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RESEARCH ARTICLE

Monotonicity in opaque verbs

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Abstract The paper is about the interpretation of opaque verbs like ''seek'', ''owe'', and ''resemble'' which allow for unspecific readings of their (indefinite) objects. It is shown that the following two observations create a problem for semantic analysis:

(a) The opaque position is upward monotone: ''John seeks a unicorn'' implies ''John seeks an animal'', given that ''unicorn'' is more specific than ''animal''.
(b) Indefinite objects of opaque verbs allow for higher-order, or ''underspecific'', readings: ''Jones is looking for something Smith is looking for'' can express that there is something unspecific that both Jones and Smith are looking for.

Given (a) and (b), it would seem that the following inference is hard to escape, if the premisses are construed unspecifically and the conclusion is taken on its underspecific reading:

Jones is looking for a sweater.
Smith is looking for a pen.
Smith is looking for something Jones is looking for.

It is shown that this monotonicity problem can be solved by analyzing unspecific readings as existential quantifications over the sub-properties of the property expressed by their object.

Keywords Intensional verbs · Opaque verbs

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1 Introduction

1.1 Quantification versus predication

In this paper I will defend a quantificational semantic analysis of the unspecific readings of *opaque* transitive verbs, i.e. verbs that induce a certain kind of ambiguity with respect to their direct object position:[1]

(1a) I owe you a horse.

(1b) Ernest is looking for a lion.

(1c) Tom's horse resembles a unicorn.

(1d) John hired an assistant.

Unlike sentences with ordinary, *transparent* verbs and indefinite objects, each of (1a–d) allows for a reading that cannot be described in terms of existential quantification over the individuals in the extension of the respective noun. Rather, it seems as though the domain of quantification is shifted, as the following naive paraphrases (of the relevant readings) indicate:

(1′a) I owe you an arbitrary horse.

(1′b) Ernest is looking for an intentional lion.

(1′c) Tom's horse resembles a generic unicorn.

(1′d) John hired a would-be assistant.

Neither arbitrary horses, nor intentional lions, nor generic unicorns are animals, and would-be assistants do not have to be assistants.[2] In fact, one may well wonder just what sort of objects the paraphrases in (1′) are supposed to be about. Given their dubious ontological status, an analysis of (1) that can do without them ought to be preferrable to one along the lines of (1′)—*ceteris paribus.* Such analyses have been developed, based on the observation[3] that opaque verbs tend to express propositional attitudes (in a broad sense). Following them, instead of trying to make literal sense of (1′), it is more worthwhile to explore the (admittedly rough) paraphrases under (1″) instead, thereby reducing the strangeness of (1) to an interaction of the lexical meaning of the opaque verb and the ordinary meaning of the indefinite as existentially quantifying over the extension of its head noun:[4]

[1] The sources of the examples (1a), (1c), and (1d) are, respectively: Buridanus (1977: 83), written in the 14th century and apparently the first discussion of opacity; Zimmermann (1993: 158); and Moltmann (1997:12). (1b) is concocted from Quine (1956: 177; 1960: 152), the first modern account of the phenomenon; Quine's original examples involve complications that would lead astray here.

[2] There is an asymmetry between (1d) and the other sentences under (1), and thus between would-be assistants and the other outlandish objects quantfied over in (1): while (1d) implies that there be a specific individual – though not (necessarily) an assistant—that John hired, no such conclusion to specificity can be drawn from any of (1a)–(1c). In a sense, (1d) is specific (with respect to the person hired) and unspecific (with respect to assistanthood) at the same time. It seems to me that this is typical of verbs of creation (among which I would consequently count *hire*), to which I will briefly return in Sect. 5.5.

[3] Quine (1956).

[4] Paraphrases similar to (1″a)–(1″c) have been provided by Montague (1969: 175f.), Quine (1956: 178), Schwarzschild (p.c., 2000), respectively. (1″d) is in the spirit of an analysis of verbs of creation Arnim von Stechow (p.c., 1991) once proposed; cf. von Stechow (2001: 309ff.).

(1″a) I am obliged to see to it that it will be the case that I give you a horse.

(1″b) Jones is trying for it to be the case that Jones finds a lion.

(1″c) Given its outward appearance, Tom's horse could be a unicorn.

(1″d) Jones saw to it that someone would be an assistant.

And semantic analysis does not have to stop here. Since the (underlined) objects of (1) seem to have their ordinary meanings in the paraphrases (1″), it is this meaning that they contribute to the original sentences. Hence an opaque verb may be described as connecting the referent of its subject to this meaning—the sense of an existential quantifier, or maybe the property expressed by a noun.[5] Following this strategy of analysis, then, (1) does not come out as a case of *quantification,* as (1′) would suggest, but rather as a form of *predication.* More precisely, the function of the opaque object would not be to quantify over strange things standing in a strange relation to the referent of the subject, but to denote a certain sense that contributes to a proposition to which the referent of the subject bears a certain attitude determined by the verb. One objective of the present paper is to show that the predication analysis of opacity, in both its variants (quantifiers or properties) encounters a serious, possibly unsurmountable problem that can be avoided by a careful formulation of a quantificational analysis restoring the intuition underlying (1′).

To avoid complications way beyond the logical analysis of opacity, the rest of this paper will almost exclusively be concerned with sentences involving *seek* (or its more colloquial synonym *be looking for).* Though I think that the overall strategy developed here can be applied to other kinds of opaque verbs (including the ones above), this task will have to be deferred to a later occasion. Some hints, and problems, will be presented in Sect. 5.5, though.

1.2 Overview

In Sect. 2, I will discuss the apparently straightforward inference pattern (M↑) and relate it to various versions of the classical Montagovian analysis of opacity:

(M↑) $\underline{\underline{x \text{ is looking for a } P.}}$
$\therefore$ x is looking for a Q.

where $P \sqsubseteq Q$, i.e. Q is more general than P. It will be shown that (M↑) falls out of a simple lexical account of *seek,* which given the Montagovin background, is obtained by combining Quine's paraphrastic treatment of opacity with a Hintikka-style approach to propositional attitudes as universal quantifiers over possibilites. According to this *Quine+Hintikka* analysis, the premiss of (M↑) expresses that whenever x's search is successful there is some P that x finds. If, on the other hand, the lexical meaning of *seek* is construed as *success-oriented* in that the premiss is taken to express that x's search terminates whenever x finds some P, (M↑) cannot be valid. Hence, within the Montagovian framework, the acceptability of (M↑) constitutes evidence in favour of a Quine+Hintikka analysis of *seek.*

[5] This idea was first expressed in Montague (1969: 176f.), where it is also pointed out that the resulting analysis does not depend on the paraphrase. The variant that trades in quantifier senses for properties has been proposed in Zimmermann (1993).

In Sect. 3, I will turn to *underspecific* readings of opaque verbs, as in (2a), if both construed in a non-specific way and as implying (2b)—i.e. roughly in one (unspecific) sense of (2c):

(2a) x is looking for something y is looking for.

(2b) y is looking for something x is looking for.

(2c) x and y are looking for the same thing.

It will be argued that underspecific readings express quantification over unspecific readings. In particular, (2a) will be analyzed along the lines of (3), where each conjunct is taken on its ordinary unspecific reading:

(3) For some P, x is looking for a P and y is looking for a P.

It then follows that, due to ($M\uparrow$), the Quine+Hintikka approach leads to *a Monotonicity Problem* in that it predicts the following pattern of inference to *a common objective* to be valid:

(CO) x is looking for a P.
y is looking for a Q.
$\therefore$ x is looking for something y is looking for.

