individuals and propositions, **seek a unicorn** receives the following logical analysis:[5]

(5) $\lambda x\ \mathbf{T}(x,(\exists y)[\mathbf{U}(y) \wedge \mathbf{F}(x,y)])$

Surface compositionality, i.e. a word-by-word analysis, is then achieved by applying the Fregean strategy of *meaning subtraction*[6], obtaining the meaning of **seek** by separating the quantifier expressed by **a**

[4] Cf. Montague (1969, 1973).

[5] The notation deviates from Montague's original account(s) in some obvious ways:

- Following the tradition of Cresswell (1973) (and, indeed, modal logic), logical translations are *proposition-based*, i.e. index (= world-time point) dependence is reserved to truth values; connectives and quantifiers operate on propositions and are interpreted accordingly. The resulting formulae can do with fewer index variables and are thus more readable. Also, as already noted by Montague (1970a: 218f.), a proposition-based interpretation avoids the complications of two separate layers of extension and intension; cf. Kaplan (1975) for related discussion.
- The logical types assigned to translations of lexical items are as low-ordered as possible; his elegant unified type assignments (i.e. one type per syntactic category), frequently forced Montague to resort to unnecessarily high types – a strategy which Partee (1997: 75) aptly called *generalizing to the worst case*.

Non-obvious notational conventions are as follows: *t* is the type of *propositions*, not truth-values; bold-face letters are (mnemonic) non-logical constants; simultaneous application to a sequence of arguments stands proxy for successive application in the reverse order ('Currying'). A fuller specification of the logical notation can be found in the Appendix.

[6] If the meaning $|\alpha|$ of an expression α is not known (to the semanticist), it can be constructed by considering expressions β that combine with α into expressions γ_β, i.e. (roughly): $\gamma_\beta = \alpha + \beta$ – provided that *(a)* the meanings of all β and γ_β are known and *(b)* they behave compositionally, i.e. that γ_β and $\gamma_{\beta'}$ have the same meaning whenever β and β' do: $|\alpha|$ is a function assigning to any $|\beta|$ the value $|\gamma_\beta|$. The strategy may be called *meaning subtraction* because, intuitively, the meanings of α and β add up to the meanings $|\gamma_\beta|$, just like α and β add up to γ_β, and hence $|\alpha|$ is obtained by taking off (or abstracting) $|\beta|$ from $|\gamma_\beta|$. Arguably, the strategy is a reconstruction of Frege's (1884: X) infamous *context principle*, and one which is quite consistent with – in fact dependent on – the principle of compositionality, contradicting the impression given in Janssen (1997: 420f.) and elsewewhere.

unicorn from the property denoted by **seek a unicorn**. Such a separation can be carried out using a series of lambda-abstractions:

(5)

≡ $\lambda x\ \mathbf{T}(x,\underline{[\lambda Q\ (\exists y)[\mathbf{U}(y) \wedge Q(y)]]}\ (\lambda y\ \mathbf{F}(x,y)))$

≡ $\underline{\underline{[\lambda \mathbb{Q}\ \lambda x\ \mathbf{T}(x,\mathbb{Q}(\lambda y\ \mathbf{F}(x,y)))]}}\ \underline{(\lambda Q\ (\exists y)[\mathbf{U}(y) \wedge Q(y)])}$

The first step isolates the (underlined) meaning of the indefinite **a unicorn** as contributing to the (varying) implicit attitude object denoted by **find a unicorn**; the second step separates that meaning from the rest, which in turn may serve as an analysis of **seek**. Given the types in (5), it turns out that **seek** denotes a relation between an individual and a quantifier, i.e. its meaning is of type ((*et*)*t*)(*et*), viz.:

(6) $\lambda \mathbb{Q}\ \lambda x\ \mathbf{T}(x,(\mathbb{Q} y)\ \mathbf{F}(x,y))$

where ‘$(\mathbb{Q} y)\ \varphi$’ abbreviates ‘$\mathbb{Q}(\lambda y\ \varphi)$’. Since the resulting type is independent of the paraphrase, Montague’s analysis is more general than Quine’s:

> As far as ‘seeks’ and ‘owes’ are concerned, circumlocution involving infinitives is possible. It is not, however, in the case of all English verbs sharing the logical peculiarities of ‘seeks’ and ‘owes’ […] Montague (1969: 177)

This claim has been debated[7]. In any case, Montague’s analysis of opacity reduces unspecificity to scope; whenever opacity occurs, the logical type of the verb is higher than that of the indefinite object.[8] The main ingredients of Montague’s analysis are:

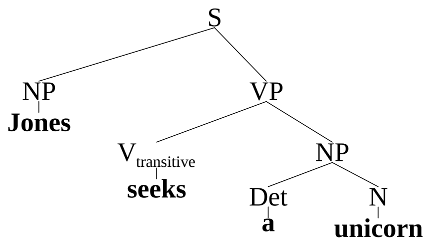
M1 ***LEXICAL TYPE ASSIGNMENT***
The (relevant) argument position of an opaque verb is defined for the meanings of indefinites (existential quantifiers), i.e. the verb expresses an intensional third-order relation.

M2 ***STRUCTURAL AMBIGUITY***
For the unspecific reading, an opaque verb takes the indefinite as its argument; for the specific reading the indefinite is quantified into that position by a general scoping mechanism.

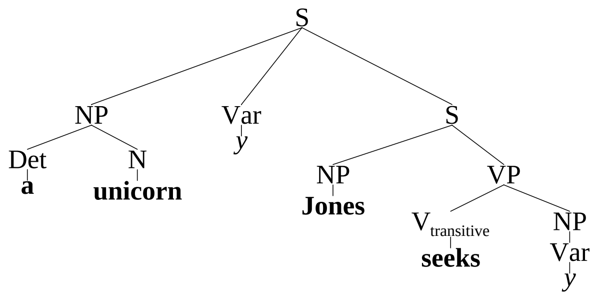
The scoping mechanism generalizes Quine’s variability in that it also covers other cases of scope ambiguity. According to it, (7a) has two distinct syntactic structures, or logical forms, viz. (7b) and (7c):

(7a) **Jones seeks a unicorn.**

(7b)



(7c)



The first structure just reverses the above abstraction process by applying the meaning of the verb to the quantifier expressed by the object and combining the result with the subject, thus arriving at:

(8) $\mathbf{T}(\mathbf{j},(\exists y)[\mathbf{U}(y) \wedge \mathbf{F}(\mathbf{j},y)])$

The construction (7c) is interpreted as in (9c), i.e. by applying the quantifier (9a) expressed by the noun phrase (**a unicorn**) to the property obtained by abstracting the (syntactic) variable or *trace* (*y*) from the open formula (9b) corresponding to the scope (**Jones seeks** *y*):

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7 More precisely, what has been debated – to wit, by Larson *et al.* (1999) – is the contention that there are any unspecificity-inducing verbs (i.e. opaque verbs in the above sense) that cannot be reduced to propositional attitudes. On the other hand, in the above quotation Montague apparently related opacity to failure of existential import, not unspecificity, citing purported counter-examples like **worship** – for which he has also been (rightly) criticized by, among others, Kripke (as reported in Bennett (1974: 82ff.)).

8 … though not necessarily the other way round: due to the spurious types obtained by Montague’s strategy of *generalizing to the worst case* (cf. fn. 5), any transparent verb can be re-categorized so as to take scope over a quantified object.

(9a) $\lambda Q\ (\exists y)[\mathbf{U}(y) \wedge Q(y)]$
(b) $\mathbf{T}(\mathbf{j},\mathbf{F}(\mathbf{j},y))$
(c) $[\lambda Q\ (\exists y)[\mathbf{U}(y) \wedge Q(y)]]\ (\lambda y\ \mathbf{T}(\mathbf{j},\mathbf{F}(\mathbf{j},y)))$
$\equiv$ $(\exists y)[\mathbf{U}(y) \wedge \mathbf{T}(\mathbf{j},\mathbf{F}(\mathbf{j},y))]$

As it stands, the interpretation (9) of the specific reading of (7a) requires an individual variable to combine with the opaque verb, which is at odds with its being an operation on quantifiers. This seemingly technical complication may be seen as reflecting a deeper conceptual distinction to which I will come in Section 3.

The technical complication can be mastered by standard techniques. Like any individual term, the bound variable may be re-interpreted as a quantifier, thanks to the categorial operation known as *Montague Lifting*, yielding $[\lambda P\ P(y)]$; alternatively, the verb itself may be re-interpreted as transparent, by the operation of *Argument Lowering*, resulting in $[\lambda y\ \lambda x\ \mathbf{S}(x,\lambda P\ P(y))]$, whenever '**S**' translates the opaque verb. Both strategies lead to the desired result (9b).[9] In Section Three we will see a reason for preferring (a variant of) the latter over the former.

M1 is general enough to cover cases of multiple opacity, as witnessed by a usage of **owe**, which according to some speakers may be read unspecifically with regard to both its direct and its indirect object. This usage is captured by either of the following analyses that only differ from each other in the relative scopes they assign to the objects – not a substantial difference given the scoping mechanism and the fact that, as far as indefinites are concerned, their relative scopes do not matter anyhow:[10]

(10) $\lambda\mathfrak{P}\ \lambda\mathfrak{Q}\ \lambda x\ \mathbf{O}(x,(\mathfrak{P}z)\ (\mathfrak{Q}y)\ \mathbf{G}(x,y,z))$
(10') $\lambda\mathfrak{P}\ \lambda\mathfrak{Q}\ \lambda x\ \mathbf{O}(x,(\mathfrak{Q}y)\ (\mathfrak{P}z)\ \mathbf{G}(x,y,z))$

As a case in point, I may promise to treat a student (i.e. some student or other) to a beer if I do not manage to put up my class-notes on the web before the end of the vacation. If I then fail to deliver the notes, according to the analysis (10), I thereby owe a student a beer – even though I do not owe a beer to any student in particular. It appears that many speakers do not accept this judgement, reserving unspecificity for the direct object position. Their usage of **owe** is captured by the following alternative analysis:

(10") $\lambda z\ \lambda\mathfrak{Q}\ \lambda x\ \mathbf{O}(x,(\mathfrak{Q}y)\ \mathbf{G}(x,y,z))$

The formula shows that, in the Montagovian account, unspecificity is a matter of types and scope and not of paraphrases in terms of attitudes; both objects relate to argument positions of the embedded predicate **G** but only one of them, the direct object, corresponds to a higher-order variable, expressing unspecificity. It is not clear how the Quinean paraphrase strategy would handle such cases. In the Montagovian approach, however, unspecificity and propositional paraphrase are completely independent of each other, in that either may occur without the other. One direction was already indicated in the above quotation. The reverse, i.e. that decomposability does not necessarily involve unspecificity, can be shown by reference to the following, quite plausible lexical decomposition of the verb **kill** (as **C**ause to **D**ie):

(11) $\lambda y\ \ \lambda x\ \mathbf{C}(x,\mathbf{D}(y))$

Despite this reduction to a propositional attitude (in the usual, broad sense), the analysis of **kill** does not induce unspecificity; a quantified object (like an indefinite) will always have scope over the verb.

Although Quine's and Montague's explanations of Buridan's puzzle proceed along the same lines in that they both assume a scope ambiguity, the details are somewhat different. In particular, in Montague's account, the above-mentioned side-effects of unspecificity – non-quantificationality and intensionality – cannot be explained in terms of underlying propositional attitudes. Rather, they are reflected in the logical type of the argument corresponding to the unspecific object.[11] Montague's account of opacity, which has been widely accepted in the semantic community[12], still has a few problems, of which we now turn to two.

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9 See Hendriks (1993) for the full story.

10 They may, once information structure (topic and focus) is taken into account, which I am ignoring here. – Notation update: '**O**' stands for the propositional attitude of being obliged to see to it that a given proposition becomes true, and '**G**' expresses the relation of giving as holding between the donor, the object transferred, and the recipient.

11 This is only true for Montague's original, truth-value based types; cf. Zimmermann (2001: 516–20) for details.

12 … widely, though not universally:
- Larson *et al.* (1999) argue for a *clausal* analysis of opacity, i.e. one which relies on syntactic reducibility to propositional attitudes; Forbes (2000) argues for what may be dubbed a *de re* analysis of opacity, i.e. one according to

2. Higher-Order Opacity
2.1 Something Inferred

The following inferences appear to be valid – even if the premise in (13) is understood unspecifically:[13]

(12) **<u>Geach is selling a textbook.</u>**
∴ **Geach is selling something.**

(13) **<u>Geach is looking for a textbook.</u>**
∴ **Geach is looking for something.**

In anybody's account, (12) is a matter of Logical Form, unrestricted existential quantification (expressed by **something**) being more general than its restricted form (**a textbook**). On the Montagovian approach (as well as on Quine's), this cannot be true of (13): in the unspecific reading, the object position of the opaque verb in the premise is not quantified over. It thus appears as if somehow the lexical meaning of **look for** must come into play. This conjecture is corroborated by the following plausible inference:

(14) **<u>Geach is looking for a textbook.</u>**
∴ **Geach is looking for a book.**

Here the quantifier in the conclusion (expressed by **a book**) is not unrestricted; but it is less restrictive than the one in the premise. This observation suggests that the relation **L** expressed by **look for** has a certain *monotonicity* property: **seek** may be monotonically increasing in its unspecific argument, presumably due to the underlying attitude **T** being closed under implication; in other words, the closure assumption ($\mathrm{MON}_{\mathbf{T}}$) implies the monotonicity ($\mathrm{MON}_{\mathbf{S}}$) of **seek**:[14]

($\mathrm{MON}_{\mathbf{T}}$) $\Box\, (\forall x)\, (\forall p)\, (\forall q)[p \Rightarrow q \rightarrow [\mathbf{T}(x,p) \rightarrow \mathbf{T}(x,q)]]$
($\mathrm{MON}_{\mathbf{S}}$) $\Box\, (\forall x)\, (\forall P)\, (\forall Q)[P \sqsubseteq Q \rightarrow [\mathbf{S}(x,\exists_P) \rightarrow \mathbf{S}(x,\exists_Q)]]$

Hence if **L** holds between an individual *x* and a (restricted existential) quantifier $\mathfrak{Q}$, then it also holds for any (restricted existential) quantifier $\mathfrak{P}$ such that $\mathfrak{Q} \subseteq \mathfrak{P}$. Since the object in the premise of (14) expresses the property of properties that apply to at least one textbook and since any such property applies to at least one book, the quantifier denoted by the object in the conclusion is indeed a super-property of the one denoted by **a textbook**. Hence monotonicity would explain the inference – and also that in (13). However, as will be argued below, there is reason to doubt that **seek** is monotonic.

In any case, monotonicity does not always help. Consider:

(15) **<u>Nicholas wants a free trip on the Concorde.</u>**
∴ **Nicholas wants a trip on the Concorde.**

This inference does not seem valid: as we all know, trips on the Concorde are excessively expensive, and hence the conclusion is likely to be false even though the premise is certainly true.[15] Hence **want**, though no doubt opaque, does not display the same kind of monotonicity behaviour as **look for**. On the other hand, the following inference goes through nevertheless:

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which the (extensional) quantifier denoted by the indefinite is related to the attitude subject via a suitable psychological relation (a way of thinking). The problems addressed in the present paper do not arise under these approaches, of which I am, however, skeptical for independent reasons that I cannot go into here.

- Zimmermann (1993) argues for a *property* analysis of opacity, i.e. one according to which indefinites express properties (as in dynamic semantics along the lines of Kamp (1981) and Heim (1982)) and opacity does not occur with (other) quantificational objects. The problems addressed in the present paper arise equally under that approach – basically because the property analysis and Montague's account, if restricted to indefinites, are intertranslatable, using type-shifting techniques à la Partee (1987).

[13] Though Geach (1965) does not address the inference pattern as such, he makes ample use of it – as in his account of the horse-monger (see above), who starts his reasoning with an instance of that pattern.

[14] '$\Rightarrow$' and '$\sqsubseteq$' respectively denote strict implication and sub-propertyhood, both of which can be defined in terms of material implication, necessity, and universal quantification. '$\exists_P$' is short for the quantifier expressed by an indefinite restricted by *P*, i.e. $\lambda Q\, (\exists x)\, [P(x) \wedge Q(x)]$.

[15] Asher (1987), to whom the example is due, and Heim (1992) provide explanations in terms of desire as a propositional attitude. This kind of explanation would be available under any account of opacity (including Montague's) as long as it is *consistent with* lexical decomposition.