In Sect. 4, an account of opaque verbs is developed that (a) avoids (CO) and at the same time (b) validates ($M\uparrow$). (a) is achieved by replacing the Quine+Hintikka analysis with a *perfect match* analysis according to which *seek* relates a subject x to a property P whenever x's search is successful just in case x finds some P. (b) is derived by generalizing underspecificity (treated as quantification over properties) and doing away with the original unspecific reading relating the subject to a single property. On this account to opacity, then, predication gives way to quantification. Moreover, it turns out that ($M\uparrow$), which comes out roughly as in (4), is valid, due to the (assumed) transitivity of $\sqsubseteq$; however, since (CO) will be analyzed along the lines of (5), it is a clear case of *non-sequitur*:

(4) For some $X \sqsubseteq P$, x's search is successful just in case x finds some X. $[P \sqsubseteq Q]$
$\therefore$ For some $X \sqsubseteq Q$, x's search is successful just in case x finds some X.

(5) For some $X \sqsubseteq P$, x's search is successful just in case x finds some X
For some $Y \sqsubseteq P$, y's search is successful just in case x finds some Y.
$\therefore$ For some $Z \sqsubseteq P$, x's search is successful just in case x finds some Z and y's search is successful just in case x finds some Z.

Section 5 touches on some remaining issues including specific readings, definite objects, and bare plurals.

2 Monotonicity inferences

2.1 Inference patterns

Consider the following inference:

(6) Jones is looking for a green sweater.
$\therefore$ Jones is looking for a sweater.

The premiss of (6) may be construed as reporting that Jones is looking for a particular sweater, e.g., the one that he had bought for his son's birthday and that he had hidden somewhere in his wardrobe. Given this *specific* construal, the inference is certainly valid, provided that the conclusion is read in an analogous way: if the premiss is true, it is testified by a green sweater which, *qua* sweater, also testifies the conclusion, again on a specific construal. Hence, given a specific construal of both premiss and conclusion, (6) instantiates a familiar pattern of *Existential Weakening* and is therefore akin to:

(7) Jones is wearing a green sweater.
∴ Jones is wearing a sweater.

On the specific construal, the premiss in (6) does not fully specify any particular sweater that Jones is looking for; neither does the premiss in (7) fully specify the sweater he is wearing. Whether or not the speaker is in a position to give such a specification, (s)he does not do so when uttering either of these sentences. However, whether or not the speaker has a particular sweater in mind, the sweater testifying the truth of either of the sentences in (7) would have to be a particular, specific object—as it would have to be for the truth of (6) on the relevant, specific construal. The specificity exemplified by one reading of (6) and the only reading of (7), then, is a semantic property that must not be confused with a pragmatic notion of specification or speaker's reference: the premisses and the conclusions are *specific* in that their truth depends on certain relations holding between Jones and (at least) one specific, though unspecified, object; they are *not specificational* in that neither gives a (full) specification of any such object. In what follows the term *specificity* will always be used in this semantic sense; and we will return to the distinction between unspecificity and non-specification in Sect. 3.

Neither the premiss nor the conclusion of (6) need to be read specifically; unlike their counterparts in (7), they also allow for an *unspecific* construal. This difference is due to the peculiar nature of the verb *seek,* which, unlike the majority of transitive verbs, allows for an unspecific reading. I will refer to verbs like *seek* as *opaque* verbs. According to the unspecific reading of the premiss in (6), Jones would not have to be looking for any sweater in particular, e.g. when he is entering a shop to buy a present for his son's birthday. Is (6) a valid inference, given the unspecific construal of its premiss? It seems so, provided that the conclusion is read unspecifically too: once the truth of the unspecific reading of the premiss of (6) has been established, denying its conclusion appears utterly incoherent. However, this time Existential Weakening cannot be the explanation: the premiss does not seem to have any existential force. Hence another logical principle must be responsible for the inference or, alternatively, it falls out of general principles of assertability.[6] In any case, it is clear that (6) instantiates a general pattern, be it of a semantic or of a pragmatic nature. The pattern is given in (M↑), where P is a less general term than Q, which I have expressed as a bracketed side-condition:

(M↑) x is looking for a P. $[P \sqsubseteq Q]$
∴ x is looking for a Q.

[6] What I have in mind here is a roughly Gricean or Stalnakerian distinction between semantically based inferences that reflect implications between propositions expressed, and pragmatically based inferences that are drawn assuming the reliability of the speaker and other properties of appropriate utterances. The exact nature of this distinction, as studied in Grice (1989) and Stalnaker (1999), is largely irrelevant to my present concerns.

(M↑) is subject to a certain amount of vagueness due to the fact that the very notion of *being less general* does not have sharp boundaries. The idea is that $P \sqsubseteq Q$ holds if it is analytic that the extension of P is a subset of the extension of Q. General worries about analyticity notwithstanding, (6) illustrates that there are perfectly clear cases and I will only be concerned with them.

(M↑) is to be understood as involving the unspecific readings of premiss and conclusion. The Existential Weakening of the specific reading of the premiss will be of no concern to us here, and mixed construals—where one of the sentences is read specifically and the other one is unspecific—are obviously invalid anyway.[7] For the rest of this paper, I will assume that (6) is correct, at least in the sense that whenever the premiss can be used to say something true, then so can be the conclusion. This might be due to a semantic entailment between (the unspecific readings of) the two sentences; but then again it might also be due to pragmatic factors. Both options will be discussed in due course.

It ought to be noted in passing that the inference in (6) cannot be reversed: Jones may be looking for a sweater to give to his son without being biased as to its particular colour. Hence the corresponding pattern (M↓) must be invalid — an observation that will become important in a moment:

(M↓) $\underline{x \text{ is looking for a } Q}$. $[P \sqsubseteq Q]$
$\therefore$ x is looking for a P

2.2 Logical analysis

Any study of the nature of the inference (M↑) must rest on some semantic account of *seek*. My starting point will be the classical Montagovian approach, according to which (transitive) opaque verbs express relations between individuals and quantifiers.[8] This analysis, familiarity with which I will assume, may be motivated in terms of Quinean paraphrases, [9] and I will occasionally rely on corresponding lexical decompositions. (3) is a case in point:[10]

(8) $\text{seek}' = \lambda\mathcal{Q}\,\lambda x\ \text{try}'(x, (\mathcal{Q}y)\ \text{find}'(x, y))$

[7] Cf. Montague (1970: 394). According to Forbes (2003: 53), there must also be *a neutral* reading that truth-conditionally boils down to the disjunction of specific and unspecific construal. I will ignore this possibility throughout this paper.

[8] Montague (1969, 1970, 1973).

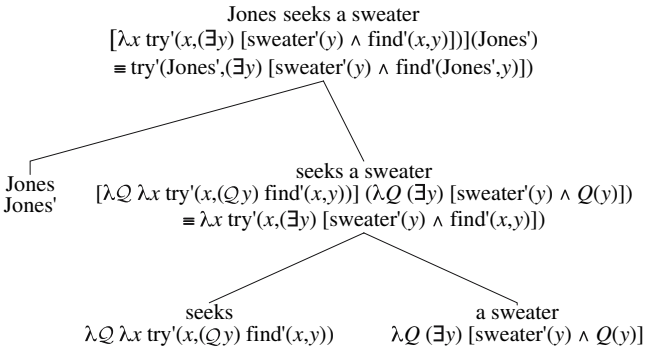
[9] Cf. Sect. 2.3 of Zimmermann (2005) for the relation to the paraphrases given in Quine (1956) and Quine (1960: 151ff.) which, incidentally, involve *strive* and *endeavour* instead of *try*.

[10] In the following I am using a one-layered semantics with sentences denoting propositions (=functions from world-time pairs to truth values), whose type is *t*. In type-logical notation, the denotation of *seek* will thus be of type $((et)t)(et)$. Given this set-up, a *property* P is a function (of a type *at),* whose *extension* is the set of objects (of type *a)* to which P assigns a true proposition. Non-obvious notational conventions are as follows: unless otherwise specified (as, e.g. in (8) below), primed English words are non-logical constants; simultaneous application to a sequence of arguments indicates successive application in the reverse order ('Currying'); a variable bound by a quantifier abbreviates a λ-bound variable in its argument; the equality symbol '=' may flank formulae of arbitrary types and expresses sameness of denotation, not extension.

Though such decompositions oversimplify matters[11] and are not strictly essential for the discussion below, I think that they are helpful in gaining a better understanding of what is going on.

Analyzing opaque verbs as attitudes towards quantifiers immediately accounts for the unspecific reading of the conclusion in (6), provided that the indefinite object expresses a restricted existential quantifier and is combined with the verb by functional application:

(9)

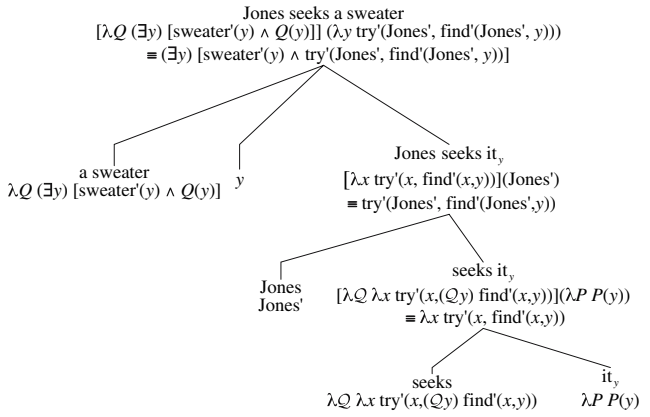


Unspecific objects, then, are—usually existential—quantifiers, and unspecificity comes out as scopally dependent quantification: the sense in which Jones seeks an unspecific sweater according to (9) is the same in which an unspecific woman may be loved by every man if (10) is true on a narrow scope reading of the quantified object:

(10) Every man loves a woman.

In order to also obtain a specific reading, a certain amount of rebracketing is necessary. Montague's classical implementation, which I will adopt here, makes use of a logical form involving *quantifier raising* (a.k.a. *quantifying in*):

(11)



[11] The notorious lack of fine-grainedness of possible worlds semantics may be one such oversimplification. More to the point, (a) the attitude occurring in (8) need not be the one expressed by the English verb *try,* and (b) it ought to be *de se* rather than propositional; also, (c) the unspecific object may in general be of a relational nature. See (a) Larson, den Dikken, and Ludlow (1999), (b) Lewis (1979a), and (c) Burton (1995) for some pertinent discussion. Another simplification – the omission of eventuality parameters—will be addressed in due course.

Specificity thus comes out as quantification into *singular* attitudes whose objects involve particular individuals. Though this in itself is known to be problematic, [12] the intricacies of *de re* attitudes appear to be largely independent of the present considerations, which is why I will content myself with the simple construal given in (11).

2.3 Lexical analysis

The analysis of unspecific objects as quantifiers by itself does not bear on the inference patterns (M$\uparrow$) and (M$\downarrow$). On the other hand, the obvious way to establish (M$\uparrow$) as a semantic entailment is to restrict the interpretation of *seek* by imposing a corresponding condition on admissible models. Since the indefinites in the schemes denote existential quantifiers $\exists_P$ restricted by properties P, the following *monotonicity postulate* does the job:[13]

($\Uparrow_S$) $\quad \Box\,(\forall x)\,(\forall P)\,(\forall Q)[P \sqsubseteq Q \;\rightarrow\; [\text{seek}'(x, \exists_P) \;\rightarrow\; \text{seek}'(x, \exists_Q)]]$

which, given the decomposition (3), boils down to:

($\Uparrow_{TF}$) $\quad \Box\,(\forall x)(\forall P)(\forall Q)[P \sqsubseteq Q \;\rightarrow\; [\text{try}'(x, (\exists y)[P(x) \wedge \text{find}'(x, y)]) \;\rightarrow\; \text{try}'(x, (\exists y)[Q(x) \wedge \text{find}'(x, y)])]]$

Rather than stipulating ($\Uparrow_s$) or ($\Uparrow_{TF}$) as deductive principles, one should, and indeed may, obtain them as consequences of a more thorough, truth-conditional analysis. More specifically, ($\Uparrow_{TF}$) is derivable within a relational approach to propositional attitudes:[14]

(12$\Uparrow$) For any proposition p, individual x, world w and time t the following holds: $[\![\text{try}']\!]\,(p)\,(x)\,(w,\ t) = 1$ iff $p(w', t') = 1$, for any worlds w' and times t' such that $(w, \text{t})\ T_x\ (w',\ t')$.

In (12$\Uparrow$), the *accessibility* relation T_x is supposed to hold between world-time pairs, or *indices,* (w, t) and (w', t') if, and only *if,* (w', t') complies with the goals x pursues in world w at time *t.* The idea is that these goals can be identified with a separation between those indices (w', t') at which x's attempts (in world w at time t) are successful from those (w'', t'') at which they fail or never came about in first place. To say that x tries to bring it about that a given proposition p is true then boils down to a claim about the *success indices* (w', t'), viz. that p holds in all of them.

According to (12$\Uparrow$), the relation try′ is *upward monotonic* (or *positive*) in its right argument:[15] whenever a proposition p implies—i.e. is a subset of[16]—a proposition q, the proposition that a given subject x stands in that relation to p implies the proposition that x stands in the same relation to q. In particular, since the proposition that x finds *some* P implies that x finds some Q whenever $P \sqsubseteq Q$, (12$\Uparrow$) guarantees the

[12] See Sect. 5.1 and the references given there.

[13] In other words, $\exists_P$ is the quantifier $\lambda Q\ (\exists y)\ [P(y) \wedge Q(y)]$. For the present purposes, the relation $\sqsubseteq$ of being less general may be defined as: $\lambda Q \lambda P\ \Box\ (\forall x)\ [P\ (x)\ \rightarrow Q\ (x)]$.

[14] The *locus classicus* of this approach is Hintikka (1969).

[15] See, e.g., Moschovakis (1974: ch. 1), Ladusaw (1979), and van Benthem (1995, ch. 11) for the general notion of monotonicity and its relevance to logic and semantic analysis.

[16] As usual, I identify sets with their characteristic functions relative to an obvious domain—the set of indices, in the case at hand. Also, by *the proposition that …* I mean the set of indices at which … holds.

validity of ($\Uparrow_{TF}$). In other words, given a standard lexical decomposition (8) and a standard modal account (12$\Uparrow$) of the underlying propositional attitude, the resulting analysis (13) of *seek* makes (M$\uparrow$) come out as valid on semantic grounds:

(13) *Quine + Hintikka Analysis of* seek
For any quantifier $\mathcal{Q}$, individual x, world w and time t the following holds:

$[\![\text{seek}']\!]$ $(\mathcal{Q})$ (x) (w, t) = 1 iff the property of being found by x is in the extension of $\mathcal{Q}$ at (w', t'), for any worlds w' and times t' such that (w, t) T_x (w', t').

While (upward) monotonicity may also come about in the absence of (8) or (12$\Uparrow$), it does not have to. The following tentative analysis is a case in point:[17]

(14) *Success-Oriented Analysis of* seek
For any quantifier $\mathcal{Q}$, individual x, world w and time t the following holds:
$[\![\text{seek}']\!]$ $(\mathcal{Q})$ (x) (w, t) = 1 iff (w, t) T_x (w', t'), for any worlds w' and times t' such that the property of being found by x is in the extension of $\mathcal{Q}$ at (w', t').