(16) **Nicholas wants a free trip on the Concorde.**
∴ **Nicholas wants something.**

The natural explanation is to construe (16) as an instance of Existential Generalization as applied to the unspecific reading of the premise. In other words, (16) ought to be be read in analogy with (17) rather than with (12):

(17) **Geach is selling *Methods of Logic*.**
∴ **Geach is selling something.**

The explanation gains force from the observation that the conclusion of (16) can be elucidated by a locution like **… namely, a free trip on the Concorde**, just as the conclusion of (17) can be expanded by **… namely, *Methods of Logic***. If this reasoning is correct, then the object of (18) [= the conclusion of (16)] must have a reading as a quantifier over the meanings of unspecific objects of opaque verbs; in other words, **something** must be able to quantify over quantifiers.

(18) **Nicholas wants something.**

The phenomenon of (existential) quantification over quantifiers is restricted to sentences like (18), where the quantifier is 'pronominal'. As a case in point, the conclusion (19) of the above inference (15) does not allow for a higher-order interpretation – at least not, if the inference is indeed faulty:

(19) **Nicholas wants a trip on the Concorde.**

2.2 Something Relativized

Further evidence for the existence of higher-order readings of sentences with opaque verbs comes from examples involving relative clauses:

(20) **Geach is looking for something Quine is looking for.**

Semantic folklore has it that the relative clause expresses a property first obtained by abstracting from the missing object (represented by a trace variable) and then combined with the noun by intersection.[16] As always in relative clauses, the trace stands in for an individual term so that the verb must first be argument-lowered[17] before combining with it. Then abstraction can take place at the relative clause level, resulting in:

(21) $\lambda y\ \mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y))$

Since the relative clause is restrictive (as indicated by the absence of an overt relative pronoun), its interpretation requires a certain amount of re-bracketing; due to compositionality reasons, the relative clause must be attached to the abstract noun **-thing** rather than the entire quantifier **something**.[18] As this head noun is void of content, intersection with it has no effect and (21) also serves as the argument to the binary quantifier denoted by **some**. The resulting (standard) interpretation of the object in (20) is:

(22) $\lambda Q\ (\exists y)[\mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y)) \wedge Q(y)]$

Given Montague's scoping mechanism *M2*, we now obtain two readings of (20), depending on whether the object takes scope over the opaque verb (22') or not (22"):

(22') $(\exists y)[\mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{g},\mathbf{F}(\mathbf{g},y))]$
(22") $\mathbf{T}(\mathbf{g},(\exists y)[\mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y)) \wedge \mathbf{F}(\mathbf{g},y)])$

On the first, wide-scope reading, (20) says that Quine and Geach are looking for the same (specific) object; on the second, unlikely reading, it says that Geach is after anything specifically sought by Quine.

2.3 Something Higher-Order

Neither of the two above readings of (20) covers a situation in which both Geach and Quine are looking for a textbook on medieval logic without either of them looking for any particular book. It is obvious how to formalize this reading using higher-order quantification:

(23) $(\exists \mathbb{Q})[\mathbf{T}(\mathbf{q},(\mathbb{Q}y)\ \mathbf{F}(\mathbf{q},\ y)) \wedge \mathbf{T}(\mathbf{g},(\mathbb{Q}y)\ \mathbf{F}(\mathbf{g},\ y))]$

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16 This interpretation of relative clauses was already proposed by Quine (1960: 110ff.) and later adopted by Montague (1970).

17 Alternatively, the trace may be Montague-lifted, of course.

18 This complication is well known. See Heim & Kratzer (1998: 82f.) for discussion and references.

On the Montagovian account of opacity, such higher-order readings are readily available given the following assumption:[19]

HOQ ***Higher-Order Quantification***
The word **something** *is ambiguous, being both an ordinary quantifier over individuals and a higher-order quantifier over ordinary quantifiers.*

More precisely, *HOQ* should be read as assigning to **something** an (ordinary) quantifier of type q = (et)t as well as a higher-order reading of type (qt)t, where the domain of individuals is replaced by the domain of (ordinary unary) quantifiers. Adapting the standard semantics of relative clauses, let us divide the higher-order variant of **something** into determiner and noun, both of which will have to be type-adapted accordingly. The following table specifies all types and denotations according to *HOQ*:

		***L**ower Order*	***H**igher Order*
something	*type*	$(et)\ t\ [= q]$	$(qt)\ t$
	denotation	$\lambda Q\ (\exists x)\ Q(x)$	$\lambda \Pi\ (\exists \mathfrak{Q})\ \Pi(\mathfrak{Q})$
some	*type*	$(et)\ ((et)\ t)$	$(qt)\ ((qt)\ t)$
	denotation	$\lambda P\ \lambda Q\ (\exists x)[P(x) \wedge Q(x)]$	$\lambda \Sigma\ \lambda \Pi\ (\exists \mathfrak{Q})[\Sigma(\mathfrak{Q}) \wedge \Pi(\mathfrak{Q})]$
-thing	*type*	et	qt
	denotation	$\lambda y\ (y = y)$	$\lambda \mathfrak{Q}\ (\mathfrak{Q} = \mathfrak{Q})$

Table 1: Types and denotations of **some-thing**

Together, *HOQ* and the quantification mechanism *M2* thus predict two sources of ambiguity: the ***L*** vs. ***H*** readings of **something** on the one hand, and the ***N**arrow scope* vs. ***W**ide scope* interpretations of the object on the other. One may expect these parameters to vary freely in sentences like:

(24) **Geach is looking for something.**

However, one of the four combinations, viz. ***NH***, leads to a *type clash*: the verb, being of type $q(et)$, cannot cope with an argument of type $(q\ t)\ t$. (24) thus ends up with three readings:

Order → / ↓ *Scope*	***L**ow*	***H**igh*
***N**arrow*	$\mathbf{T}(\mathbf{g},(\exists y)\ \mathbf{F}(\mathbf{g}, y))$	–
***W**ide*	$(\exists y)\ \mathbf{T}(\mathbf{g},\mathbf{F}(\mathbf{g}, y))$	$(\exists \mathfrak{Q})\ \mathbf{T}(\mathbf{g},(\mathfrak{Q} y)\ \mathbf{F}(\mathbf{g}, y))$

Table 2: Readings of (24)

The ***L*** readings are just as in the above treatments (8) and (9c) of (7a)[**Jones seeks a unicorn**], only with the relativization to unicorns lifted. It may be noted in passing that, as it stands, the ***H*** reading is not entirely adequate. Rather, higher-order existential quantification should somehow be restricted because otherwise the quantifier could be instantiated by **nothing**, thus allowing for unwelcome inferences like:

(25) **I owe you nothing.**
∴ **I owe you something.**

[19] Cf. Moltmann (1997: 20) for a more general proposal and Zimmermann (1993: 171ff.) for a similar one in a different framework (cf. fn. 12), where 'higher-order' means *expressing a property of properties*. For simplicity, I assume that the two uses of **something** constitute separate readings; this will not affect the present discussion.

Presumably, the restriction would have to be on (ordinary) existential quantifiers;[20] I leave the matter open, because it will not be of any importance in the following.

In order to obtain (23) using the lexical hypothesis *HOQ*, one only needs to generalize the above relative clause treatment to higher-order traces. Applying the same re-bracketing as before, the relative clause in (20) would then receive the following interpretation:

(26) $\lambda\mathfrak{Q}\ \mathbf{T}(\mathbf{q},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{q}, y))$

(26) can be obtained by directly combining the trace (the variable '$\mathfrak{Q}$' of type q) with the opaque verb – it is just of the right type. Again, the head noun **-thing** is semantically trivial, so that the object of (20) receives the following higher-order interpretation:

(26') $\lambda\Pi\ (\exists\mathfrak{Q})[\mathbf{T}(\mathbf{q},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \Pi(\mathfrak{Q})]$

Of course, this unary (higher-order) quantifier is due to the ***H*** interpretation of the determiner **some**. Finally, quantifying (26') into the matrix **Geach is looking for** $\mathfrak{Q}$ leads to the desired result (23). To summarize, *HOQ* predicts the following readings of (20):

	L	***H***
N	$\mathbf{T}(\mathbf{g},(\exists y)[\mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y) \wedge \mathbf{F}(\mathbf{g},y)]$	–
W	$(\exists y)[\mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{g},\mathbf{F}(\mathbf{g},y))\ ]$	$(\exists\mathfrak{Q})[\mathbf{T}(\mathbf{q},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{q}, y)) \wedge \mathbf{T}(\mathbf{g},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{g}, y))\ ]$

Table 3: Readings of (20)

Table 3 lists precisely those readings of (20) that can be obtained by letting the two parameters – type of [**some**]**thing**, scope of the object – vary as much as possible. Hence they are the readings one would initially expect, given the above setup. However, closer inspection of the interpretation mechanisms reveals that there are more complex ways of combining them. In particular, one may, as it were, activate the ***W***ide scope parameter twice over by scoping the ***H***igher-order reading of **something** over the opaque verb and at the same time assigning the variable bound by the quantifier wide scope. The result would be:

(27) $(\exists\mathfrak{Q})[\mathbf{T}(\mathbf{q},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{q}, y)) \wedge (\mathfrak{Q}y)\ \mathbf{T}(\mathbf{g},\mathbf{F}(\mathbf{q}, y))]$

(27) is true of a situation in which Geach happens to be looking for his favourite pencil, whereas Quine is just after some instrument or other to jot down a note. And more combinations along these lines are conceivable. It may well be that none of them constitutes a genuine reading of (20), so that the parameters underlying Table 3 are indeed correct.

Let us finally note that, given the ***WH*** reading (25) of (20), **seek** is unlikely to be monotonic in the sense indicated further above. For if it were, any two sentences of the forms **Geach is looking for a**[**n**] *N* and **Quine is looking for a**[**n**] *N'* would jointly imply (20). This fact may be illustrated by a specific example. Suppose **seek** were monotonic and (28) and (29) were true for their respective narrow and wide scope readings (28') and (29'):

(28) **Geach is looking for a pen.**
(28') $\mathbf{T}(\mathbf{g},(\exists y)[\mathbf{P}(y) \wedge \mathbf{F}(\mathbf{g},y)])$
≡ $\mathbf{S}(\mathbf{g},\lambda Q\ (\exists y)[\mathbf{P}(y) \wedge Q(y)])$
(29) **Quine is looking for a book.**
(29') $(\exists y)[\mathbf{B}(y) \wedge \mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y))]$
≡ $(\exists y)[\mathbf{B}(y) \wedge \mathbf{S}(\mathbf{q},\lambda P\ P(y))]$

Now, clearly, the following inclusions hold, where **b** is some specific book witnessing (29'):

(30) $[\lambda Q\ (\exists y)[\mathbf{P}(y) \wedge Q(y)]] \subseteq [\lambda Q\ (\exists x)\ Q(x)]$
(30') $[\lambda P\ P(\mathbf{b})] \subseteq [\lambda Q\ (\exists x)\ Q(x)]$

Hence, by monotonicity, (28') and (29') respectively imply:

[20] This is what would be expected under the property analysis (cf. fn. 12), according to which opacity only arises in connection with existential quantifiers (or their property counterparts). Note that the narrow-scope reading the Montagovian account of opacity assigns to the premise of (25) is at best marginal.

(28”) $\mathbf{S}(\mathbf{g},\lambda Q\ (\exists x)\ Q(x))$
$\equiv$ $\mathbf{T}(\mathbf{g},(\underline{\underline{\exists}}y)\ \mathbf{F}(\mathbf{g},\ y))$
(29”) $\mathbf{S}(\mathbf{q},\lambda Q\ (\exists x)\ Q(x))$
$\equiv$ $\mathbf{T}(\mathbf{q},(\underline{\underline{\exists}}y)\ \mathbf{F}(\mathbf{q},\ y))$

But then the denotation of $\underline{\underline{\exists}}$ of **something** satisfies the quantificational matrix of (25), thus verifying (20).

One may summon pragmatics to protect monotonicity from this absurdity. Maybe if (28) and (29) are true, then so is (20), but it would nevertheless be misleading to utter the sentence. It is by no means obvious that any such reasoning bears scrutiny. In particular, in fleshing it out one would somehow have to draw a line between illicit generalizations such as (28') and (29') and perfectly natural monotonicity inferences like (13) and (14) above. And though this line must be drawn with or without monotonicity, in a pragmatic account one would have to rely on rational principles of effective communication, whereas without monotonicity the line could be drawn conventionally and/or conceptually. In the absence of any particular proposal, the alleged monotonicity of **seek** should therefore be taken with caution.

3. Specificity

3.1 Eliminating Essential Propositions

The ***WL*** reading of (24) above is true if, and only if, the referent of the subject (Geach) bears a certain psychological attitude (of trying) to a proposition of a certain form (that Geach find a specific individual), viz.:

(31) $\mathbf{F}(\mathbf{g},\ y)$

Propositions of this form are *essential*, covering precisely the worlds in which a given individual (y) has a given property (being found by Geach); in other words, essential propositions are those of the form $P(x)$, for fixed (non-trivial) properties P and individuals x.[21] However, it has been argued – correctly, I believe – that essential propositions are well beyond the cognitive grasp of ordinary human beings.[22] Take Geach. Only five minutes ago, he held his copy y of Buridan’s *Sophismata* in his hand, but now it looks like it disappeared. So he starts looking for y. Does he thus bear the attitude of trying towards the set $f(y)$ of indices at which he (Geach) finds y? No – at least not if that attitude is reconstructed in the following way:

(T) **try** expresses a relation holding between an individual x and a proposition p at an index i if and only if, at i, x performs an action the goal of which is to bring about a situation (index) of which p holds.

However, in order for Geach to direct his action(s) to $f(y)$, it appears that he would have to be able to distinguish the indices of which $f(y)$ holds from those of which $f(y)$ does not hold – which he cannot because, from his perspective, a possible world that differs from ours only in that some other copy z of the *Sophismata* took y’s place would be indistinguishable from reality. Hence it is not y that Geach is after but *his copy of* Sophismata. In general, if some person x appears to be reported as standing in the relation of trying (or any other psychological attitude) to an essential proposition like $f(y)$, the report should be construed as being about x standing in a relation to some proposition $f(c)$, where c is an individual concept suitably connecting x and y. More specifically, and following Kaplanian lines[23], the ***WL*** reading of (24) reports Geach *(i)* to have an internal *vivid name* for (or a *de re access* to) y and *(ii)* to try to find the individual with that name (or thus accessed). Formalization of *(i)* can then proceed via a ternary predicate ***VN*** relating a concept (i.e. access) N (of type et) and two individuals (Geach and

[21] Essential propositions are as close as possible worlds semantics can get to Kaplan’s (1989) *Russellian* or *singular* propositions (which is why they are sometimes referred to as such). Note that the ***WL*** reading in Table 2 does not require the essential proposition to be unique: there may be more than one specific individual sought by Geach. Nor is the form of the essential proposition(s) unique: in the case at hand, it may also be described as the set of worlds in which Geach (= x) has the property P of seeking the particular object y.

[22] Lewis (1981). The argument depends on the – initially plausible, but hotly debated – assumption that attitudes and intentions can be characterized in purely qualitative terms, which I will simply take for granted.