The idea behind (14) is that a search for an unspecific object successfully terminates as soon as a specific object with the right characteristics has been found: once there is a (specific) green sweater that he finds, the Jones of the premiss in (6) is happy, i.e. he is at an index complying with his goals. (14) thus construes unspecific searches as being directed to *arbitrary* objects of the kind described unspecifically.

Let us note in passing that the success-oriented analysis (14) is compatible with the Quinean decomposition (8) as long as the attitude expressed by *try* is not treated à la Hintikka (12$\Uparrow$). If one takes the following, backward Hintikka approach (12$\Downarrow$) instead, (14) will follow:[18]

(12$\Downarrow$) For any proposition p, individual x, world w and time t the following holds:
$[\![\text{try}']\!]$ (p) (x) (w, t) = 1 iff (w, t) T_x (w', t'), for any worlds w' and times t' such that $p(w', t')$ = 1.

The accessibility relation in (14) and (12$\Downarrow$) being the same, (14) reverses the implicational direction of the truth condition (13) and hence implies the obvious formalization ($\Downarrow_S$) of (M$\downarrow$):

($\Downarrow$s) $\Box$ $(\forall x)$ $(\forall P)$ $(\forall Q)[Q \sqsubseteq P \rightarrow [\text{seek}'(x, \exists_P) \rightarrow \text{seek}'(\text{x}, \exists_Q)]]$

It follows that (14) is incompatible with a semantic account of the inference pattern (M$\uparrow$). Otherwise one would get the unbearable consequence that the premiss of (6) leaves the objective of Jones's search completely open—which is what ($\Downarrow$s) and ($\Uparrow$s) together imply, as the reader may care to verify. However even if, on the basis of (14), some pragmatic explanation to the effect that (M$\uparrow$) is correct could be concocted, one would still have to explain why (M$\downarrow$) is not. And this looks hopeless if (M$\downarrow$) were valid on semantic grounds.

Part of the intuition behind (14) may be saved, without totally giving up on (M$\uparrow$). According to (14), for a search to be successful it is sufficient to find an object matching the description. But then it also appears to be necessary: it is hardly

[17] Forbes (2003: 59) calls this kind of analysis 'happy outcome paraphrases'.

[18] Of course, one must also assume that 'find'' in (8) does express the relation of finding.

imaginable that a search is successfully terminated without a corresponding find. The following analysis thus suggests itself:[19]

(15) *Exact Match Analysis of* seek
For any quantifier $\mathcal{Q}$, individual x, world w and time t the following holds: $[\![\text{seek}']\!]\ (\mathcal{Q})\ (x)\ (w, t) = 1$ iff, for any worlds w' and times t', $(w, t)\ T_x\ (w', t')$ holds iff at (w', t'), the property of being found by x is in the extension of $\mathcal{Q}$.

(15) does not imply (M↓)—as little as it implies (M↑). But maybe the latter could be derived by pragmatic reasoning. Conceivable strategies to this effect will be discussed later, as will be the very adequacy of (15) itself. For now let us note that (15) may also be obtained by the lexical decomposition (8), provided that one assumes an underlying back and forth Hintikka attitude:

(12⇔) For any proposition p, individual x, world w and time t the following holds: $[\![\text{try}']\!]\ (p)\ (x)\ (w, t) = 1$ iff for any worlds w' and times t': $(w, t)\ T_x\ (w', t')$ iff $p(w', t') = 1$.

It thus turns out that, given the Montagovian approach to opacity, the monotonicity behaviour of an opaque verb is contingent on its lexical analysis. Given a Quinean paraphrase, the monotonicity of an opaque verb may be seen to reflect the monotonicity of the attitude underlying it. Since the upward monotonicity inferences (M↑) appear to be warranted whilst downward monotonicity is definitely out, one may conclude that the Quine + Hintikka approach (13) is to be preferred over the other two, because it predicts upward (and bans downward) monotonicity without further pragmatic ado. The exact match analysis (15) is second best in that it is at least compatible with upward (and the rejection of downward) monotonicity, leaving the rest to pragmatic fine-tuning. Ironically, the loser is the success-oriented analysis (14) that reverses the desired monotonicity predictions and leaves little room for pragmatic repair. However, the following section will show that not all is well with upward monotonicity either.

The three lexical analyses discussed above are by no means the only conceivable ones within the Montagovian approach to unspecific objects as quantifiers, not even when one adds the Quinean reduction to propositional attitudes. As a case in point, the following, highly flexible decomposition strategy offers an alternative:

(16) *Varying Attitudes Analysis of* seek
For any quantifier $\mathcal{Q}$, individual x, world w and time t the following holds: $[\![\text{seek}']\!](\mathcal{Q})\ (x)\ (w, t) = 1$ iff, for any worlds w' and times t' such that (w, t) stands to (w', t') in x's (modal) attitude to $\mathcal{Q}$ at (w, t), the property of standing in the relation x intends to stand in to $\mathcal{Q}$ at (w, t) is in the extension of $\mathcal{Q}$ at (w', t').

The idea behind (16) is that the propositional attitude and the embedded relation underlying the unspecific reading of *seek* may change with the circumstances described: John may seek an old unicorn by trying to put himself in a position to see one, whereas Mary may be looking for a tall Norwegian in that she wants to marry one.[20] (16) leaves open which facts determine what a given subject's intentional

[19] Cf. Cooper (2005) for a recent proposal along these lines.

[20] An example supplied by an anonymous referee shows that the pertinent attitude need not even be one of desire: *The ranger is looking for fires in his district.*

attitude in a given situation is, and in what relation he or she intends to stand to a given unspecific object. Thus it may or may not hold that the pertinent attitude is upward monotonic. Even so, since the attitude and the intended relation depend on the unspecific object of pursuit (as represented by the quantifier $\mathcal{Q}$) monotonicity does not necessarily carry over to the whole construction; for, according to (16), '$\mathcal{Q}$' does not only occur in the monotonic context created by the pertinent intentional attitude, but also in the underlined environments where it helps determining that attitude and the relation in its scope; and whether the latter positions are monotonic is left open. For instance, wanting-to-marry may be Mary's attitude towards the object denoted by a *tall Norwegian* but not towards the denotation of a *Norwegian*—in which case ($\Uparrow$s) would fail. Yet even though the varying attitudes are in need of further specification, I can see no reason why (16) could not be turned into a viable analysis. I still refrain from discussing it in the sequel, mainly because I would like to focus on the interaction between lexical monotonicity and logical form and the overall lexical monotonicity properties of (16)—neither ($\Uparrow$s) nor ($\Downarrow$s) are predicted[21]—are close enough to the exact match analysis (15), which is easier to compare to its contestants (13) and (14).

3 The Monotonicity problem

3.1 Monotonicity versus Existential Weakening

Consider the following inference:

(17) Jones is looking for a green sweater.
$\therefore$ Jones is looking for something.

At first blush, (17) looks like a variant of (6). Indeed, the inference may be construed as falling under the upward monotonicity pattern (M$\uparrow$). In particular, still on the understanding that neither the premiss nor the conclusion are read specifically, (17) seems to be as valid an inference as (6). Treating *something* as an unrestricted existential quantifier as in (18), (17) may be formalized as (19a) or, given the decomposition (8), (19b):

(18) $\text{something}' = \lambda P\ (\exists x)\ P(x)$

(19a) $\underline{\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])}$
$\therefore$ $\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)\ P(y)])$

(19b) $\underline{\text{try}'(\text{Jones}', (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge \text{find}'(\text{Jones}', y)])}$
$\therefore$ $\text{try}'(\text{Jones}', (\exists y)\ \text{find}'(\text{Jones}, y))$

[21] – at least not on a natural understanding of the analysis. After all, some perverse interpretation of *pertinence* may render (16) equivalent to (13) or even (15). If, for instance, in every possible world and at every time, trying were everybody's pertinent attitude and finding their intended relation, then (16) would boil down to (13). And (16) collapses into (15) on the following assumptions: (a) any x's modal atttiude to any existential quantifier $\exists_P$ at any given index (w, t) holds between (w, t) and any (w', t') iff either: $(w, t)\ T_x\ (w', t')$ and the property of being found is *not* in the extension of $\exists_P$ at (w', t'); or else it is, but (w', t') is not T_x-accessible from (w, t); (b) no subject ever intends to stand to anything in any relation. Given (a) and (b), the condition in (13) boils down to the denial of (a), which is equivalent to the biconditional in (15).