[23] Kaplan (1969). A more sophisticated version, augmenting propositions and accesses by subjective perspectives, has been developed by Lewis (1979). To avoid unnecessary distractions, I want to steer clear of these complications. For the same reason I have been assuming that the infinitives in the paraphrases stand for propositions rather than properties.

his copy of *Sophismata*, in reverse order)[24], whereas *(ii)* is an ordinary *de dicto* attitude ascription involving the same concept N. The following formula thus captures the truth-conditions of the ***WL*** reading of (24) more adequately than the formalization in Table 2:

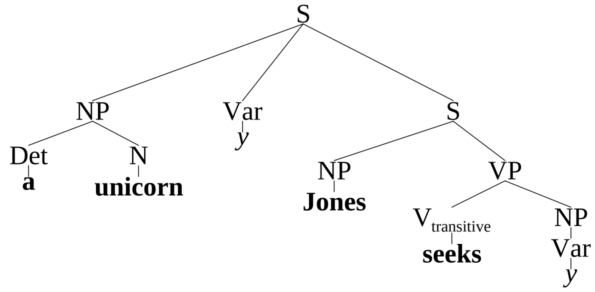
(32) $(\exists y)\ (\exists N)[\boldsymbol{VN}(N,y,\mathbf{g}) \wedge \mathbf{T}(\mathbf{g},(\exists z)[N(z) \wedge \mathbf{F}(\mathbf{g},z)])]$

Similarly, (33) is a more adequate formalization of the *de re* reading of (7a) than was Montague's (9c):

(7a) **Jones seeks a unicorn.**
(9c) $(\exists y)[\mathbf{U}(y) \wedge \mathbf{T}(\mathbf{j},\mathbf{F}(\mathbf{j},y))]$
(33) $(\exists y)\ (\exists N)[\mathbf{U}(y) \wedge \boldsymbol{VN}(N,y,\mathbf{j}) \wedge \mathbf{T}(\mathbf{j},(\exists z)[N(z) \wedge \mathbf{F}(\mathbf{j},z)])]$

The question is how to arrive at (32) given the syntactic input (7c):

(7c)



3.2 Specificity by Coercion

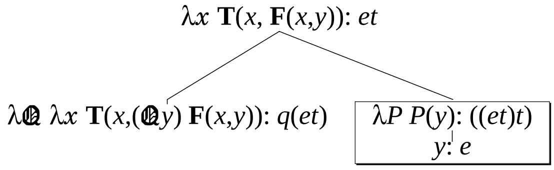
As already noted in Section 1.3, the combination of the trace variable y in (7c) with the opaque verb leads to a type mismatch – the former being of type e while the latter expects a quantifier of type $(et)t$. In the simplistic Montagovian interpretation of the *de re* construction there are two equivalent ways out of the embarrassment:

ML ***Montague Lift***
The Montague-lifted version of an individual x of type e is the following quantifier of type q:
$\lambda P\ P(x)$

AL ***Argument Lowering***
The argument-lowered version of a relation $\Re$ *of type q(et) is the following relation of type e(et):*
$\lambda y\ \lambda x\ \Re(x,\ \lambda P\ P(y))$

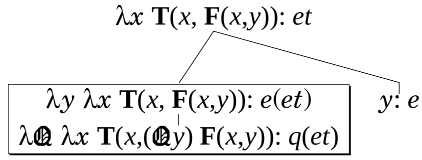
When applied to the decomposable verb **seek**, these two (alternative) type shifting strategies yield:

(34a)



Montague Lifting

(b)



Argument Lowering

Either strategy is meant to apply when a more straightforward combination of meanings (like application, composition, or intersection) is unavailable. In other words, (34a) and (34b) are semantic *coercion mechanisms*[25] that see to it that one of the initially unfitting expressions is re-interpreted in a way that allows for a straightforward combination with the other one. In the case at hand, the specific construal of

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[24] The precise nature of ***VN*** shall not concern us here. Suffice it to say that ***VN*** is likely to be context-dependent (hence the italics) and that $\boldsymbol{VN}(N,y,x)$ and $\boldsymbol{VN}(N,z,x)$ together imply $N(y)$ and $y = z$; in other words, N must be a partial individual concept of y. More substantial conditions can be gleaned from the literature from Kaplan (1969) onward; see especially Aloni (2001: ch. 2) for a thorough discussion and a specific proposal.

[25] I am using the term *coercion* in a more general way than Pustejovsky (1993), whose use of the term would cover Montague Lifting, but not Argument Lowering. See Blutner (2002) for a recent survey of coercion and related mechanisms. The approach taken there – *underspecification* to be resolved by contextual determination of hidden parameters – does not seem to be applicable in cases of type variance as considered in the present paper.

opaque verbs, the two relevant expression are (a) the opaque verb as obtained by analyzing the unspecific use and (b) the variable bound by its quantified object. The two strategies only differ with regard to which of (a) and (b) must give way. But they agree both on their starting point and on the result.

In the more sophisticated Kaplanian *de re* approach, the type mismatch is the same. However, the strategy of type-shifting the argument of the opaque verb is unavailable. Not only does ***ML*** yield the wrong result – this is what this whole section has been all about; it is even beyond repair. The reason is that, on the one hand, the neo-Kaplanian *de re* construal requires the opaque verb to combine with an individual to form a property, viz. the following:

(35) $\lambda x\ (\exists N)[\boldsymbol{VN}(N,y,x) \wedge \mathbf{T}(x,(\exists z)[N(z) \wedge \mathbf{F}(x,z)])]$

On the other hand, there is no compositional way of re-interpreting the variable y as a quantifier y^+ such that the result (36) of applying **S**[eek] to y^+ is logically equivalent to (35).[26]

(36) $\lambda x\ \mathbf{T}(x,y^+(\lambda y\ \mathbf{F}(x,y)))$
$\equiv$ $\mathbf{S}(y^+)$

To see this, it suffices to consider indices at which **T** denotes the universal relation holding between all individuals and propositions, while the extension of ***VN*** is empty. Then, whichever quantifier y^+ may be, (36) and (35) will denote the universal and the empty property (of individuals) respectively.

Even though ***ML*** does not carry over, compositionality is not lost on the improved *de re* construal (33). For it turns out that the strategy employed in (34b) can be adapted. This is immediately clear from the fact that the desired result (35) is equivalent to:

(37) $\lambda x\ (\exists N)[\boldsymbol{VN}(N,y,x) \wedge \mathbf{S}(x, \lambda P\ (\exists z)[N(z) \wedge P(z)])]$

Hence one may refine (34b) to obtain the perfectly compositional:

(38)

$\lambda x\ (\exists N)\ [\boldsymbol{VN}(N,y,x) \wedge \mathbf{S}(x,\lambda P\ (\exists z)\ [N(z) \wedge P(z)])]: et$

$\lambda y\ \lambda x\ (\exists N)\ [\boldsymbol{VN}(N,y,x) \wedge \mathbf{S}(x,\lambda P\ (\exists z)\ [N(z) \wedge P(z)])]: e(et)$ $\quad y: e$

$\mathbf{S}: ((et)t)(et)$

De Re Lowering

More precisely, and more generally, the operation of *De Re Lowering* is a type shift turning an attitude to unspecific objects into a binary relation between individuals:

DRL **De Re *Lowering***
The de-re-lowered version of a relation $\mathfrak{R}$ *of type q(et) is the following relation of type e(et):*
$\lambda y\ \lambda x\ (\exists N)[\boldsymbol{VN}(N,y,x) \wedge \mathfrak{R}(x, \lambda P\ (\exists z)[N(z) \wedge P(z)])]$

This comparatively simple (*sic!*) compositional derivation of the specific reading may come as a surprise given the complications of quantifying into overt attitude contexts.[27]

In its unspecific use, then, the verb **seek** has its *notional* sense, expressing a relation between a person and a concept, represented by the indefinite; in the specific reading the verb appears in a purely *objectual* sense, expressing a relation between the attitude subject and an individual quantified over by the indefinite.[28] The choice between the two uses is one of grammatical environment – or so it seems; if the verb directly combines with a quantificational object, its notional sense will be activated; but when combined

[26] One may, however, reverse functor-argument structure by re-interpreting y as an operation of type $(q(et))(et)$ that yields (35) when applied to **S**, viz.:
$\lambda\mathfrak{R}\ \lambda y\ \lambda x\ (\exists N)\ [\boldsymbol{VN}(N,y,x) \wedge \mathfrak{R}(x, \lambda P\ (\exists z)\ [N(z) \wedge P(z)])]$
Note how this operation, to which we will return in Section 5.2, mimicks *De Re* Lowering.

[27] Cf. Cresswell & von Stechow (1982: 525ff.). Quantifying into opaque verbs is simpler in that the position quantified over is fixed by the lexical meaning of the verb, whereas in overt clausal embeddings there is not even an upper limit to the *number* of quantifiers to outscope the attitude. However, a more general *de re* mechanism would be needed for *unspecific* opaque objects containing names or descriptions. We will have to return to these matters in Section 5.2.

[28] The terms *notional* and *objectual* are Quine's (1956) and Forbes's (2000), respectively.

with an individual term (like a variable bound by the object), then the verb contributes its objectual sense. In the case of our example **seek**, (39a)[= (6) above] represents the notional sense, whereas (39b) is the neo-Kaplanian account of its objectual sense:

(39a) $\lambda\mathcal{Q}\ \lambda x\ \mathbf{T}(x,(\mathcal{Q}y)\ \mathbf{F}(x,y))$
(b) $\lambda y\ \lambda x\ (\exists N)[\boldsymbol{VN}(N,y,x) \wedge \mathbf{T}(x,(\exists z)[N(z) \wedge \mathbf{F}(x,z)])]$

According to the coercion view, which is the standard view, the objectual sense (39b) can and must be derived from the notional sense. But the coercion view is not the only one.

3.3 Specificity by Indeterminacy

De Re Lowering is considerably more complex than either of the traditional strategies exemplified in (34). And although it, too, is a type coercion mechanism, it is one of a peculiar kind. For, unlike Montague Lifting and Argument Lowering, *De Re* Lowering is not a *logical* operation in that it introduces non-logical material in the form of the relation ***VN***. This fact may be taken as evidence that ***DRL*** is of a lexical rather than a syntactic nature. The interpretation of syntactic constructions and processes is usually taken to be a matter of logical combination, substantial content being confined to the lexicon. Although this separation is rarely made explicit, it does underlie most work in logically oriented natural language semantics.

The facts that the objectual sense of an opaque verb is quite remote from its notional sense and that it cannot be obtained by logical combination may indicate that type coercion is not involved at all. After all, one of the premises of the coercion account was that a type clash occurs between (a) the opaque verb *as obtained by analyzing the unspecific use* and (b) the variable bound by its quantified object. In other words, the coercion approach takes it for granted that the natural function of an opaque verb is as a host to a quantifier, where it gives rise to the unspecific reading, and that the specific usage must be derived from that. This may be, and in fact has been, disputed.[29] Of course, a mere lexical ambiguity seems unlikely, because the same variation between a notional and an objectual sense appears to occur in many opaque verbs.[30] Instead, the two uses of the predicate could be two facets of one single overall meaning of **seek**. The idea is this: among the things eligible for being sought are both ordinary individuals (of type e) and unspecific objects (quantifiers of type q), and what it means to be sought by someone depends on the type of these things: *(!)* an *individual* is sought by trying to find whatever fits the vivid name the subject has of that individual; a *quantifier* is sought by trying to make the preoperty of being found by the subject acceptable to (i.e. an element of the extension of) the quantifier. This idea is fleshed out by merging the two types of objects sought into one denotation of **seek**:

(39c) $\lambda\mathcal{Q}\ \lambda x\ \mathbf{T}(x,(\mathcal{Q}y)\mathbf{F}(x,y)) \oplus \lambda y\ \lambda x\ (\exists N)[\boldsymbol{VN}(N,y,x)\wedge\mathbf{T}(x,(\exists z)[N(z)\wedge\mathbf{F}(x,z)])]$
$\equiv$ $\mathbf{S} \oplus \lambda y\ \lambda x\ (\exists N)[\boldsymbol{VN}(N,y,x) \wedge \mathbf{S}(x, \lambda P\ (\exists z)[N(z) \wedge P(z)])]$

The formula merely merges the notional sense (39a) of **seek** with the neo-Kaplanian account (39b) of its objectual sense, using a *type-transcendent* version $\oplus$ of set-theoretic union. The precise nature of the formula and the language it belongs to need not concern us here, as long as it can be made sense of.[31] And that sense clearly captures the characterization *(!)* of the extension of **seek**.

According to (39c), then, the difference between the notional and the objectual sense of **seek** – or any other opaque verb – is not conceptual, or lexical. The meaning of the word **seek** is a certain relation between individuals and all kinds of objects. What precisely it means for an individual to stand in that relation to a given object may very much depend on the nature of that object and, in particular, on its logical type. But that does not mean that which relation the verb denotes depends on that object. The relation is always the same, but it is *indeterminate* as to the kind of objects that it connects. In (39c) this relation is

29 During the past decade, various colleagues suggested to me that specific readings of opaque verbs may not be the results of type coercion but rather instances of semantic indeterminateness; I am not sure I can remember all sources (let alone the earliest one). The present investigation was kicked off by a discussion during the Rutgers seminar mentioned in the Acknowledgements, where the indeterminacy view was brought up and defended by Matthew Stone.

30 … though not in all of them. As announced in fn. 2 we will return to this point in Section Six.

31 Obviously, (39c) is not a formula of the type-theoretic language we have been using so far: the union of two relations of different types is type-transcendent, i.e. it cannot itself have a type in the ordinary sense. However (39c) can be expressed in a straightforward extension of that language, allowing for unions of types as functional domains. Details are given in the Appendix.

defined using the same notation as in the standard coercion account. It would have been more faithful to the spirit of indeterminacy, of course, to represent the type-transcendent relation by a single letter, '**Σ** ' say; but (39c) will largely facilitate the comparison in the sections to follow. Still, its disjunctive form should be viewed as an artefact of the representation and should not distract from the fact that, according to the indeterminacy view, only one relation holds between subjects and different kinds of objects.

Though (39c) is in line with the idea informally expressed in *(!)*, it is not obvious that that idea itself is in line with pre-theoretic intuition. In fact, if (40) and (41) happen to be true for their respective unspecific and specific readings, the sense in which Quine is related to the abstract object of an unspecific pen (represented by a quantifier) appears to differ from that in which Geach is related to his particular writing utensil:

(40) **Quine seeks a pen.**
(41) **Geach seeks a pen.**

What makes (41) true is the fact that there is this specific object that Geach is quite literally looking for. However, no such object – whether unspecific, abstract, intensional, or what-have-you – exists in Quine's case. The following paraphrase of (41) into semi-technical, Quinean jargon helps bringing out the point:

(42) **A pen is such that Geach <u>seeks</u> it.**

It seems that the underlined sense of **seek** cannot be quite the same as the one featuring in the *unspecific* reading of (40): the relation (expressed by unspecific **seek**) in which Quine is reported to stand to whatever he is after does not seem to be the relation in which Geach stands to the particular pen he is reported to be looking for. Again, Geach is quite literally looking for this object; but Quine is not looking for any object – whether pen or quantifier – in *that literal sense*. True, he is looking for something – an unspecific pen to be sure – but not in the way in which Geach is looking for his dear old Conway Stewart. At least these are my intuitions. But then good theories need not square with pre-theoretic intuitions, as long as they are sound and correct in their predictions.

According to the indeterminate interpretation (39c) of **seek**, matters are quite different. Here Quine and Geach do stand in the same relation to an unspecific (and abstract) and a specific (and concrete) object, respectively. The difference is purely circumstantial, not linguistic, let alone conceptual. It is simply that the way Quine, or anyone, goes about looking for an unspecific object is rather different from the way in which Geach, or anyone, is looking for a specific object. In that respect, seeking is like peeling. Peeling an egg is quite different from peeling a potato. But that does not mean that there are two concepts of peeling, one for eggs and one for potatoes (and yet another one for salami). The difference only lies in the objects. And just like eggs and potatoes are radically different objects when it comes to peeling them, so are specific and unspecific objects (or individuals and quantifiers) when it comes to seeking them. In particular – so the indeterminacy view goes – there is only one concept of seeking.

Let us sum up. In the coercion view, the unspecific and the specific construal of an opaque verb are distinct relations. In the case of **seek**, the former is the relation **S** given in (39a); the latter, which is derived from it and to which we will refer as '**S***', is specified in (39b). Intuitively, the difference shows in that standing in **S** to something is not the same as standing to it in **S***. In the indeterminacy view, **S** and **S*** are parts of the same relation **Σ** (= **S**∪**S***), and the purported difference is an illusion due to the fact that the kinds of objects to which one can stand in **S** are different from the kinds of objects to which one can stand in **S***. It seems that intuition is not too helpful when it comes to deciding between the two approaches to the lexical meaning of opaque verbs. Let us therefore look for (!) more decisive evidence.

4. Higher-Order Specificity

4.1 Higher-Order Findings

In the indeterminacy view, the opaque verb **seek** unequivocally expresses a relation **Σ** that may hold between a subject *x* and an object *O* independently of *O*'s type – *x* and *O* just have to be suitably related. Although it may be hard to come up with a complete characterization of this relation, there are some obvious conditions, satisfaction of which guarantees that **Σ** holds between a given *x* and *O*. And this is where, according to the indeterminacy view, types may come in. Some such (sufficient) conditions on being related by **Σ** can only be met by objects of suitable types. For instance, **Σ** holds between *x* and *O* if *x* is **T**rying for the property of being **F**ound by *x* to be in the extension of *O*:

- *Unspecificity Criterion*
  $\mathbf{T}(x,O(\lambda y\ \mathbf{F}(x,y))$ [$\equiv \mathbf{S}(x,O)$]

If the criterion is met, **Σ** holds between *x* and *O* and a sentence expressing this is perceived as being unspecific; hence the name. Obviously, the Unspecificity Criterion can only be met if the object *O* can be applied to properties of individuals. In a misleading way, this is borne out by the formalization. Read as an expression of ordinary type logic, the formula is only well-formed if '*O*' denotes a quantifier. Otherwise a type clash would ensue: '**F**' needs an individual expression as its second argument so that the argument of '*O*' comes out as being of type *et*; and since'**T**' takes a proposition as its right argument, *O* must be of type (*et*)*t*. However, if we follow the lead of the indeterminacy approach, relations like the denotation **F** of **find** need not be homogeneous, only connecting objects of fixed types. In particular, the type of the bound variable '*y*' need not be determined by the predication '**F**(*x*,*y*)'. Reading in this more liberal way, we find that, in order to meet the Unspecificity Criterion, an object *O* must be some sort of quantifier (or operator), but not necessarily one over individuals. For instance, the ***H***igher-order reading of **something** could satisfy the Unspecificity Criterion, provided that **F**inding that quantifier could be made any sense of. On the other hand, an individual definitely cannot satisfy the Unspecificity Criterion (in lieu of '*O*'), simply because, I take it, it cannot be applied as an operator to a property. From the indeterminacy point of view, this explains why individual-denoting objects cannot be construed unspecifically.

The specific construal, too, may be seen as a special case of satisfying the indeterminate relation **Σ**. We may formulate the corresponding criterion to be met by a subject *x* and an object *O* in Kaplanian terms:

- *Specificity Criterion*
  $(\exists N)[\boldsymbol{VN}(N,O,x) \wedge \mathbf{T}(x, (\exists z)[N(z) \wedge \mathbf{F}(x,z)])]$ $[\equiv \mathbf{S}^*(x,O)]$

Again it may first seem that the condition on *O* determines its type: read as a formula of ordinary type logic, the criterion demands *O* to be an individual; for this is the type of objects occupying the third argument position of the ***V***ivid ***N***ame relation. However, as before, one may wonder whether the condition extends to objects of other types. For this to be the case, the attitude subject *x* would have to have a vivid name *N*, i.e. some sort of qualitative description, of something that is not an individual. Since *N* is a description of *O*, the third argument of the embedded **F**ind predicate (occupied by *z*) should be of the same type as *O*. Hence, whether such a case ever arises again largely depends on whether the achievement of **F**inding can be directed to objects that are not individuals.

The type underspecification in the above criteria opens the possibility of one object satisfying both, possibly in relation with different subjects. In particular, it is conceivable that a subject *x* and an individual quantifier $\mathfrak{Q}$ of type *q* satisfy the Unspecificity Criterion, while some (possibly distinct) individual *y* and the same quantifier $\mathfrak{Q}$ meet the Specificity Criterion. If, moreover, $\mathfrak{Q}$ is denoted by some indefinite **a**[**n**] *N*, then, according to the indeterminacy view, both *X* **seeks a**[**n**] *N* and *Y* **seeks a**[**n**] *N* would be true, where *X* and *Y* are names of *x* and *y*, respectively. Moreover, since both *x* and *y* bear **Σ** to $\mathfrak{Q}$, then so would the co-predication *X* **and** *Y* **seek a**[**n**] *N* be true[32] On the other hand, one may expect the coercion analysis to predict such co-predications as zeugmatic, the apparent common satisfaction of … **seeks a**[**n**] *N* by *x* and *y* being a case of equivocation. It would thus seem that such cases may form a test ground for the two rivalling approaches to the lexical semantics of opacity.

If such cases exist. The following two fictitious scenarios are as close as I have come to finding them:

Scenario 1
Geach hears that Quine has developed a serious case of *meinongitis*, a disease that leads victims to believe in all kinds of weird objects, like gold mountains, or cardinal numbers. In fact, rumour has it that Quine spends his time on gigantic search operations in order to prove the existence of such objects. In order to find out whether there is anything to these stories, Geach snitches Quine's diary and scans it for evidence of search preparation: page for page, *Geach is looking for something Quine is looking for*.

Scenario 2
Geach hears that Quine has developed a serious case of *meinongitis*, a disease that makes one believe in all kinds of weird objects, like gold mountains, or cardinal numbers. In fact, rumour has it that Quine donated a large sum for the protection of the endangered species of mermaids and that he has just left for an expedition to discover the last specimens in their natural habitat. Alarmed by the bewildering news, Geach decides to search Quine's office for pertinent evidence. What he is after is some kind of record of Quine's quest for mermaids: in a sense, *Geach is looking for something Quine is looking for*.

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[32] *Co-predication* is distributive application of a given predicate to a given group; the term originates with Copestake & Briscoe (1995), I believe.

In either of the stories the final sentence is intended to describe Geach as trying to find an unspecific object of Quine's intentions.[33] Though both utterances are clearly marginal, the second one seems even harder to get, presumably due to a difference in specificity. For, unspecific though Quine's object of desire in Scenario 2 may be, it is not unspecific for Geach, who, somewhat paradoxically, may be described as looking for a specific unspecific object – or, less paradocially: as specifically looking for an object of an unspecific quest. Not so in the other case, where Geach is not committed to finding a specific such object, as long as it is proof of Quine's unfortunate state of mind (or brain). Hence, with apparent redundancy, Geach may be described as looking for an unspecific unspecific object – or, less oddly: as unspecifically looking for an object of an unspecific quest.

Let us first take a look at Scenario 1. Its final sentence (20) has already been considered. However, the readings that we have come across so far all miss the point of the above story:

(20) **Geach is looking for something Quine is looking for.**

(22') $(\exists y)[\mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{g},\mathbf{F}(\mathbf{g},y))]$

(22'*) $(\exists y)\ (\exists N)\ (\exists M)$
$[\ \boldsymbol{VN}(N,y,\mathbf{q}) \wedge \mathbf{T}(\mathbf{q},(\exists z)[N(z) \wedge \mathbf{F}(\mathbf{q},z)]) \wedge$
$\boldsymbol{VN}(M,y,\mathbf{g}) \wedge \mathbf{T}(\mathbf{g},(\exists z)[M(z) \wedge \mathbf{F}(\mathbf{g},z)])\ ]$

(22") $\mathbf{T}(\mathbf{g},(\exists y)[\mathbf{T}(\mathbf{q},\mathbf{F}(\mathbf{q},y)) \wedge \mathbf{F}(\mathbf{g},y)])$

(22"*) $\mathbf{T}(\mathbf{g},(\exists y)\ (\exists N)[\boldsymbol{VN}(N,y,\mathbf{q}) \wedge \mathbf{T}(\mathbf{q},(\exists z)[N(z) \wedge \mathbf{F}(\mathbf{q},y)]) \wedge \mathbf{F}(\mathbf{g},y)])$

(23) $(\exists \mathfrak{Q})[\mathbf{T}(\mathbf{q},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{g},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{g},y))]$

Given Scenario 1, (22") is false, and a Kaplanian *de re* construal (22"*) does not save it: plainly, Geach's goal is not to find objects Quine is *specifically* looking for, but rather concerns Quine's putative *unspecific* searches. Also, the wide-scope readings (22') (or its cumbersome Kaplanian version (22'*)) and (23) can be discarded because each implies that, in some sense, Quine is looking for something – which need not be the case according to the scenario. Rather, the relevant reading of (20) is one according to which Geach is unspecifically looking for unspecific objects of Quine's intention. To see what this means, one should consider the following continuation:

Scenario 1, continued
After hours of searching, he finally discovers the incredible truth in the entry for July 17, 1953, which reads: 'Still no relief from mermaid deprivation – heading for Copenhagen now.' So the search is over: *Geach found something Quine had been looking for*.

The object of Geach's act of finding, then, is an unspecific object of Quine's acts of seeking. Since, according to the Montagovian account, unspecific objects in this sense are (existential) quantifiers, it follows that the relevant notion of finding relates persons to quantifiers. Hence this particular, abstract sense of **find** must be of type $q(et)$, which is precisely what he had been after. Let us formalize this particular use of **find** as relating a specific and an unspecific object by the constant '$\mathbf{F}^{\#}$'. The present tense version (43) of the last sentence of the continuation can then be treated as in (44), which involves a higher-order existential quantifier:

(43) **Geach finds something Quine is looking for.**

(44) $(\exists \mathfrak{Q})[\mathbf{T}(\mathbf{q},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \mathbf{F}^{\#}(\mathbf{g},\mathfrak{Q})]$

Since Geach's goal was reached by finding an unspecific object of Quine's quest, it also follows that the relevant notion of seeking involves the abstract notion $\mathbf{F}^{\#}$ of finding. In other words, the missing reading of (20) can be formalized as

(45) $\mathbf{T}(\mathbf{g},(\exists \mathfrak{Q})[\mathbf{T}(\mathbf{q},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \mathbf{F}^{\#}(\mathbf{g},\mathfrak{Q})])$

A similar consideration shows that the intended reading (45') of the final sentence of Scenario 2 also involves higher-order finding $\mathbf{F}^{\#}$:

(45') $(\exists \mathfrak{Q})\ [\mathbf{T}(\mathbf{q},(\mathfrak{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{g},\mathbf{F}^{\#}(\mathbf{g},\mathfrak{Q}))]$

Marginal though it may be, (45') is precisely the kind of reading relevant for a co-predication test: it meets the Unspecificity Criterion, ascribing to Geach a specific attitude to an object that at the same time satisfies

[33] In order to facilitate the comparison with the analyses provided in the previous sections, I have chosen an example involving the same attitude twice over. This is not essential. Something like **Geach is looking for something Quine owes him** would have done equally well: just imagine a scenario with Geach scanning through promissory notes and trying to ascertain that Quine still owes him something.

the Unspecificity Criterion with respect to Quine. However, if (45') is a reading of (20), then, *a fortiori* so is its unspecific variant (45), which is less strained to begin with. It will turn out, though, that the compositional derivation of (45) suffices to rule out the applicability of any co-predication test along the lines indicated. Hence we will ignore (45') for most of the present section, only briefly returning to its marginal character towards the end. Let us now turn to the question of how to obtain (45) as an analysis of (20).

4.2 Seeking High, Seeking Low: Ambiguity

The motivation behind the present investigation into these marginal examples is to analyze them in terms of indeterminacy and then apply a co-predication test. Before we can do this, however, we had better made sure that the higher-order findings are in fact cases of indeterminacy at all; otherwise (45) and (45') would not instantiate the Specificity and Unspecificity Criteria in the first place. In other words, even if the specificity/ unspecificity contrast is accounted for in terms of indeterminacy, the one between **F** and **F#** may be of a different kind.[34] In fact, the simplest way of deriving (45) is to stipulate an ambiguity in the transparent verb **find – F** vs. **F#** – and have it carry over to the opaque verb **seek**, which then also gets two readings, according to whether the object to be found is an individual or a quantifier. In the first case, we have the familiar relation between individuals and quantifiers; in the second case, the latter quantify over the objects of **find** in the **F#**-sense, i.e. they are higher-order quantifiers:

($\mathbf{S}_{\Downarrow}$) $\lambda\mathcal{Q}\ \lambda x\ \mathbf{T}(x,(\mathcal{Q}y)\ \mathbf{F}(x,y))$ [= (6)]
($\mathbf{S}_{\Uparrow}$) $\lambda\Pi\ \lambda x\ \mathbf{T}(x,(\Pi\mathcal{Q})\ \mathbf{F}^{\#}(x,\mathcal{Q}))$

The idea that the ⇑/⇓-ambiguity of **seek** reflects an underlying ambiguity in **find** may be independently motivated by the above abstract construal (44) of (43). However, if **find** were ambiguous between **F** and **F#**, i.e. (judging from the types) between a transparent and an opaque reading, one would expect the following sentence to be ambiguous between a transparent, a specific, and an unspecific reading[35]:

(49) **Geach finds a mermaid.**
(49*t*) $(\exists y)[\mathbf{M}(y) \wedge \mathbf{F}(\mathbf{g},y)]$
(49*s*) $(\exists y)\ (\exists N)[\boldsymbol{VN}(N,y,\mathbf{g}) \wedge \mathbf{F}^{\#}(\mathbf{g}, \lambda P\ (\exists z)[N(z) \wedge P(z)])]$
(49*u*) $\mathbf{F}^{\#}(\mathbf{g},\lambda P\ (\exists y)[\mathbf{M}(y) \wedge P(y)])$

And not only that. Given that (43) is true of the above continuation of Scenario 1, (49) would have to be true too; after all, its unspecific reading (49*u*) instantiates the existential quantification (44). This I take to be absurd: there is no ambiguity in (49), the sentence being unequivocally false for the scenario in question. Hence, whatever the source of the purported ambiguity in **seek** may be, it cannot be an analogous ambiguity of the verb **find**. In particular, we still require an explanation for the observation that sentences like (43) produce the same kind of higher-order effects as do their opaque counterparts like (20). Given the close connection between the two, it seems more likely that there is a single account for both. I thus conclude that the ambiguity thesis is not viable. It was not very plausible to begin with anyway: **F#** construals also occur in other languages, and there are analogous phenomena with other opaque verbs. So there ought to be a systematic explanation.

4.3 Seeking High-Or-Low: Indeterminacy

If ambiguity does not explain the higher-order (⇑) uses of **seek**, maybe indeterminacy can. I can think of two ways the meaning of **find** may look if it is indeterminate as to the order of the specific objects:

($\mathbf{F}_{\oplus}$) $[\lambda y\ \lambda x\ \mathbf{F}(x,y)] \oplus [\lambda\mathcal{Q}\ \lambda x\ \mathbf{F}^{\#}(x,\mathcal{Q})]$ [$\equiv \mathbf{F}\oplus\mathbf{F}^{\#}$]
($\mathbf{F}_{\vee}$) $\lambda\mathcal{Q}\ \lambda x\ [(\mathcal{Q}y)\ \mathbf{F}(x,y) \vee \mathbf{F}^{\#}(x,\mathcal{Q})]$

$\mathbf{F}_{\oplus}$ is the most straightforward way of implementing indeterminacy, making use of the type-transcendent union already encountered in Section 3.3: indeterminacy between two senses of different types comes out as the union of the two senses. $\mathbf{F}_{\vee}$ emulates the same union within the higher of the two original types, after casting the transparent relation **F** in the type *q*(*et*) of opaque verbs.[36] As it turns out, neither of the

[34] I am deeply indebted to Nicholas Asher for pointing this out to me after a presentation of a previous verison to this papter.

[35] (49*t*) and (49*s*) may turn out to be equivalent, however, given a detailed truth-conditional specification of **F#**.

[36] This is done by a well-known type shift mapping *R* of type *e*(*et*) to $\lambda\mathcal{Q}\ \lambda x\ (\mathcal{Q}y)\ R(x,y)$ – the prime example of the Montagovian strategy of generalizing to the worst case mentioned in fn. 5 above. – It may be noted that the two

two is of any use here. In fact, both are plagued by the same problems as the ambiguity analysis of **find**, predicting that sentences like (49) would be be true for the continuation of Scenario 1. Moreover, neither of them can be used in a lexical decomposition of **seek**, which would come out as one of the following:

($\mathbf{S}_{\oplus}$) $\lambda\mathcal{Q}\ \lambda x\ \underline{\mathbf{T}(x,\mathbf{F}^{\#}(x,\mathcal{Q}))}$ $[\equiv \lambda\mathcal{Q}\ \lambda x\ \mathbf{T}(x,\mathbf{F}_{\oplus}(x,\mathcal{Q}))]$
($\mathbf{S}_{\vee}$) $\lambda\mathcal{Q}\ \lambda x\ [\mathbf{T}(x,[(\mathcal{Q}y)\ \mathbf{F}(x,y) \vee \mathbf{F}^{\#}(x,\mathcal{Q})]]$ $[\equiv \lambda\mathcal{Q}\ \lambda x\ \mathbf{T}(x,\mathbf{F}_{\vee}(x,\mathcal{Q}))]$

The underlined part of $\mathbf{S}_{\oplus}$ results from applying $\mathbf{F}_{\oplus}$ to $\mathcal{Q}$ and x, drawing on a generalized version of β-conversion: the domain of $\mathbf{F}_{\oplus}$ covers both individuals and quantifiers, and the values assigned to either will be the value assigned by the corresponding component, which is $[\lambda\mathcal{Q}\ \lambda x\ \mathbf{F}^{\#}(x,\mathcal{Q})]$ in the case of quantifiers.[37] But, surely, ($\mathbf{S}_{\oplus}$) is as inadequate a reconstruction of indeterminate **seek** as can be; in fact, it boils down to the reading $\mathbf{S}_{\Uparrow}$ according to the ambiguity analysis.