As we saw in the preceding section, the validity of the inference (19) depends on the lexical analysis of *seek*. On the other hand, given (18), the validity of (17) is a matter of logical form alone once premiss and conclusion receive their *specific readings:*

(20a) $\underline{(\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge \text{seek}'(\text{Jones}', \lambda P\, P(y))]}$
$\therefore$ $(\exists y)\ \text{seek}'(\text{Jones}', [\lambda P\, P(y)])$

(20b) $\underline{(\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge \text{try}'(\text{Jones}', \text{find}'(\text{Jones}', y))]}$
$\therefore$ $(\exists y)\ \text{try}'(\text{Jones}', \text{find}'(\text{Jones}, y))$

However, as I will argue in the following subsection, there is indirect evidence that (17) should come out as an instance of Existential Weakening even if its premiss is not construed specifically. Obviously, in that case the conclusion is neither read as in (19) nor as in (20), but must rather be understood as *quantifying over unspecific objects,* as in (21), where $\mathcal{Q}$ is a variable of type $(et)t$:[22]

(21a) $\underline{\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])}$
$\therefore$ $(\exists \mathcal{Q})\ \text{seek}'(\text{Jones}', \mathcal{Q})$

(21b) $\underline{\text{try}'(\text{Jones}', (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge \text{find}'(\text{Jones}', y)])}$
$\therefore$ $(\exists \text{Q})\ \text{try}'(\text{Jones}', (\text{Q}y)\ \text{find}'(\text{Jones}', y))$

According to the conclusion of (21), Jones's search is directed towards an unspecific object; in that respect this reading is like the unspecific reading given in (19). However, there is a subtle difference. Whereas the conclusion of (21) merely states that there is at least some unspecific object that Jones is after, the conclusion of (19) specifies one such object, viz. the denotation of something′. In terms of the above distinction, the conclusion in (21) is both unspecific and non-specificational. The one in (19), on the other hand, names an unspecific object testifying it and is, in that sense, specificational. In order to have a catchy term for this subtle distinction, I will continue to call the latter construal the (*ordinary*) *unspecific* reading and refer to the former reading as *underspecific.* Let me just add that the distinction between unspecificity and underspecificity is aimed at the quantificational structure of the sentence, not at its content. In fact, under the classical analysis (13), the conclusions of (19) and (21) express the very same proposition: if Jones is looking for something, then—by monotonicity—he must be looking for the most general unspecific object. Still, the sentences do differ in the way in which the proposition is expressed. In the examples to be discussed next this difference will also have an effect on the propositions expressed.

3.2 Quantifying over unspecific objects

(21) can be derived as a reading of (17), using the following translation of *something*:

(22) $\text{something}' = \lambda\prod\ (\exists \mathcal{Q}\ \prod(\mathcal{Q})$

[22] Zalta (1988: 216ff.) discusses inferences like (17) as instances of Existential Weakening; Geach (1965), though never addressing the pattern as such, makes ample use of them. Arguments for, and analyses of, a reading of *something* along the lines of (21) have been given in Moltmann (1997: 20) and Zimmermann (1993: 171f.). The following presentation is based on Sect. 2 of Zimmermann (2005).

Logical translation being a function, there is an obvious conflict between (18) and (22). In order to resolve it, I assume that *something* is ambiguous; this decision is primarily made for expository reasons. Given the close similarity between the two readings—after all, they only differ in logical type, not in substance—it is tempting to try and capture the difference between (18) and (22) with one indeterminate denotation. This would obviously go beyond the scope of the present framework, [23] but then the ambiguity may be felt to be a type-theoretic artefact. I think it is not, but I will not go into the matter here.

In order to see that *something* can indeed be used to quantify over unspecific objects, one may consider examples involving relative clauses:

(23) Jones is looking for something Smith is looking for.

Semantic folklore has it that the relative clause expresses a property obtained by abstracting from the missing object (represented by a *trace* variable) and to be combined with the noun by intersection:[24]

(24) λy try′(Smith′, find′(Smith′, y))

For compositionality reasons, the relative clause must be attached to the noun *-thing* rather than the entire quantifier *something*.[25] As this head noun is void of content, intersection with it has no effect and (24) also serves as the argument to the binary quantifier denoted by *some*. The resulting (standard) interpretation of the object in (23) is:

(25a) $\lambda Q\ (\exists y)$ [seek′(Smith′, [$\lambda P\ P(y)$]) $\wedge$ $Q(y)$]

(25b) $\lambda Q\ (\exists y)$ [try′(Smith′, find′(Smith′, y)) $\wedge$ $Q(y)$]

We thus obtain two readings of (23), depending on whether the object takes scope over the opaque verb (26) or not (27):

(26a) $(\exists y)$ [seek′(Smith′, [$\lambda P\ P(y)$]) $\wedge$ seek′(Jones′, [$\lambda P\ P(y)$])]

(26b) $(\exists y)$ [try′(Smith′, find′(Smith′, y)) $\wedge$ try′(Jones′, find′(Jones′, y))]

(27a) seek′(Jones′, [$\lambda Q\ (\exists y)$ [seek′(Smith′, [$\lambda P\ P(y)$]) $\wedge$ $Q(y)$]])

(27b) try′(Jones′, $(\exists y)$ [try′(Smith′, find′(Smith′, y)) $\wedge$ find′(Jones′, y)])

In the first, wide-scope reading, sentence (23) expresses that Smith and Jones are looking for the same (specific) object; in the second, somewhat unlikely reading, it says that Jones is after anything specifically sought by Smith. However, neither of the two above readings of (23) covers a situation in which both Smith and Jones are looking for a green sweater without either of them being looking for any particular

[23] A type-theoretic framework that allows for such indeterminate denotations as the union of the two analyses of *something* can be found in the appendix to Zimmermann (2005). Let me hasten to add, however, that the treatment of *something* offered in that paper is nevertheless of the ambiguity kind.

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

[25] This complication is well known. See Heim and Kratzer (1998: 82f.) for discussion and references.

sweater. That (23) is true of such a situation is more readily seen by considering the following variant:[26]

(23′) Jones is looking for something Smith is looking for too.

It is obvious how to formalize this—underspecific—reading assuming higher-order quantification, and I do not see how to derive it without that assumption:[27]

(28a) $(\exists \mathcal{Q})$ [seek′(Smith′, $\mathcal{Q} \wedge$ seek′(Jones′, $\mathcal{Q}$)]

(28b) $(\exists \mathcal{Q})$ [try′(Smith′, $(\mathcal{Q}y)$ find′(Smith′, y)) $\wedge$ try′(Jones′, $(\mathcal{Q}y)$ find′(Jones′, y))]

Adapting the standard semantics of relative clauses, we may 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 needed:

It may be noted in passing that, as it stands, the ***H*** reading of *some-thing* is not entirely adequate. Rather, higher-order existential quantification should somehow be restricted because otherwise the quantifier could be instantiated by (lower-order) *nothing* thus allowing for unwelcome inferences like:

(29) I owe you nothing.
∴ I owe you something.

Presumably, the restriction would have to be on (ordinary) existential quantifiers;[28] I will ignore this complication for now and return to it in Sect. 4.2.