$\mathbf{S}_{\vee}$ does not fare much better, for it moves the indeterminacy from the expression to the attitude subject, which is clearly inadequate. In Scenario 1, Geach is *in some sense* looking for something Quine was looking for, but he would not have been content had he found a mermaid; similarly, Quine's Meinongian search would not have been over had he come across his own diary entry containing a representation of what he was looking for.[38] Briefly, someone looking for an unspecific object is *either* trying to find (a) a corresponding specific object *or* trying to find (b) a representation of the unspecific object – and *not* trying to find something that is either (a) or (b).

Putting the indeterminacy in the expression is not hard. It suffices to give wide scope to the type-transcendent union. The following formalization therefore ought to be a better candidate for $\Uparrow/\Downarrow$-indeterminate **seek** than either of $\mathbf{S}_{\oplus}$ and $\mathbf{S}_{\vee}$:

($\mathbf{S}_{\Downarrow\oplus\Uparrow}$) $[\lambda\mathcal{Q}\ \lambda x\ \mathbf{T}(x,(\mathcal{Q}y)\ \mathbf{F}(x,y))] \oplus [\lambda\Pi\ \lambda x\ \mathbf{T}(x,(\Pi\mathcal{Q})\ \mathbf{F}^{\#}(x,\mathcal{Q}))]$ $[= \mathbf{S}_{\Downarrow}\oplus\mathbf{S}_{\Uparrow}]$

One may suspect that $\mathbf{S}_{\Downarrow\oplus\Uparrow}$ runs into a co-predication problem. In Scenario 1, Geach is looking for something Quine is looking for *in some sense*. And, we may assume, Quine is indeed looking for something. So, redundantly speaking, *in some sense* Quine is looking for something Quine is looking for. The point is that the senses are not the same. Hence though both (50) and (51) are true for Scenario 1, (52) is not:

(50) **Geach is looking for something Quine is looking for.**
(51) **Quine is looking for something Quine is looking for.**
(52) **Both Geach and Quine are looking for something Quine is looking for.**

As the reader is invited to verify, the previous analysis ($\mathbf{S}_{\vee}$) of **seek** predicts all three sentences to be true for that scenario. However, the data come out correctly for ($\mathbf{S}_{\Downarrow\oplus\Uparrow}$), even though $\mathbf{S}_{\Downarrow\oplus\Uparrow}$ happens to be the only sense of **seek**. The reason is that the relevant readings of (50) and (51) differ in logical form. The only readings according to which (50) and (51) are true in the scenario are:

(50') $\mathbf{T}(\mathbf{g},(\exists\mathcal{Q})[\mathbf{T}(\mathbf{q},(\mathcal{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \mathbf{F}^{\#}(\mathbf{g},\mathcal{Q})])$ [= (45)]
(51') $(\exists\mathcal{Q})[\mathbf{T}(\mathbf{q},(\mathcal{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{q},(\mathcal{Q}y)\ \mathbf{F}(\mathbf{q},y))]$ $[\equiv (\exists\mathcal{Q})\ \mathbf{T}(\mathbf{q},(\mathcal{Q}y)\ \mathbf{F}(\mathbf{q},y))]$

To derive these readings with the analysis ($\mathbf{S}_{\Downarrow\oplus\Uparrow}$) of **seek**, one should first notice that they share the interpretation of the object, viz.:[39]

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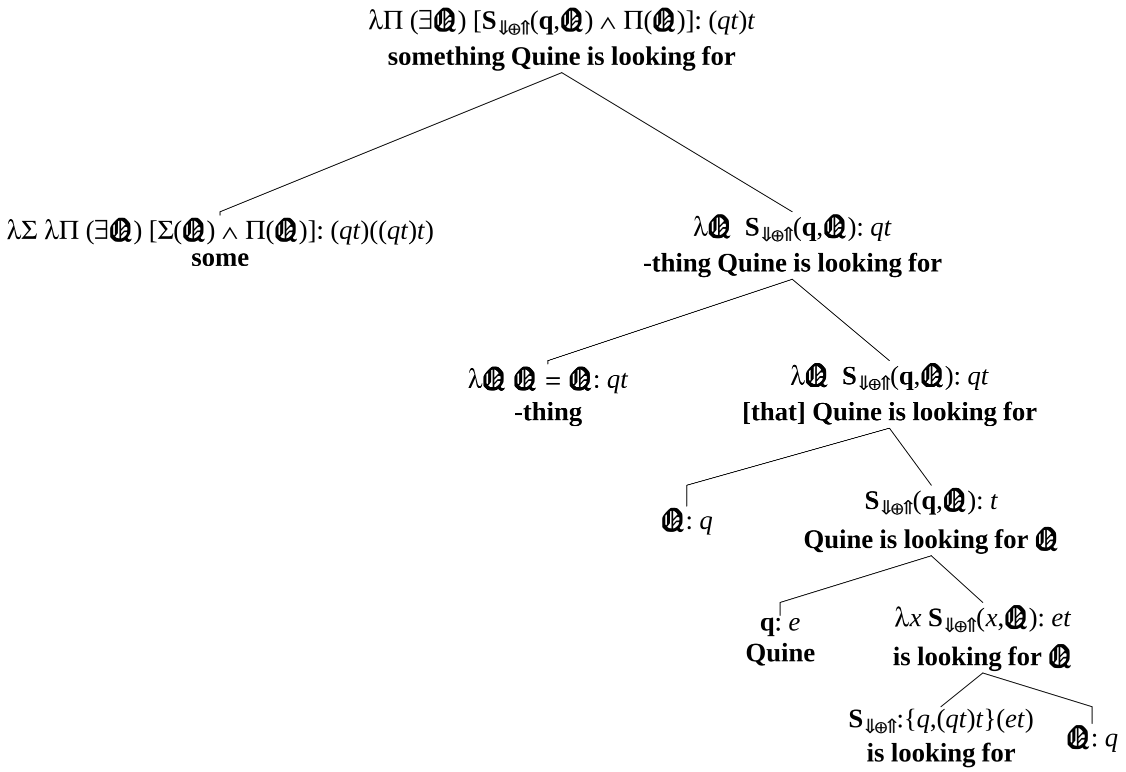
unions are obtained by two distinct operations, viz. type-transcending merge vs. type-shifted disjunction. This is no coincidence: given the framework in the Appendix, neither operation can replace the other one in these formulae.

37 The relevant laws of the logic of type-transcendent union are listed in the Appendix.

38 This reasoning is not entirely waterproof: if **try** is closed under implication, then anyone trying to **F**ind an unspecific mermaid would *a fortiori* try to **F**ind-or-**F**ind# the quantifier expressed by **a mermaid**. But wait for the next paragraph.

39 The tree merges syntactic and semantic information in an obvious way. Notation: curly brackets around types indicate indeterminacy between them; see the Appendix for precise definitions.

(53)

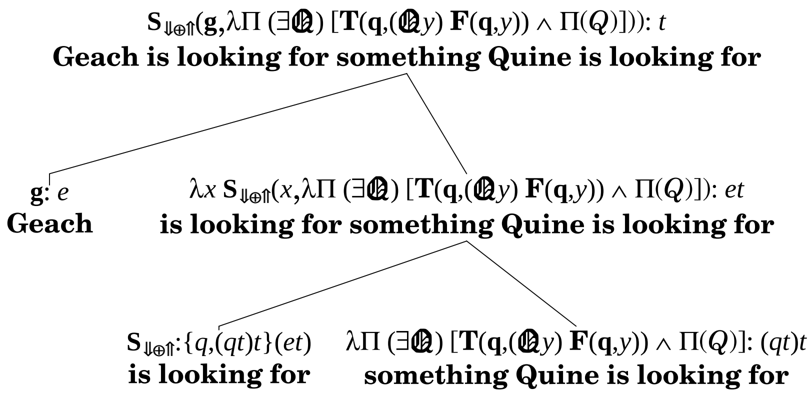


Again, the argument of the verb (the trace $\mathcal{Q}$) resolves the indeterminacy in **seek** so that the object comes out as:

(53') $\lambda\Pi\ (\exists\mathcal{Q})\ [\mathbf{T}(\mathbf{q},(\mathcal{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \Pi(Q)]$

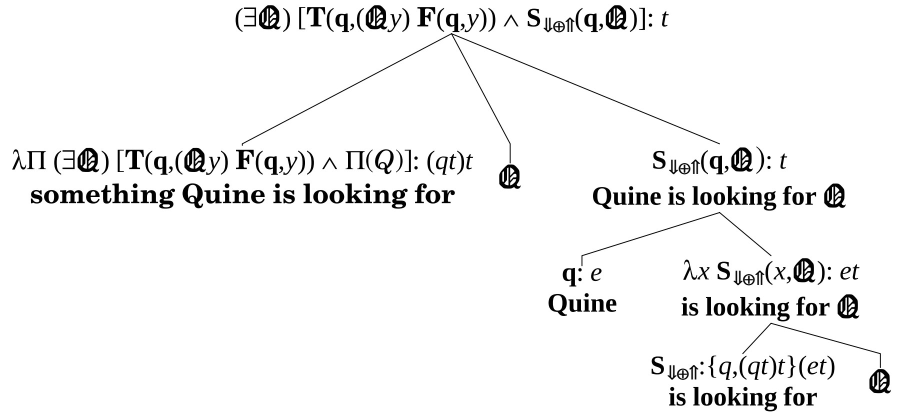
But in order to obtain (50'), the object as interpreted in (53') must take narrow scope, whereas it has wide scope in (51'):

(50'')



([≡ (50')]

(51")



([≡ (51')]

According to the indeterminacy approach to ⇓ vs. ⇑, (50") and (51") are the only true readings of (50) and (51). Hence it is obvious that (52) must be false, as desired. So, of the three above ⇑/⇓-indeterminacy analyses of **seek**, ($\mathbf{S}_{\Downarrow\oplus\Uparrow}$) is clearly the best. Nevertheless I am sceptical about it. The reason is that, still in the same scenario, the following three sentences should come out as *true* (in at least one sense):

(54) **Geach is looking for something.**
(55) **Quine is looking for something.**
(56) **Both Geach and Quine are looking for something.**

According to ($\mathbf{S}_{\Downarrow\oplus\Uparrow}$), (54) and (55) are implied by (50) and (51). More precisely, either has a reading that is implied by the respective readings (50') and (51'), to wit:

(54') $(\exists\Pi)\ \mathbf{T}(\mathbf{g},(\Pi\mathbb{Q})\ \mathbf{F}^{\#}(x,\mathbb{Q}))$ [≡ $(\exists\Pi)\ \mathbf{S}_{\Downarrow\oplus\Uparrow}(\mathbf{g},\Pi)$]
(55') $(\exists\mathbb{Q})\ \mathbf{T}(\mathbf{q},(\mathbb{Q}y)\ \mathbf{F}(x,y))$ [≡ $(\exists\mathbb{Q})\ \mathbf{S}_{\Downarrow\oplus\Uparrow}(\mathbf{q},\mathbb{Q})$]

However, these two readings together do not imply (56). Now, (56) may still happen to be true for Scenario 1, given the analysis ($\mathbf{S}_{\Downarrow\oplus\Uparrow}$), due to certain *lexical* properties of **seek**, like monotonicity or some connection between **F** and $\mathbf{F}^{\#}$. But I think (56) ought to be *logically* implied by (54) and (55), which according to ($\mathbf{S}_{\Downarrow\oplus\Uparrow}$) it is not. I take this to be enough motivation to try a different approach to the ⇑/⇓-shift.

4.4 Seeking High as Seeking Low: Coercion

Regarding Scenario 1 and its continuation, one cannot help thinking that Geach did not *literally* find an unspecific object, let alone a quantifier. Rather, what he found was a *trace* of Quine's search activities, in form of a diary entry containing a reference to a certain unspecific object. In other words, the object found by Geach *represented* a quantifier $\mathbb{Q}$ satisfying: **Quine is looking for** $\mathbb{Q}$. If we write '$\boldsymbol{R}$' for the relation of representation as it holds between an unspecific object and anything that denotes that unspecific object (the italicization again indicating that this is likely to be a context-dependent variable rather than an ordinary non-logical constant), we may reduce the above *ad hoc* relation $\mathbf{F}^{\#}$ to the ordinary, transparent **F**ind relation in the following way:

(57) $\mathbf{F}^{\#} = \lambda\mathbb{Q}\ \lambda x\ (\exists z)[\boldsymbol{R}(z,\mathbb{Q}) \wedge \mathbf{F}(x,z)]$

Using (57), the relevant reading (44) of (43) now reads:

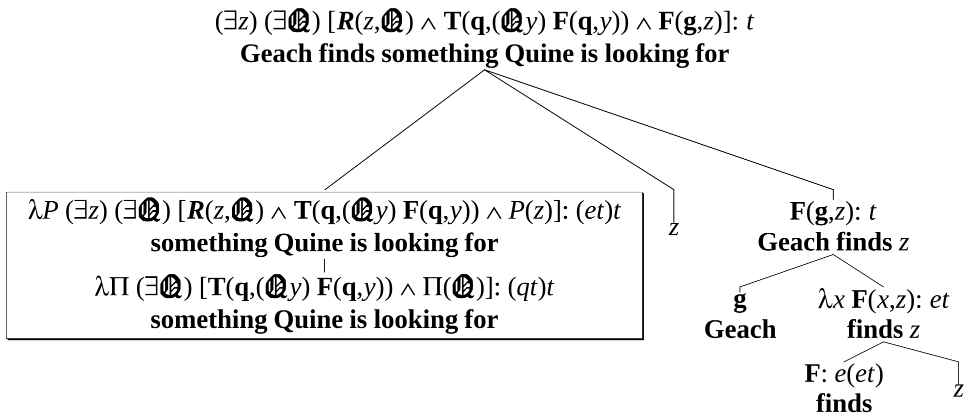
(58) $(\exists z)\ (\exists\mathbb{Q})[\mathbf{T}(\mathbf{q},(\mathbb{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \boldsymbol{R}(z,\mathbb{Q}) \wedge \mathbf{F}(\mathbf{g},z)]$

The improvement in this formalization is that, once $\mathbf{F}^{\#}$ is definable in terms of **F**, it may be derived from it systematically. In fact, there is quite a natural way of obtaining (58) as a reading of (43) without positing ambiguity or indeterminacy. The reason is that, given the intended reading (26') of the object **something Quine is looking for**, (58) must derive from feeding a higher-order quantifier to the transparent verb **find** of type $e(et)$:

(26') $\lambda\Pi\ (\exists\mathbb{Q})[\mathbf{T}(\mathbf{q},(\mathbb{Q}y)\ \mathbf{F}(\mathbf{q},y)) \wedge \Pi(\mathbb{Q})]$

It is indeed natural to solve this apparent type conflict by coercion. This may be done by either type-shifting *(i)* the verb **find** from $e(et)$ to $q(et)$, or *(ii)* the object (26') from $(qt)t$ to $(et)t$ [= q]. In either case the latter would have to quantify over the object position of the former. For reasons that will become clear in a moment, we will only consider option *(ii)*:[40]

(59)



To obtain the highlighted shift in (59), the following (somewhat complicated[41]) operation can be used, which may come in handy in coercion contexts in general:

QL ***Quantifier Lowering***
The lowered version of a higher-order quantifier $\mathfrak{Q}$ of type (qt)t is the following ordinary quantifier of type q:

$$[\lambda Q\ (\mathfrak{Q}\mathcal{Q})\ (\exists y)[\boldsymbol{R}(y,\mathcal{Q}) \wedge Q(y)]]$$

I leave it to the reader to check that this coercion analysis solves all the problems encountered in connection with the ambiguity and indeterminacy analyses. In particular, it should be noted that ***QL*** coercion on the one hand avoids the co-predication problem of (52), because it requires the object of (50) to undergo ***QL*** if the sentence is to be true of Scenario 1, whereas (51) is only true of a literal (and redundant) construal; on the other hand, (54) – (56) come out as straightforward logical consequences of (50) – (52), involving higher-order quantification. Hence ***QL*** coercion fares a lot better than its rivals. Moreover, the fact that the ⥣-readings are rather rare and remote may be seen as further evidence for an account in terms of coercion. I will therefore assume that the ⥣-readings are indeed produced by ***QL***.

It must not be left unmentioned that the precise nature of the coercion mechanism underlying the ⥣-readings is not entirely clear. The reason is that **seek**, being opaque, does not call for coercion when combined with a higher-order quantifier; there just is no type conflict. In other words, in view of the independently motivated ***W***ide Scope ***H***igher order reading of (20) copied from Table 3 above, the application (60) of ***QL*** appears to be unmotivated:[42]

(20) **Geach is looking for something Quine is looking for.**

(***WH***) $(\exists\mathcal{Q})[\mathbf{T}(\mathbf{q},(\mathcal{Q}y)\ \mathbf{F}(\mathbf{q}, y)) \wedge \mathbf{T}(\mathbf{g},(\mathcal{Q}y)\ \mathbf{F}(\mathbf{g}, y))]$

---

[40] The type shift on the verb would have mapped **F** onto: $\lambda\mathcal{Q}\ \lambda x\ (\exists z)\ [\boldsymbol{R}(z,\mathcal{Q}) \wedge \mathbf{F}(x,z)]$. – To keep the semantic apparatus to a minimum, quantification is expressed by a Montagovian scope mechanism. More local interpretation devices could have been used; cf. Heim & Kratzer (1998: 178ff.) for a survey.

[41] Part of the complications are an artefact of the framework. The operation comes out a lot more natural within the property approach to opacity.

[42] The problem vanishes under the clausal approach to opacity, where the syntactic structure underlying **seek** contains an occurrence of **find**, which may then trigger ***QL***. The reading (***WH***) of (20) could still be accounted for by a different scoping. – Incidentally, type shifting the verb (as in fn. 40) would have led to the wrong reading in (60), as the reader may check.

(60)

$\mathbf{T}(\mathbf{g}, (\exists z)\,(\exists \mathcal{Q})\,[\boldsymbol{R}(z,\mathcal{Q}) \wedge \mathbf{T}(\mathbf{q},(\mathcal{Q}y)\,\mathbf{F}(\mathbf{q},y)) \wedge \mathbf{F}(\mathbf{g},z)])\!: t$
Geach is looking for something Quine is looking for

$\mathbf{g}$
Geach

$\lambda x\, \mathbf{T}(x, (\exists z)\,(\exists \mathcal{Q})\,[\boldsymbol{R}(z,\mathcal{Q}) \wedge \mathbf{T}(\mathbf{q},(\mathcal{Q}y)\,\mathbf{F}(\mathbf{q},y)) \wedge \mathbf{F}(x,z)])\!: et$
is looking for something Quine is looking for

$\lambda \mathcal{Q}\, \lambda x\, \mathbf{T}(x,(\mathcal{Q}y)\,\mathbf{F}(x,y))\!: q(et)$
is looking for

$\lambda P\, (\exists z)\,(\exists \mathcal{Q})\,[\boldsymbol{R}(z,\mathcal{Q}) \wedge \mathbf{T}(\mathbf{q},(\mathcal{Q}y)\,\mathbf{F}(\mathbf{q},y)) \wedge P(z)]\!: (et)t$
something Quine is looking for

$\lambda \Pi\, (\exists \mathcal{Q})\,[\mathbf{T}(\mathbf{q},(\mathcal{Q}y)\,\mathbf{F}(\mathbf{q},y)) \wedge \Pi(\mathcal{Q})]\!: (qt)t$
something Quine is looking for

Despite this unclarity, I take the relation between ⇓- and ⇑-construals of **seek** and **find** to be governed by coercion.

The coercion analysis of higher-order finding also goes some way towards explaining the oddness of (45') as a reading of (20).

(20) **Geach is looking for something Quine is looking for.**

(45') $(\exists \mathcal{Q})\,[\mathbf{T}(\mathbf{q},(\mathcal{Q}y)\,\mathbf{F}(\mathbf{q}, y)) \wedge \mathbf{T}(\mathbf{g},\mathbf{F}^{\#}(\mathbf{g}, \mathcal{Q}))]$

As is apparent from its *de dicto* counterpart (60), deriving (45') would involve quantifying in on top of the type coercion under scrutiny. In particular, given a coercion view of specificity, (45') would thus necessitate double coercion on a single constituent, which may have to be ruled out in general.[43]

The scenarios discussed in this section had been intended to show that it is possible to stand in the specific **seek** relation to an unspecific object. However, according to the above coercion analysis of the ⇓/⇑-contrast this is not the case: subjects only stand in the specific **seek** relation to representations of quantifiers, not to the quantifiers themselves. The point is best illustrated by the failures of co-predication mentioned earlier. According to the relevant readings of (50) and (51), Geach and Quine can be said to each stand in a seeking relation to the same unspecific object *O* (denoted by higher-order **something Quine is looking for**), but the relations are not the same: the relation Quine bears to *O* is denoted by **seek**; but Geach stands to *O* in the relation of *seeking-a-representation-of*. Hence co-predication fails precisely because Geach does not stand in any **seek** relation to the unspecific object *O*.

The upshot of our long discussion of these admittedly marginal examples is entirely negative. Appearances to the contrary, specific quests for unspecific objects do not constitute any evidence against the view that **seek** is indeterminate between a specific and an unspecific construal.[44]

5. Co-Predication and Coordination
5.1 Co-Predication: Semantics vs. Pragmatics

In the previous section we used co-predication data as a test for deciding between coercion (or ambiguity) and indeterminacy to account for purported specific higher-order readings. In this section we will apply similar tests to specific vs. unspecific readings. The idea is simple enough: since the coercion approach supposes a structural ambiguity where there is none according to the indeterminacy interpretation, the two should disagree on co-predications of subjects that differ in the sense in which they satisfy a predicate in point. However, matters are not that simple. In fact, all theories of opacity agree on the most straightforward co-predications. Imagine Geach and Quine both needing a pen to write a postcard home, but

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43 Cf. de Swart (2000).

44 I am indebted to Nicholas Asher for making me see that the decision between coercion and indeterminacy with respect to higher-order specificity has no bearing on the decision between coercion and indeterminacy with respect to the objectual and the notional sense. This insight gave the present paper its direction.

whereas Geach knows he has his own pen somewhere in his briefcase, Quine hopes that there are pens lying around in the post-office, which they are entering together. Quine immediately starts searching the place, while Geach opens his briefcase. Hence it would seem that both (61) and (62) are true:

(61) **Quine is looking for a pen.**
(62) **Geach is looking for a pen.**

However, although (63) does not seem to be outright *false*, applying it to the situation at hand is clearly somewhat strained:

(63) **Both Quine and Geach are looking for a pen.**

On the other hand, nothing is wrong with the general statement:

(64) **Both Quine and Geach are [each] looking for something.**

Let us now see how the various approaches to opacity deal with these data. It will be instructive to compare the indeterminacy analysis (65) of **seek** with the coercion analysis based on *De Re* Lowering as well as the standard Montagovian approach, both of which take (66) to be the lexical meaning of **seek**:

(65) $\lambda\mathfrak{Q}\ \lambda x\ \mathbf{T}(x,(\mathfrak{Q}y)\ \mathbf{F}(x,y)) \oplus$
$\lambda y\ \lambda x\ (\exists N)[\boldsymbol{VN}(N,y,x) \wedge \mathbf{T}(x,(\exists z)[N(z) \wedge \mathbf{F}(x,z)])]$ [≡ (39c)]
(66) $\lambda\mathfrak{Q}\ \lambda x\ \mathbf{T}(x,(\mathfrak{Q}y)\ \mathbf{F}(x,y))$ [= (39a) = (6)]

To begin with, all three approaches agree on the true, unspecific reading of (61); and as to the true, specific reading of (62), the standard analysis with its essential propositions is the odd one out:

(61*sic*) $\mathbf{T}(\mathbf{q},(\exists y)[\mathbf{P}(y) \wedge \mathbf{F}(\mathbf{q},y)])$
(62*s*) $(\exists y)[\mathbf{P}(y) \wedge \mathbf{T}(\mathbf{g},\ \mathbf{F}(\mathbf{g},y))]$
(62*ic*) $(\exists y)\ (\exists N)[\mathbf{P}(y) \wedge \boldsymbol{VN}(N,y,\mathbf{g}) \wedge \mathbf{T}(\mathbf{g},(\exists z)[N(z) \wedge \mathbf{F}(\mathbf{g},z)])]$

Similarly, the readings attributed to (63) only differ *re de re*:

(63*sic**n***) $\mathbf{T}(\mathbf{q},(\exists y)[\mathbf{P}(y) \wedge \mathbf{F}\ (\mathbf{q},y)]) \wedge \mathbf{T}(\mathbf{g},(\exists y)[\mathbf{P}(y) \wedge \mathbf{F}\ (\mathbf{g},y)])$ ***n**arrow scope*

(63*s**m***) $(\exists y)\ (\exists z)[\mathbf{P}(y) \wedge \mathbf{P}(z) \wedge \mathbf{T}(\mathbf{q},\ \mathbf{F}\ (\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{g},\ \mathbf{F}\ (\mathbf{g},z))]$ ***m**edium scope*
(63*ic**m***) $(\exists y)\ (\exists z)\ (\exists N)\ (\exists M)[\mathbf{P}(y) \wedge \mathbf{P}(z) \wedge \boldsymbol{VN}(N,y,\mathbf{q}) \wedge \boldsymbol{VN}(M,z,\mathbf{g}) \wedge$
$\mathbf{T}(\mathbf{q},(\exists y)[N(y) \wedge \mathbf{F}(\mathbf{q},y)]) \wedge \mathbf{T}(\mathbf{g},(\exists z)[M(z) \wedge \mathbf{F}(\mathbf{g},z)])]$

(63*s**w***) $(\exists y)[\mathbf{P}(y) \wedge \mathbf{T}(\mathbf{q},\ \mathbf{F}\ (\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{g},\ \mathbf{F}\ (\mathbf{g},y))]$ ***w**ide scope*
(63*ic**w***) $(\exists y)\ (\exists N)\ (\exists M)[\mathbf{P}(y) \wedge \boldsymbol{VN}(N,y,\mathbf{q}) \wedge \boldsymbol{VN}(M,y,\mathbf{g}) \wedge$
$\mathbf{T}(\mathbf{q},(\exists z)[N(z) \wedge \mathbf{F}(\mathbf{q},z)]) \wedge \mathbf{T}(\mathbf{g},(\exists z)[M(z) \wedge \mathbf{F}(\mathbf{g},z)])]$

(63*sic**n***) co-predicates unspecifically looking for a pen of Quine and Geach; according to any of the three approaches, the reading is obtained by directly combining the opaque verb with the indefinite object. The ***m*** readings attribute looking for a specific pen to both, although the pen in question may be a different one for each – as may be the particular vivid name under which it is known to them; the reading is obtained by quantifying the object into the open sentence *x* **are looking for** *y* and then quantifying the subject into it. Reversing this order of quantifiers finally leads to a ***w**ide* scope reading of the object, according to which Geach and Quine are looking for the same pen, although they may describe it in different terms. The three scoping possibilities exhaust the readings predicted for (63) in any of the three accounts of opacity.

Given that the specific readings obtained by the standard approach are unlikely to be true anyway and that Quine just is not looking for any object under a specific unique description that would meet the requirements of the ***V**ivid **N**ame* condition, this only leaves the unspecific co-predication (63*sic**n***) as a possible candidate for a true reading of (63). Since the unspecific reading of (62) is not *logically* entailed by its true specific reading, the only way of making it – and thus the co-predication (63*sic**n***) – true, is by specific assumptions on the *lexical* meaning of **seek**. One such assumption was considered in Section 2.1 already, in connection with lexically motivated inferences: **seek** may be monotonically increasing in its unspecific argument. And although we have seen reasons to be wary of this assumption, let us briefly reconsider it. The monotonicity of **seek** may be reduced to a closure of implication in the underlying attitude **T**; in other words, the closure assumption (67) implies the monotonicity (68) of **seek**, which in turn may have repercussions on the truth of (63*sic**n***) in the situation at hand:[45]

[45] '⇒' and '⊑' respectively denote strict implication and sub-propertyhood, both of which can be defined in terms of material implication, necessity, and universal quantification. '$\exists_P$' is short for the quantifier expressed by an indefinite restricted by

(67) $\Box\ (\forall x)\ (\forall p)\ (\forall q)[p \Rightarrow q \rightarrow [\mathbf{T}(x,p) \rightarrow \mathbf{T}(x,q)]]$
(68) $\Box\ (\forall x)\ (\forall P)\ (\forall Q)[P \sqsubseteq Q \rightarrow [\mathbf{S}(x,\exists_P) \rightarrow \mathbf{S}(x,\exists_Q)]]$

Indeed, we may safely assume that Geach knows his missing Conway Stewart to be a pen, i.e. the vivid name **CS** witnessing (62*ic*) in the sense of (69), implies penhood in the sense of (70):

(69) $\mathbf{P}(\mathbf{cs}) \wedge \boldsymbol{VN}(\mathbf{CS},\mathbf{cs},\mathbf{g}) \wedge \mathbf{T}(\mathbf{g},(\exists z)[\mathbf{CS}(z) \wedge \mathbf{F}(\mathbf{g},z)])$
(70) $\Box\ (\forall y)[\mathbf{CS}(y) \rightarrow \mathbf{P}(y)]$

However, given the general principle (68), (69) and (70) together imply the unspecific reading of (62); thus, with (61*sic*), (63*sic**n***) comes out as true. Why, then, would it still sound odd when someone commented on the postal situation as in (63)? Two hypothetical reasons spring to mind. The first builds on the fact that Geach is only looking for an *unspecific* pen insofar as he is looking for a *specific* one. Hence the unspecific reading of (62), though true, is not as informative as its specific reading (62*ic*). Invoking standard (Gricean) pragmatic reasoning, (61) would be rather misleading and thus inappropriate *if used unspecifically* – and this oddness might carry over to the co-predication (63) *of which it is part*. I can see at least two problems with this kind of reasoning: for one thing, the hearer normally cannot tell whether (61) is used unspecifically or not, and hence one premise of the Gricean reasoning is shaky; for another thing, it is not obvious why principles of informativity should carry over from one expression to others of which it is part. The other reason why (61) may be inappropriate has to do with the fact that, unlike Geach, Quine is indeed looking for any old pen, as long as it can be used for writing. Hence Geach and Quine, though both satisfying the predicate of being unspecifically seeking a pen, satisfy it in different ways, whereas the conjunction may suggest they do not. Again, I find this argument rather dubious if only for the reason that it seems to overgeneralize. For, as we have said, nothing appears to be wrong with (64) which attributes some seeking or other to both Geach and Quine and which is true even though the activities are as different as in the case of (63). The conclusion is that, in the absense of any pragmatic explanation, the inadequacy of (63) provides further evidence against the monotonicity (68) of **seek** and, indeed, the inferential closure (67) of the underlying attitude of **T**rying.