Table 1 Types and denotations of *some-thing*

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

[26] According to some speakers, only this variant has the reading in question. I do not know why the addition of *too* should be obligatory here, but I am fairly sure that it is an independent phenomenon pertaining to the semantics and pragmatics of *too.* In any case I will ignore the whole phenomenon altogether and confine myself to the simpler variant (23).

[27] As Martin Emms (p.c., 2004) pointed out to me, there is a connection between this higher-order construal of (23) and Geach's (1967) Hob-Nob sentence. However, there is a difference in that the intentional identity in *Hob believes that a witch blighted his mare, and Nob thinks she killed his sow* involves a(n underlined) personal pronoun where (23) has (a relative pronoun and) a trace. I suspect that the difference is relevant when it comes to accounting for Montague's (1970: 396) rule that 'multiple reference often necessitates transparency'. For it seems to me that the intentional construal only comes about when alternative interpretations of coreference (descriptive, *de re)* are contextually ruled out, e.g. by background assumptions concerning the existence of witches; cf. van Rooy and Zimmermann (1996: 134f.) on this point. On the other hand, the pertinent reading of (23) is quite straightforward, and even more so than any of its contestants, including the *de re* reading (26).

[28] This is what would be expected under the property analysis of Zimmermann (1993), 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 premiss of (29) is at best marginal.

In order to obtain (28) using the analysis given in Table 1, one only needs to generalize the above relative clause treatment to higher-order traces.[29] Applying the same re-bracketing as before, the relative clause in (23) receives the following interpretation:

(29a) $\lambda\mathcal{Q}$ seek′(Smith′, $\mathcal{Q}$)

(29b) $\lambda\mathcal{Q}$ try′(Smith′, ($\mathcal{Q}y$) find′(Smith′, y))

(29) can be obtained by directly combining the trace variable $\mathcal{Q}$ of type q with the opaque verb. Again, the head noun *-thing is* semantically trivial, so that the object of (23) receives the following higher-order interpretation:

(30a) $\lambda\prod(\exists\mathcal{Q})$ [seek′(Smith′, $\mathcal{Q}$) $\wedge$ $\prod(\mathcal{Q})$]

(30b) $\lambda\prod(\exists\mathcal{Q})$ [try′(Smith′, ($\mathcal{Q}$y) find′(Smith′, y)) $\wedge$ $\prod(\mathcal{Q})$]

Of course, this unary (higher-order) quantifier is obtained by the ***H*** interpretation of the determiner *some.* Finally, quantifying (30) into the matrix *Jones is looking for* $\mathcal{Q}$ leads to the desired underspecific construal (28). To summarize, Table 1 allows for the following readings of (23):
The vertical division in Tables 2 and 3 marks the ambiguity of *some-thing* according to Table 1; the horizontal division reflects un-/specificity. It may be noted that one of the four combinations of the interpretive parameters, viz. ***NH,*** is unavailable because

Table 2 Readings of (23), without decomposition

Order → ↓ Scope	**L**ow	**H**igh
Narrow	seek′(Jones′, [λ $\mathcal{Q}$ ($\exists y$) [seek′(Smith′, [λP $P(y)$]) $\wedge$ $\mathcal{Q}(y)$]])	–
Wide	($\exists y$) [seek′(Smith′, [λP $P(y)$]) $\wedge$ seek′(Jones′, [λP $P(y)$])]	($\exists\mathcal{Q}$) [seek′(Smith′, $\mathcal{Q}$) $\wedge$ seek′(Jones′, $\mathcal{Q}$]

Table 3 Readings of (23), using decomposition (8)

	Low	**H**igh
Narrow	try′(Jones′, ($\exists y$)[try′(Smith′, find′(Smith′, y)) $\wedge$ find′(Jones′, y)])	–
Wide	($\exists y$)[try′(Smith′, find′(Smith′, y)) $\wedge$ try′(Jones′, find′(Jones′, y))]	($\exists\mathcal{Q}$) [try′(Smith′, ($\mathcal{Q}y$) find′(Smith′, y)) $\wedge$ try′ (Jones′, ($\mathcal{Q}y$) find′(Jones′, y))]

[29] An anonymous reviewer observed that (apparently) transparent verbs sometimes give rise to higher-order readings, as illustrated by the following examples: (i) *You bought something that I bought too: a tea cozy,* and (ii) *I ate something that you ate too: a slice of pumkin pie*. While I suspect that cases like (i) can be dealt with by reinterpreting *buy as intentionally buy*, I am not sure what to do with (ii). In any case, the phenomenon seems rather restricted (though I don't know in what way), and not entirely parallel to the one under scrutiny: as Moltmann (1997: 6) observes, on the higher-order reading, opaque verbs accept unpersonal proforms even where properties of persons are involved; this does not seem possible for the kinds of uses of transparent verbs as in (i) or (ii), cf.: ?*Reg met something Dora met too, viz. a speaker of Mandarin.*

it leads to a type clash: the verb, being of type $q(et)$, cannot cope with an argument of type $(qt)\ t$. Hence it appears that Tables 2 and 3 list precisely those readings of (23) that can be obtained by letting these two parameters vary as much as possible. However, closer inspection of the interpretation mechanisms reveals that there are more ways of combining them. In particular, one may, as it were, activate the Wide scope parameter twice over by scoping the Higher-order reading of *some-thing* over the opaque verb, at the same time assigning the variable bound by the quantifier wide scope:

(31a) $(\exists\mathcal{Q})\,[\text{seek}'(\text{Smith}', \mathcal{Q}) \wedge (\mathcal{Q}y)\,\text{seek}'(\text{Jones}', [\lambda P\, P(y)])]$

(31b) $(\exists\mathcal{Q})\,[\text{try}'(\text{Smith}', (\mathcal{Q}y)\,\text{find}'(\text{Smith}', y)) \wedge (\mathcal{Q}y)\,\text{try}'(\text{Jones}', \text{find}'(\text{Jones}', y))]$

(31) is true of a situation in which Jones happens to be looking for his favourite pencil, whereas Smith is just after some instrument or other to jot down a note. And more combinations along these lines are conceivable. I suspect that none of them constitutes a genuine reading of (23) and that the parameters underlying Tables 2 and 3 are indeed correct and complete.

3.3 Adding monotonicity

It is now obvious that, even given an unspecific construal of its premiss, the inference (17) comes out as an instance of Existential Weakening. In other words, given the fact that the higher-order analysis of *some-thing* is needed in order to obtain the underspecific ***WH*** reading (28) of (23), the conclusion that it also arises in the conclusion of (17) seems unavoidable. And this is so whether or not the general monotonicity pattern ($M\uparrow$) is valid. One reading of (17), it seems, just does not fall under this pattern but under the pattern ($\exists$) of (higher-order) Existential Weakening.

($\exists$) x is looking for a P.
$\therefore$ x is looking for something.

($\exists$a) $\text{seek}'(x, [\lambda Q\ (\exists y)[P(y) \wedge Q(y)]])$
$\therefore$ $(\exists\mathcal{Q})\,\text{seek}'(\text{x}, \mathcal{Q})$

($\exists$b) $\text{try}'(x, (\exists y)[P(y) \wedge \text{find}'(x, y)])$
$\therefore$ $(\exists\mathcal{Q})\,\text{try}'(x, (\mathcal{Q}y)\,\text{find}'(x, y))$

Given ($\exists$), it is hard to see how the monotonicity pattern ($M\uparrow$) could be upheld. For consider the following inference:

(32) Jones is looking for a green sweater.
Smith is looking for a pink hat.
$\therefore$ Jones is looking for something Smith is looking for (too).