Finally, note that (64) as such does not present a problem to any analysis. Given the higher-order interpretation of **something** of Section 2.3 above, the following formalization, adequate and true, is obtained:

(71) $(\exists \mathbb{Q})[\mathbf{T}(\mathbf{q},(\mathbb{Q} y)\ \mathbf{F}(\mathbf{q},y)) \wedge \mathbf{T}(\mathbf{g},(\mathbb{Q} y)\ \mathbf{F}(\mathbf{g},y))]$

5.2 Coordination: Mixed Objects

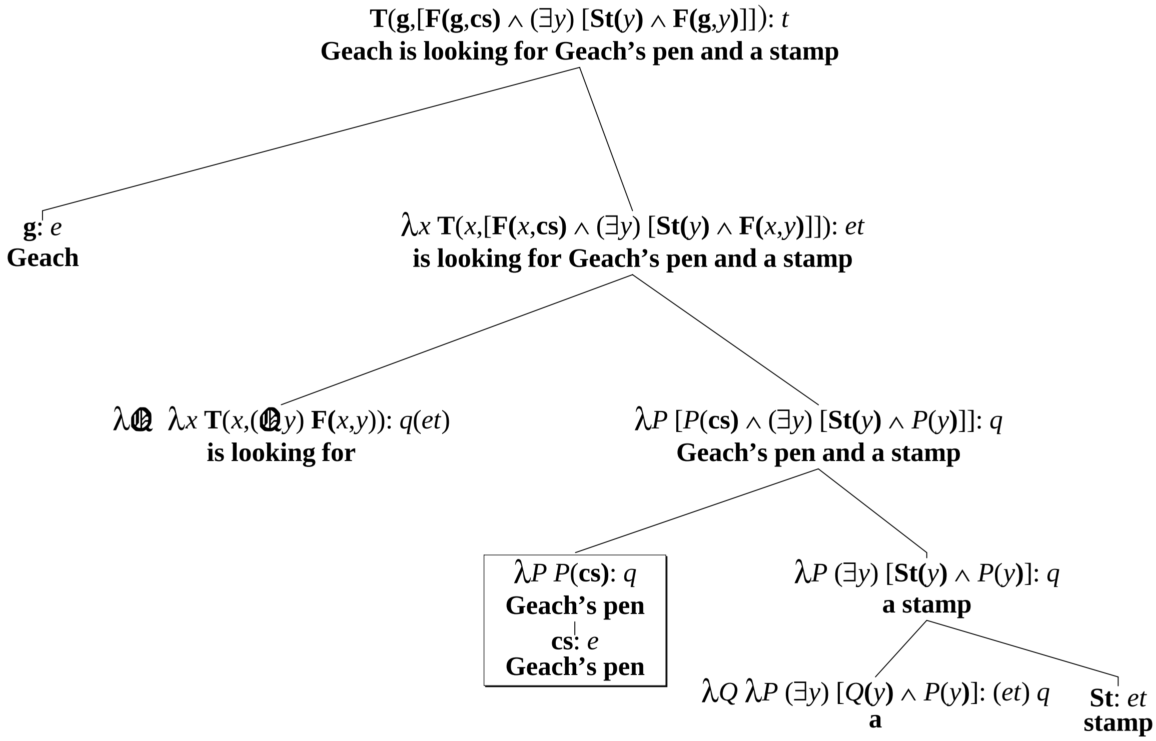
Apart from a pen, what both Geach and Quine need is a stamp. Geach had bought some the day before, so he includes them in his search of his briefcase, which may now be accurately reported by:

(72) **Geach is looking for his pen and a stamp.**

Although there is no specific stamp that Geach is looking for, the missing pen is quite specific. It is again instructive to have a look at the standard formalization of the intended, *mixed* reading of (72):

P, i.e. $\lambda Q\ (\exists x)\ [P(x) \wedge Q(x)]$.

(72*s*)



For simplicity we treat **his stamp** as a name of **cs**. The application of Montague Lifting at the place indicated is essential for this reading. In particular, it could not have been obtained by Argument Lowering, because the unspecificity of the right conjunct would have been lost. And it is this feature of the – inadequate – standard account of the reading under discussion which stands in the way of an adaptation of the coercion analysis: the latter is based on a Kaplanian *de re* interpretation which, as we have seen, does not lend itself to any version of Montague Lifting. Nor does it seem possible to find another type-shifting mechanism to this end. The reason is that, according to the coercion account, the required reading would have to invoke two distinct construals of **seek**, a specific one that involves ***VN***, and the underlying unspecific one that does not.

The indeterminacy approach fares better in this respect, because in principle the same verb **seek** can take a specific and an unspecific object at the same time. However, the technicalities are somewhat delicate. To begin with, the two objects cannot be directly conjoined: **Geach's pen** is of the non-conjoinable[46] type *e*, whence it would have to be Montague-lifted first, thus becoming eligible for the unspecific sense of **seek**. In other words, conjoining the objects would lead to a variant of the standard interpretation involving essential propositions; I leave it to the readers to verify this. However, the desired result may be reached in an indirect way. To this end, one may first observe that the true reading of (72) boils down to the conjunction of the respective <u>s</u>pecific and <u>u</u>nspecific readings of (73) and (74):

(73) **Geach is looking for his pen.**
(*s*) (∃*N*)[***VN***(*N*,**cs**,**g**) ∧ **T**(**g**,(∃*z*)[*N*(*z*) ∧ **F**(**g**,*z*)])]
(74) **Geach is looking for a stamp.**
(*u*) **T**(**g**,(∃*y*)[**St**(*y*) ∧ **F**(**g**,*y*)])

Within the indeterminacy approach it is possible to derive (72) as a conjunction of (73) and (74). The idea is that the conjoined object may express a conjunctive condition (75) on opaque predicates ℜ (dependent on the subject *x*), viz. that they hold of each of the conjuncts:[47]

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[46] I am relying on the standard type shifting terminology: a type is *conjoinable* (or *Boolean*) if it is either *t* or a pair whose right component is conjoinable. Cf. Partee (1997: 75).

[47] The formalization is inspired by the account of mixed coordinations (of indirect questions and **that**-clauses under attitude verbs like **know**) sketched in Krifka (2001: 314ff.). Apart from the type-mixing, this abstract way of interpreting conjunction is in line with the general approach taken in Hendriks (1993).

(75) $\lambda\Re\ \lambda x\ [\Re(x,\mathbf{cs}) \wedge \Re(x,\underline{\lambda P\ (\exists y)[\mathbf{St}(y) \wedge P(y)]})]$,

where $\Re$ is a variable of the type $(\{e,q\}(et))$ of opaque verbs (according to the indeterminacy approach) and the underlined part is the (standard) analysis of **a stamp**. Applying (75) to the indeterminate analysis (65) of **seek** (and the result to **g**) then yields the conjunction of (73) and (74), which is equivalent to:

(76) $(\exists N)[\boldsymbol{VN}(N,\mathbf{cs},\mathbf{g}) \wedge \mathbf{T}(\mathbf{g},(\exists z)\ (\exists y)[N(z) \wedge \mathbf{St}(y) \wedge \mathbf{F}(\mathbf{g},z) \wedge \mathbf{F}(\mathbf{g},y)])]$
[≡ $\boldsymbol{\Sigma}(\mathbf{g},\ \mathbf{cs}) \wedge \boldsymbol{\Sigma}(\mathbf{g},\exists_{\mathbf{St}})$],

where **Σ** is the indeterminate relation expressed by **seek**. However, the advantage of indeterminacy over coercion in the case of mixed object readings is illusory, as becomes clear when we switch from conjunction to disjunction, for which purpose we assume that Geach remembers having a couple of pencils in his briefcase that are equally suitable for his purposes. Then the following sentence is true in that Geach would be satisfied if he found **cs** as much as he would be content with finding any of his pencils.

(77) **Geach is looking for his pen or a pencil.**

Using the same trick of construal as in (75), (77) comes out as (78), which is a legitimate reading, but not the intended one:

(78) $\boldsymbol{\Sigma}(\mathbf{g},\ \mathbf{cs}) \vee \boldsymbol{\Sigma}(\mathbf{g},\exists_{\mathbf{St}})$
[≡ $(\exists N)[\boldsymbol{VN}(N,\mathbf{cs},\mathbf{g}) \wedge \mathbf{T}(\mathbf{g},(\exists z)[N(z) \wedge \mathbf{F}(\mathbf{g},z)])] \vee \mathbf{T}(\mathbf{g},(\exists y)[\mathbf{St}(y) \wedge \mathbf{F}(\mathbf{g},y)])$]

(78) may be used by a speaker who wants to express uncertainty as to what exactly Geach is looking for. In the situation at hand, this reading is false because Geach is neither looking for his pen nor for a pencil but for anything that would be either his pen (as given to him) or a pencil (of some sort). Hence there is no hope to reduce the intended reading of (77) to (78). This intended reading is readily formalized, however:

(79) $(\exists N)[\boldsymbol{VN}(N,\mathbf{cs},\mathbf{g}) \wedge \mathbf{T}(\mathbf{g},(\exists z)\ (\exists y)[N(z) \wedge \mathbf{F}(\mathbf{g},z) \wedge \mathbf{St}(y) \wedge \mathbf{F}(\mathbf{g},y)])]$

Unlike (78), (79) does not allow for a paraphrase in terms of the indeterminate relation **Σ**. How, then, does the reading (79) come about? Maybe the puzzle dissolves once the parallel between conjunction and disjunction is given up and the latter receives a non-Boolean interpretation as it has been proposed in other environments.[48] However, I think that a conceptually simpler way leads to a generalization of the *de re* mechanism to arbitrary occurrences of referential terms in objects of opaque verbs, as it would be needed in any approach to opacity: unspecifically read objects may contain proper names (e.g., in relative clauses) that must be interpreted *de re* if reference to essential propositions is to be avoided. And there seems to be no reason why this mechanism should not be applied to the case at hand. Even though I do not know the details of such a *de re* construal, I am convinced that it could somehow be provided, thus solving the puzzle of mixed objects independently of the lexical entry and type of the opaque verb. I therefore conclude that, as far as the choice between coercion-based vs. indeterminacy-induced specificity is concerned, the evidence provided by coordination and co-predication data is inconclusive. But there are other grounds for the decision.

6. Lexical Gaps

6.1 Missing Specificity[49]

According to the coercion approach, specific readings arise as a result of a type mismatch: the opaque verb, expecting a quantified object, must cope with a referential term, and it does so by adapting its lexical content. The mechanism responsible for this meaning adaptation is perfectly general, applying to any opaque verb and referential object in a canonical way. However, not all such combinations are attested. As we have already seen, some specific readings are rather remote, to say the least. In fact, the direct object of **owe** always seems to be interpreted unspecifically. Let us reconsider (the English translation of) Buridan's classical example:

(1) **I owe you a horse.**

Under the coercion approach, (1) ought to have a reading according to which there is a particular horse that the speaker must give to the hearer:

(80) $(\exists y)\ (\exists N)[\mathbf{H}(y) \wedge \boldsymbol{VN}(N,y,\boldsymbol{i}) \wedge \mathbf{H}(y) \wedge \mathbf{O}(\boldsymbol{i},(\exists z)[N(z) \wedge \mathbf{G}(\boldsymbol{i},z,\boldsymbol{y})])]$

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48 Cf. Zimmermann (2000). As far as I can see, an account of the wide-scope reading (78) in terms of non-Boolean disjunction would be more natural – and, incidentally, in the spirit of the analysis suggested in Rooth & Partee (1982).

49 The ideas expressed in this section were developed in discussion with Joachim Sabel.

A minor worry with this formalization is that it treats obligation on a par with psychological attitudes, which is almost certainly inadequate for independent reasons. In particular, obligations do not depend on the ways individuals mentioned in them are given to those under obligation; rather, it appears that any way of presenting the individuals would do, thus making the first conjunct in the matrix of (80) superfluous. This leads to the following, more adequate formalization, where vividity is weakened to uniqueness:

(80') $(\exists y)\ (\exists N)[\mathbf{H}(y) \wedge (\forall u)[N(u) \leftrightarrow u = y] \wedge \mathbf{O}(\boldsymbol{i},(\exists z)[N(z) \wedge \mathbf{G}(\boldsymbol{i},z,\boldsymbol{y})])]$

In the next subsection, we will see that this substitution of the ordinary *de re* construal for a more objective relation is also needed in other cases. What is of interest to us in the present context is the inadequacy of (80'), i.e. the fact that (1) appears to lack a specific reading. And this is not because such a reading could not be made sense of. In fact, the explicit paraphrase (81) of (1) is ambiguous in precisely the way expected:

(81) **I am obliged to give you a horse.**

The lack of a specific reading seems to be an idiosyncrasy of the verb **owe**, as corroborated by the oddness of sentences like the following:

(82) **I owe you this horse.**
(83) **I owe you Flavellus.**

How can this gap be explained? Why does **owe** shun specificity? (1) ought to be just as ambiguous as (81); and (82) and (83) ought to be perfectly normal. From the coercion perspective all this is quite mysterious.

At first glance, undefinedness may appear natural and helpful: why not *restrict* the meaning of **owe** such that individuals cannot occupy the object slot? The problem with this idea is that, given the coercion approach, it is vacuous: objects are quantifiers anyway, and the sense in which they may be individuals is a derived one. However, blocking all quantifiers that are derived from individuals – in the sense of (80') or whatever may turn out to be adequate – would be too strong: any unique description of an individual corresponds to an existential quantifier, which may be expressible by an indefinite and should thus not be banned as a possible unspecific debt. And the same goes for Montague-lifted individuals, i.e. the quantifiers of the form $(\lambda P\ P(u))$, which would be obtained by a standard quantifying-in mechanism. Hence missing unspecificity remains a mystery.

Not so from the indeterminacy point of view. If no sense emerges from the combination of a verb and an individual-denoting expression, then the verb simply does not express a relation in which a subject can stand to an individual; it only takes unspecific objects as (second) arguments. Hence rather than being of the indeterminate type $e(\{e,q\}(et))$, the relation denoted by **owe** is of the simple type $e(q(et))$. Ignoring the indirect object (which I take to be specific), this is precisely the type of an opaque verb according to the coercion approach. However, with indeterminacy there is no coercion – the object must combine by functional application – and thus no specific reading will be predicted. Instead, (1) only gets one, unspecific reading, whereas (82) and (83) are instances of type clashes – just like (84) where a proposition would have to occupy the position of the direct object, which it cannot, for lexical reasons.

(84) ***I owe you that I give you a horse.**

6.2 Missing Unspecificity

More lexical idiosyncrasies can be found. In particular, there is the mirror-image of missing specificity as encountered in connection with **owe**: *missing unspecificity*. Of course, there cannot be an opaque verb that *never* shows any unspecific readings; for that would meet the defining criterion of transparency. But there are verbs that do *not always* give rise to unspecificity. One of them is **resemble**, which is opaque, as the following example shows:[50]

(85) **Tom's horse resembles a unicorn.**

If Tom had a horse with a bulged forehead, (85) could well be true without there being any unicorns; the horse merely shares some features with any typical, if non-existent, representatives of the species unicorn. And, as expected, there is another, definitely false reading of (85) that says that Tom's horse bears re-

[50] The example is from Zimmermann (1993: 158), where it is used to show that opacity does not imply reducibility to propositional attitudes – thus re-establishing Montague's claim (cf. Section 1.3). In the meantime Roger Schwarzschild (p.c.) pointed out to me that '___ **resembles** …' resembles, i.e. could almost be, ' ___ **could almost be** …'.

semblance to a certain unicorn; this is the specific reading. Now consider:

(86) **Tom resembles a professor.**

Surprisingly, (86) is not ambiguous in the same way.[51] Certainly, there is the specific reading that would be true if Tom (my younger son) looked sufficiently like me. But the unspecific reading according to which he would have to share some properties with a typical professor – forgetfulness and short-sightedness, maybe – does not exist. Given the indeterminacy approach, this gap can be accounted for in various ways. One possibility is to force a specific reading whenever the quantifier $\mathfrak{Q}$ denoted by an indefinite object involves personhood, in the following sense:

(87) A quantifier $\mathfrak{Q}$ of type *q* *involves* a property *P* of type (*et*) iff the following holds:

$$(\forall x)\ [(\mathfrak{Q}y)\ x = y \rightarrow P(x)]$$

I will use the symbol '»' to express involvement. According to (87) the quantifier denoted by **a professor** involves being a person (i.e. the property expressed by **is a person**), whereas the quantifier denoted by **a unicorn** does not. In order to force specificity for quantifiers involving personhood, one may split up the meaning of **resemble** into three subrelations:

- a relation between individuals *x* and *y* where *x* (specifically) resembles *y*;
- a relation between individuals *x* and quantifiers $\mathfrak{Q}$ where $\mathfrak{Q}$ involves personhood and applies to the property of (specifically) resembling *x*;
- a relation between individuals *x* and quantifiers $\mathfrak{Q}$ where $\mathfrak{Q}$ does not involve personhood and *x* unspecifically resembles $\mathfrak{Q}$.

The three parts can then be glued together using the type-transcendent union operation ⊕. More precisely, and relying on a lexical decomposition suggested by Roger Schwarzschild,[52] a plausible analysis of **resemble** looks like this:

(88) $\lambda y\ \lambda x\ (\exists N)\ (\exists M)\ (\exists u)\ (\exists v)\ [\boldsymbol{VN}(N,x,u) \wedge \boldsymbol{VN}(M,y,v) \wedge \Diamond\ (\exists z)\ [N(z) \wedge M(z)]]$

$\oplus$ $\lambda\mathfrak{Q}\ \lambda x\ [\mathfrak{Q}\text{»}\mathbf{P} \wedge (\exists N)\ (\exists u)\ [\boldsymbol{VN}(N,x,u) \wedge (\mathfrak{Q}y)\ (\exists M)\ (\exists v)\ [\boldsymbol{VN}(M,y,u) \wedge \Diamond\ (\exists z)\ [N(z) \wedge M(z)]]]]$

$\oplus$ $\lambda\mathfrak{Q}\ \lambda x\ [\neg\ \mathfrak{Q}\text{»}\mathbf{P} \wedge (\exists N)\ (\exists u)\ [\boldsymbol{VN}(N,x,u) \wedge \Diamond\ (\mathfrak{Q}y)\ N(y)]]$

The idea behind (88) is that specific resemblance holds between two individuals if they are *possibly identical*. Given that the latter notion trivializes when understood as modalized identity between the individuals themselves (collapsing into identity *tout court*), we need to construe it in terms of *de re* modality, thereby introducing vivid names (as used by some unspecified subject).[53] This explains the first part of the relation as well as the second one, which generalizes the first part to the worse case of a quantifier (involving personhood) in object position.The third part reflects the intuition that, in the case of existential $\mathfrak{Q}$, unspecific resemblence is modalized *de re* predication: resembling a unicorn boils down to possibly being a unicorn. The trick is that, by the relativization in the first conjunct, this reading does not arise with quantifiers involving the property of being a person. In fact, the latter always come out as equivalent to their specific readings.