(32) is clearly invalid. Yet it would have to be valid if *seek* obeyed upward monotonicity. For then ($M\uparrow$) will have the unspecifically interpreted premises imply the conclusion if the latter is construed underspecifically:

(33a) $\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])$
$\text{seek}'(\text{Smith}', [\lambda P\ (\exists y)[\text{hat}'(y) \wedge \text{pink}'(y) \wedge P(y)]])$
$\therefore$ $(\exists\mathcal{Q})\,[\text{seek}'(\text{Smith}', \mathcal{Q}) \wedge \text{seek}'(\text{Jones}', \mathcal{Q})]$

(33b) try′(Jones′, (∃*y*)[sweater′(*y*) ∧ green′(*y*) ∧ find′(Jones′, *y*)])
try′(Smith′, (∃*y*)[hat′(*y*) ∧ pink′(*y*) ∧ find′(Smith′, *y*)]
∴ (∃$\mathcal{Q}$) [try′(Smith′, ($\mathcal{Q}$*y*) find′(Smith′, *y*)) ∧ try′(Jones′, ($\mathcal{Q}$*y*) find′(Jones′, *y*))]

The reason why (32) comes out valid given upward monotonicity (M↑) is that the objects in the premisses denote existential quantifiers that are less general than the unrestricted quantifier expressed by the ***L*** reading of *something.*[30]

(34i) [λ*P* (∃*y*)[sweater′(*y*) Λ green′(*y*) ∧ *P*(*y*)]] ⊑ [λ*Q* (∃*x*) *Q*(*x*)]

(34ii) [λ*P* (∃*y*)[hat′(*y*) ∧ pink′(*y*) ∧ *P*(*y*)]] ⊑ [λ*Q* (∃*x*) *Q*(*x*)]

Hence (M↑) may be applied to each of the premisses, leading to the conclusions in (35), where the objects obtain their ordinary unspecific readings:

(35i-a) seek′(Jones′, [λ*Q* (∃*x*) *Q*(*x*)])

(35i-b) try′(Jones′, (∃*y*) find′(Jones′, *y*))

(35ii-a) seek′(Smith′, [λ*Q* (∃*x*) *Q*(*x*)])

(35ii-b) try′(Smith′, (∃*y*) find′(Smith′, *y*))

Thus, starting from the premisses in (32) and using (35) as intermediate steps, the unrestricted existential quantifier [λ*Q* (∃*x*) *Q*(*x*)] turns out to be a witness for the conclusion in (33). The pattern underlying (32) is an *inference to a common objective:*[31]

(CO) *x* is looking for a *P*.
y is looking for a *Q*.
∴ *x* is looking for something *y* is looking for.

The upshot is that either (M↑) is wrong or else (CO) is valid. The latter alternative is rather unattractive. The inference is intuitively inacceptable, and it is unclear why this should be so given its purported semantic validity. The dilemma is that monotonicity inferences and inferences to a common objective go together, and hence blocking or accepting one means blocking or accepting the other. This is the *Monotonicity Problem.*

4 Opacity by type coercion

In the present section I will propose a solution to the Monotonicity Problem that rests on a perfect match analysis of *seek.* To this end, I will first show how a straightforward generalization of the underspecific higher-order reading of *something* to arbitrary indefinites (like a *green sweater)* blocks the critical (CO)

[30] It should be noted that they are also less general than any unspecific object that is more general than their Boolean join. Hence merely blocking the inference to the most general unspecific object (denoted by the ***L*** reading of *something)* doesn't help.

[31] (CO) is reminiscent of the *scope fallacy* (a.k.a. the *illicit quantifier-shift*) that is sometimes held responsible for a faulty reasoning to a first cause, leading from *Everything has a cause* to *Something (viz., God) is the cause of everything*—and from *Both Jones and Smith are wearing a sweater* to *There is a sweater that both Jones and Smith are wearing.*

inferences but preserves (M↑). Hence, the Monotonicity Problem could be solved, if it were not for the original unspecific readings. In Sect. 4.2 I will argue that the latter can be fully replaced by the (generalized) underspecific readings if the Montagovian analysis is given up in favour of a construal of opaque verbs as attitudes towards properties. Sections 4.3 and 4.4 respectively show how the resulting analysis preserves (M↑) and still blocks (CO). In Sect. 4.5 some lexical fine-tuning is added.

4.1 More underspecificity

In Sect. 1 we have seen that the Quine + Hintikka analysis (13) of *seek* leads to upward monotonicity inferences. Hence in the light of the discussion in the preceding section, it looks like it ought to be given up. The success-oriented analysis (14) was bad for the independent reason that it invites downward monotonicity inferences. The exact match analysis (15) is better off than the other two: being inconsistent with both (M↑) and (M↓), it steers clear of the Monotonicity Problem without making obviously false predictions.

While the exact match analysis of *seek* avoids the Monotonicity Problem, it does have a problem with monotonicity: once the original inference (6) is blocked, the question arises why instances of (M↑) appear so straightforward.[32] A conceivable explanation coming to mind resorts to relevance, vagueness, and the shiftiness of standards: perhaps an inference like (6) feels valid because the exact kind of unspecific object Jones is reported to be looking for in the premiss is of no concern for the speaker or hearer. In other words, the difference between (unspecific) sweaters and (unspecific) red sweaters may be *neutralized* to a degree that the more general predicate *(sweater)* is acceptable as a means of referring to the narrower concept.[33] However, if this were so, one would expect the inference to go both ways: once the difference between (unspecific) sweaters in general and sweaters of specific colours is irrelevant, the corresponding downward entailment from conclusion to premiss in (6) ought to be just as acceptable as the original direction of inference. But it isn't. So this reasoning does not help. Since I am not aware of any other pragmatic approach to explain the apparent validity of (6), I will try and capture it by semantic means.

The exact match analysis (15) forces seek′ to be a non-monotonic operator (with respect to the argument corresponding to the direct object). Hence trying to account for (M↑) in semantic terms might appear a hopeless task unless one is prepared to give up the exact match analysis. But it isn't and I am not. For help comes from closer inspection of the inference (17), which was used to motivate higher-order quantification in the previous section and is repeated here solely for the readers' convenience:

(17) Jones is looking for a green sweater.
∴ Jones is looking for something.

As noticed above, (17) looks like a monotonicity inference. Yet, on the underspecific reading of the conclusion, it is not. Rather, as the formalization (36) brings out, it is

[32] At least to most speakers. A few appear to have intuitive difficulties with (M↑), and some even reject it. I will offer some speculation about these speakers' intuitions in the next subsection.

[33] The kind of neutralization I have in mind is made explicit by Lasersohn's (1999) *pragmatic halos*.

an instance of Existential Weakening and therefore valid even according to an exact match analysis of *seek:*

(36) $\underline{\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])}$ [=(21a)]
$\therefore$ $(\exists \mathcal{Q})\ \text{seek}'(\text{Jones}', \mathcal{Q})$

In other words, higher-order Existential Weakening may create an appearance of upward monotonicity. This observation is the key to a solution to the monotonicity problem. The idea is to model the original inference (6) after (36); hence (6) ought to come out as something like:

(37) $\underline{\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])}$
$\therefore$ $(\exists \mathcal{Q})\ [\text{sweater}'(\mathcal{Q}) \wedge \text{seek}'(\text{Jones}', \mathcal{Q})]$

Of course, (37) is not well-formed, let alone valid: as a predicate of type *et,* sweater′ does not take unspecific objects as arguments. In order to turn (37) into a well-formed and valid argument, the right argument of seek′ in the premiss would have to be a witness for the conclusion, which in turn means that the predicate sweater′ would have to be replaced by a higher-order version ↑sweater′ that is applicable to quantifiers:

(38) $\underline{\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])}$
$\therefore$ $(\exists \mathcal{Q})\ [\uparrow\text{sweater}'(\mathcal{Q}) \wedge \text{seek}'(\text{Jones}', \mathcal{Q})]$