One interesting feature of the indeterminacy treatment of missing unspecificity is that it makes opacity a matter of degree, ranging from *fully opaque* verbs (like **owe**) that only admit unspecific readings, via *ordinary opaque* verbs (like **seek**) that always allow for the characteristic ambiguity, and *mixed* cases (as in **resemble**) to *transparency*, the absence of unspecific readings. It would be interesting to see how much of this range is actually made use of in natural languages, but such an investigation is well beyond the limited scope of this paper.

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51 At least, learning this from the participants in the Rutgers seminar (mentioned in the Acknowledgements) took me by surprise; I have since asked more native speakers only some of whom confirmed the judgement. In any case, I am very much indebted to my informants for this observation as well as the diagnosis in terms of personhood.

52 Cf. fn. 51. The formal implementation is my own.

53 It should be noted that the final conjuncts in the first and the third parts of (88) are, respectively, equivalent to the following conditions, which are more tedious but capture the idea of possible identity more directly:

- $\Diamond\ (\exists x')\ (\exists y')\ [N(x') \wedge M(y') \wedge x' = y']$
- $\Diamond\ (\mathfrak{Q}y)\ (\exists x')\ [N(x') \wedge x' = y]$

In this connection I may also mention that the modality expressed by '◊' is unlikely to be metaphysical possibility, but rather some hightly restricted form of existential quantification over Logical Space; in any case it is far from being well understood (by Roger Schwarzschild, or myself, for that matter).

Despite the parallels between missing specificity and missing unspecificity, the coercion approach can in principle cope with the latter. In fact, restricted generalization to the worst case can be adaped, taking the union of the second and third parts of the relation in (88). This union is a relation of type ($q(et)$) and can be defined in more orthodox type notation, using disjunction in place of type-transcendent union:

(89) $\lambda\mathfrak{Q}\ \lambda x[[\mathfrak{Q}\gg\mathbf{P} \wedge (\exists N)\ (\exists u)\ [\boldsymbol{VN}(N,x,u) \wedge (\mathfrak{Q}y)\ (\exists M)\ (\exists v)\ [\boldsymbol{VN}(M,y,u) \wedge \Diamond\ (\exists z)\ [N(z) \wedge M(z)]]]]$
$\vee \quad [\neg\ \mathfrak{Q}\gg\mathbf{P} \wedge (\exists N)\ (\exists u)\ [\boldsymbol{VN}(N,x,u) \wedge \Diamond\ (\mathfrak{Q}y)\ N(y)]]]$

(89) obviously yields the same readings as (88) whenever a quantified object is interpreted *in situ*. For the specific reading, one needs to employ a *de re* interpretation mechanism. The only obstacle is that resemblance is not a psychological attitude. Hence vivid names should not be relativized to the referent of the (grammatical) subject. One possibility, already indicated in the previous subsection, is to introduce an objective restriction on descriptions of *res*; another option, arguably more adequate in the case at hand, is to follow (88) and existentially generalize the attitude subject, along the following lines:

GDRL ***Generalized*** **De Re** ***Lowering***

The generalized de-re-*lowered version of a relation* $\mathfrak{R}$ *of type q(et) is the following relation of type e(et):*

$$\lambda y\ \lambda x\ (\exists N)\ (\exists u)\ [\boldsymbol{VN}(N,y,u) \wedge \mathfrak{R}(x, \lambda P\ (\exists z)[N(z) \wedge P(z)])]$$

It thus appears that, from the coercion point of view, the choice of the pertinent *De Re* Lowering operation – ***DRL*** vs. ***GDRL*** vs. some objectivized version – would have to be lexically controlled, however this may be done. In any case, applying ***GDRL*** to the relation in (88) yields the desired result; as a somewhat tedious calculation shows, the generalized *de-re*-lowered version of (88) is equivalent to the first component of the indeterminate relation in (87).[54]

The upshot of the discussion of specificity-related lexical gaps is that, as long as the mystery of missing unspecificity cannot be resolved using coercion, the indeterminacy approach has a slight advantage.

7. Conclusions and Prospects

7.1 Summary

Opaque verbs are verbs that admit unspecific readings of indefinite objects. The standard interpretation of opaque verbs, following ideas from Quine and Montague, takes these indefinites to denote existential quantifiers, which may be thought of as standing for unspecific objects, and the opaque verb to express a property of, or a relation to, unspecific objects – the property or relation being the *notional* sense of the verb. Opaque verbs may also be construed like ordinary transparent verbs, thereby expressing their *objectual* sense. In the standard approach to opacity, the objectual sense is derived from the notional sense by a logical transformation, a type shift, which on closer inspection turns out to be inadequate, at least in some cases. Replacing the logical transformation by a more suitable operation that takes into account the mental attitude of the subject to the specific object, naturally leads to the question of whether that extra-logical operation could be part of the lexical meaning of the opaque verb, rather than being grammatically induced, as the standard approach would have it. If so, opaque verbs would lexically express one *indeterminate* sense instead of a notional sense that can be coerced into an objectual sense if need arises. On the face of it, it seems hard to decide which, if any, of these two construals of opaque verbs – the indeterminateness approach or the coercion approach – is more adequate. Three potential pieces of evidence were examined to decide the question.

The first was the phenomenon of *higher-order specificity*, seemingly involving – somewhat paradoxically – specific readings of unspecific objects. The coercion approach should have problems distinguishing the phenomenon from ordinary unspecificity, in particular in cases of co-predication. However, it turns out that higher-order specificity is itself based on an independent coercion mechanism, which allows the specificity-coercion approach to steer clear of any co-predication problems with specific higher-order readings. And the indeterminateness approach does not have any problems with higher-order specificity to being with. Hence the phenomenon does not help deciding between the two approaches.

Secondly, we looked at possibilities for conjoining specific and unspecific attitudes and objects, as they occur in *co-predications* and *mixed coordinate objects*. As to the former, it appears that both coercion and indeterminacy are too generous in admitting co-predications that are clearly felt to be inappropriate. However, it may well be that the over-generated readings can be explained away on pragmatic grounds. In

[54] The proof relies on the properties of the ***V***ivid ***N***ame relation mentioned in fn. 24.

any case, they would not help us decide between the theories, which agree on the pertinent data. On the other hand, mixed coordinations of specific and unspecific objects, seemed to reveal a tiny advantage of the indeterminacy approach – which, however, vanished once a fuller range of data was taken into account. For it proved that mixed disjunctions presented serious problems for both approaches – problems which could presumably be solved by adding a general *de re* mechanism. Again, the data turned out to be inconclusive.

Finally a difference in adequacy between the two approaches to opacity came up in connection with theoretically predicted, but *unattested ambiguities*. The existence of verbs (like **owe**) that do not allow for specific readings is hard to explain from the coercion point of view, whereas in the indeterminateness approach it comes out as a simple type-difference between such verbs and ordinary opaque verbs. The mirror-image phenomenon – missing specific readings in otherwise opaque verbs (like **resemble**) – can be explained in terms of undefinedness on both approaches. But the difference remains: missing specificity can only be accounted for in terms of indeterminateness.

There are bound to be more phenomena that can be used to decide the question. And it may also be that some solution to the puzzle of missing specificity in coercion terms may be found. In other words, I regard the above, largely negative results as a first step to deeper investigation.

7.2 A Final Speculation

The difference between the two approaches to the meaning of opaque verbs lies in the possibility of reducing one of their two senses to the other. According to the coercion approach, the objectual sense can be reduced to the notional sense; according to the indeterminacy approach, the two are merely facets of one overall meaning. The above discussion presupposed that one of these two approaches is right. However, this need not be so. Apart from the rather unattractive possibility of genuine lexical ambiguity (which clearly produces more problems than it solves), there remains the vague hope of reversing the direction of analysis: what if the objectual sense turned out to be the underlying one, with the notional derived from it by some as yet unknown mechanism? After all, this would be a reduction in the plainest sense, viz. an explanation of the (logically) complex in terms of the (logically) simple. Following this lead is definitely beyond this paper – but, I think, not completely off the mark.

Acknowledgements

This paper mainly develops ideas that came up in discussion in a seminar I co-taught with Roger Schwarzschild at Rutgers in the spring term 2000. I owe a great unspecific debt to Roger and all the participants. More specific thanks go to an anonymous reviewer, Nicholas Asher, Joy Grohmann (*née*, and at the time, Trombley), Joachim Sabel, Arnim von Stechow, and Matthew Stone for reasons given in the footnotes; to those native speakers who drew my attention to the data discussed in Section 6; to Rachel Hendery for stylistic suggestions and grammatical corrections; and to the audiences on various occasions that I had to present part of the above material: the *DIP* colloquium (Amsterdam, September 2000), the *Sinn und Bedeutung 2000* (Amsterdam, December 2000), the Berlin semantics *Kreis* (May 2001), and of course the Munich workshop on intensionality.

Appendix: The Logic of Type-Transcendent Union

The type-theoretic language *L* used in the above text is a straightforward implementation of the construction ideas mentioned in footnotes 5 and 31. Here are the most important definitions.

The *basic types* are the symbols *e* and *t*. The set of *types T* is the smallest set that contains the basic types as elements and such that for any $a_1,\ldots a_n, b \in T$: $(\{a_1,\ldots,a_n\},b) \in T$ (for any positive integer *n*); in case $n = 1$, one may write '(ab)' for $(\{a\},b\})$ and omit outer parentheses and commas.

For each $a \in T$, we assume there to be a (possibly empty) set of non-logical constants Con_a and an infinite set Var_a or variables. The *L-expressions* L_a of arbitrary types *a* are defined by the following recursion:

- $Con_a \subseteq L_a$;
- $Var_a \subseteq L_a$;
- '$\alpha(\beta)$' $\in L_a$ whenever $\alpha \in L_{Xa}$ and $\beta \in L_b$, for some $X \subseteq T$ and $b \in X$;
- '$[\lambda x\ \alpha]$' $\in L_a$ whenever $a = bc$, $x \in Var_b$, and $\alpha \in L_c$, for some b, $c \in T$;
- '$(\alpha \oplus \beta)$' $\in L_a$ whenever $\alpha \in L_{Xb}$, $\beta \in L_{Yb}$, and $a = (X \cup Y, b)$ for some X, $Y \subseteq T$ and $b \in T$ such that $X \cap Y = \emptyset$;
- '$(\neg\ \varphi)$' $\in L_a$ whenever $a = t$ and $\varphi \in L_a$;
- '$(\alpha \wedge \psi)$' $\in L_a$ whenever $a = t$ and φ, $\psi \in L_a$;
- '$(\forall x)\ \varphi$' $\in L_a$ whenever $a = t$, $\varphi \in L_a$, and $x \in Var_b$, for some $b \in T$;
- '$(\Box\ \varphi)$' $\in L_a$ whenever $a = t$ and $\varphi \in L_a$.

Other connectives and quantifiers are defined as abbreviations in the usual fashion. A pair $\mathfrak{F} = (U,W)$ is called a *frame* whenever U and W are two non-empty, disjoint sets of *urelements*; these conditions are imposed to guarantee that the domains of distinct types are disjoint. The following definitions assume a frame $\mathfrak{F} = (U,W)$. For any type $a \in T$, the domain D_a of $\mathfrak{F}$-*objects of type* a is defined by the following recursion (on the depth of types):

- $D_e = U$;
- $D_t = \wp(W)$;
- $D_{(\{a_1,\ldots,a_n\},b)} = \{f \mid f\colon (D_{a_1} \cup \ldots \cup D_{a_n}) \rightarrow D_b\}$;

Given a frame $\mathfrak{F} = (U,W)$, an $\mathfrak{F}$-*model* is a pair $\mathfrak{M} = (\mathfrak{F},F)$, where $F\colon \bigcup_{a\in T} Con_a \rightarrow \bigcup_{a\in T} D_a$ such that $F(\mathbf{c}) \in D_a$ whenever $\mathbf{c} \in Con_a$. Likewise an $\mathfrak{F}$-*assignment* is a function $g\colon \bigcup_{a\in T} Var_a \rightarrow \bigcup_{a\in T} D_a$ such that $g(x) \in D_a$ whenever $x \in Var_a$. If g is an $\mathfrak{F}$-assignment, $x \in Var_b$, and $u \in D_b$ (for some b), then $g^{x/u} = (g \setminus \{x, g(x)\}) \cup \{(x,u)\}$.

Given an $\mathfrak{F}$-model $\mathfrak{M} = (\mathfrak{F},F)$ the *denotation* $[\![\alpha]\!]^{\mathfrak{M},g}$ *of* an L-expression a of type a (relative to an $\mathfrak{F}$-assignment g) is an $\mathfrak{F}$-object of type a defined by the following recursion (on the structure of expressions):

- $[\![\mathbf{c}]\!]^{\mathfrak{M},g} = F(\mathbf{c})$, if $\mathbf{c} \in Con_a$;
- $[\![x]\!]^{\mathfrak{M},g} = g(x)$, if $x \in Con_a$;
- $[\![\alpha(\beta)]\!]^{\mathfrak{M},g} = [\![\alpha]\!]^{\mathfrak{M},g}([\![\beta]\!]^{\mathfrak{M},g})$;
- $[\![\lambda x\ \alpha]\!]^{\mathfrak{M},g}(u) = [\![\alpha]\!]^{\mathfrak{M},g^{x/u}}$ whenever $x \in Var_b$ and $u \in D_b$;
- $[\![(\alpha \oplus \beta)]\!]^{\mathfrak{M},g} = [\![\alpha]\!]^{\mathfrak{M},g} \cup [\![\beta]\!]^{\mathfrak{M},g}$;
- $[\![\neg\varphi]\!]^{\mathfrak{M},g} = W \setminus [\![\varphi]\!]^{\mathfrak{M},g}$;
- $[\![(\varphi \wedge \psi)]\!]^{\mathfrak{M},g} = [\![\varphi]\!]^{\mathfrak{M},g} \cap [\![\psi]\!]^{\mathfrak{M},g}$;
- $[\![(\forall x)\ \varphi]\!]^{\mathfrak{M},g} = \{w \in W \mid \{u \mid w \in [\![\varphi]\!]^{\mathfrak{M},g^{x/u}}\} = D_b\}$ whenever $x \in Var_b$;
- $[\![\Box\varphi]\!]^{\mathfrak{M},g} = \{w \in W \mid [\![\varphi]\!]^{\mathfrak{M},g} = W\}$.

Using the above local interpretation as a starting point, global semantic notions (entailment, validity, logical equivalence,…) may be defined in the usual way, by quantifying over all models. For instance, two L-expressions α and β are *logically equivalent* (and hence intersubstitutable *salva denotatione*) – notation: '$\alpha \equiv \beta$' – if $[\![\alpha]\!]^{\mathfrak{M},g} = [\![\beta]\!]^{\mathfrak{M},g}$ for all $\mathfrak{F}$-models $\mathfrak{M}$ and $\mathfrak{F}$-assignments g on arbitrary frames $\mathfrak{F}$. In particular, assuming the symbol '$\equiv$' to be flanked by L-expressions only, the following logical equivalences can be established by routine arguments:

- $(\alpha \oplus \beta) \equiv (\beta \oplus \alpha)$
- $((\alpha \oplus \beta) \oplus \gamma) \equiv (\alpha \oplus (\beta \oplus \gamma))$
- $([\lambda x\ \alpha] \oplus [\lambda y\ \beta])(\gamma) \equiv \alpha^{x}/\gamma$ – provided that no free variable of β occurs in α

where the result α^{x}/γ of replacing free x in α by β is defined in the usual fashion.

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