The precise nature of the predicate ↑sweater′ is immaterial as long as it guarantees that the quantifier expressed by *a sweater* falls under it. For instance, it is readily seen that either of the following predicates does the job:

(39) $\lambda Q\ (\exists \mathcal{Q})\ (\mathcal{Q}) = [\lambda P\ (\exists y)\ [\text{sweater}'(y) \wedge\ Q(y) \wedge\ P(y)]])$

(40) $\lambda \mathcal{Q}\ \Box\ (\forall P)\ [\mathcal{Q}(P)\ \rightarrow\ (\exists y)\ [\text{sweater}'(y) \wedge\ P(y)]]$

Though not fully equivalent, (39) and (40) do agree on existential quantifiers. Restricting them in that way, we do not have to decide between the two: both may be read as designating unspecific objects that are less general than an unspecific sweater. Let us, for definiteness, adopt the somewhat simpler (39) as a provisional formalization of ↑sweater′ in (38); it will eventually give way to a different analysis. In any case, the predicate ↑sweater′ can obviously be derived from the ordinary reading of the noun in a systematic way, by letting ↑ be the following operator of type $(et)(qt)$:

(41) $\lambda N\ \lambda \mathcal{Q}\ (\exists Q)\ (\mathcal{Q} = [\lambda P\ (\exists y)\ [N(y) \wedge Q(y) \wedge P(y)]])$

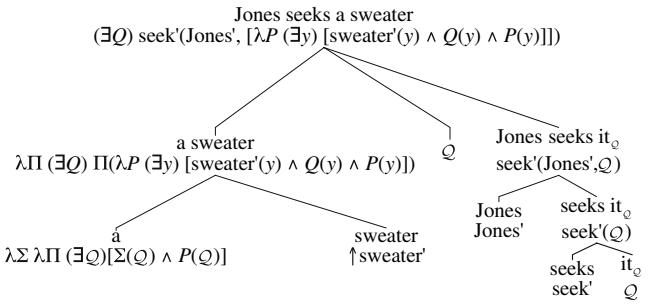
Whatever the source of the re-construal (39) of *sweater,* it is of the right type to combine with the higher-order version (42) of the indefinite article that we already encountered as the ***H*** reading of *some in* Table 1; the result is given in (43):

(42) $a' = \lambda\Sigma\lambda\Pi\ (\exists \mathcal{Q})\ [\Sigma(\mathcal{Q}) \wedge \Pi(\mathcal{Q})]$

(43) $a'(\uparrow\text{sweater}')$
$\equiv$ $[\lambda\Sigma\ \lambda\Pi(\exists \mathcal{Q})\ [\Sigma(\mathcal{Q}) \wedge \Pi(\mathcal{Q})]]\ (\lambda \mathcal{Q}\ (\exists Q)\ (\mathcal{Q} = [\lambda P\ (\exists y)\ [\text{sweater}'(y) \wedge Q(y) \wedge P(y)]]))$
$\equiv$ $\lambda\Pi\ (\exists \mathcal{Q})\ [(\exists Q)\ (\mathcal{Q} = [\lambda P\ (\exists y)\ [\text{sweater}'(y) \wedge Q(y) \wedge P(y)]]) \wedge \Pi(\mathcal{Q})]$
$\equiv$ $\lambda\Pi\ (\exists Q)\ \Pi(\lambda P\ (\exists y)\ [\text{sweater}'(y) \wedge Q(y) \wedge P(y)])$

We thus arrive at the following account of one reading of the conclusion of (6):

(44)



Given this analysis, inference (6) can be obtained by Existential Weakening. According to (44)—and contrary to earlier suggestions[34]—underspecific readings are not peculiar to the 'grammatical' noun *-thing* but *may* also occur with noun phrases headed by ordinary lexical nouns.

The monotonicity effect caused by the wide scope construal (44) is independent of the lexical analysis of *seek* and would also arise on the basis of the Quine + Hintikka analysis (13) and the success-oriented analysis (14). We will have to bear this in mind until we return to the Monotonicity Problem in Sect. 4.3. For the time being, however, let us stick to the exact match analysis (15).

Let me sum up the proposal so far before giving it its final formulation. Inferences like (6) and, more generally, those falling under the scheme (M↑), can be accounted for on the basis of a non-monotonic lexical construal (15) of the opaque verb *seek,* if the object takes wide scope and is given a higher-order reading derivable by re-interpreting its head noun as a predicate of unspecific objects. Given such a construal, the inferences become instances of Existential Weakening.

4.2 Coercion and properties

Though we managed to reconcile the apparent upward monotonicity of *seek* with the exact match analysis, we only did so by assuming an additional, underspecific reading of the conclusion. The ordinary unspecific reading, according to which the object expresses an existential quantifier and takes narrow scope, is still with us. To be sure, that reading still blocks the monotonicity inference, due to the non-monotonicity of the exact match. Hence (6) ought to have a reading according to which the inference does not go through. In other words, the following sentence ought to have a consistent reading that does not involve specificity:

(45) Jones is looking for a green sweater, but Jones is not looking for a sweater.

Surely, this is odd.[35] However, an obvious way out of the embarrassment about (45) emerges once we take a closer look at the derivation of the underspecific reading.

[34] That *-thing* is special in this respect is implicit in the accounts given in Zimmermann (1993: 171f.), Moltmann (1997: 20), and Sect. 2.3 of Zimmermann (2005).

[35] (45) may be rendered consistent on a speech-act construal of negation as denial, roughly paraphrasable as *I am not saying that Jones is looking for a sweater.* Note that this reading also occurs with transparent verbs, as in: *Jones does not drive a car—he drives a Porsche.* I am indebted to Helen de Hoop (p.c., 2004) for helpful discussion at this point. See also Forbes (2003: 57) for some critical remarks.

(44) involves a re-interpretation of the head noun *sweater* as referring to kinds of sweaters, which raises the question what the source of this re-interpretation is. The first guess may be the lexicon: perhaps *sweater* is just polysemous. The following variants of (6) show that matters cannot be that simple:

(46) Jones is looking for a green sweater that he can afford.
∴ Jones is looking for a green sweater.

(47) Jones is looking for a green sweater that he can afford.
∴ Jones is looking for a sweater that he can afford.

If (46) is to be explained along the same lines as (6), its conclusion must be assigned an underspecific reading, viz.:

(48) $(\exists \mathcal{Q})\,[\uparrow \text{sweater}'(\mathcal{Q}) \wedge \uparrow \text{green}'(\mathcal{Q}) \wedge \text{seek}'(\text{Jones}', \mathcal{Q})]$

The problem with (48) is that it not only requires a polysemous interpretation of *green* but also a generalization of adjectival modification to higher-order predicates: just as green′ combines with sweater′ to form a predicate of individuals, so must ↑green′ be combinable with ↑sweater′, resulting in a predicate of unspecific objects (i.e. quantifiers). Moreover, in order to capture (47) in the same way, the lifting operation would have to be performed on the predicate expressed by the relative clause:

(49) $(\exists \mathcal{Q})\,[\uparrow \text{sweater}'(\mathcal{Q}) \wedge \uparrow(\lambda y\ \text{can-afford}'(\text{Jones}', y))(\mathcal{Q}) \wedge \text{seek}'(\text{Jones}', \mathcal{Q})]$

Hence a general process is called for, applying to syntactically complex expressions and turning predicates of type *et* into higher-order predicates of type *qt.* Typically, such *coercion* processes are triggered by some kind of sortal mismatch. In the case at hand, it may not be obvious what this mismatch could consist in. After all, in its ordinary reading, the noun phrase *a sweater* denotes a quantifier, which—*qua* unspecific object—can serve as an argument to the opaque verb *seek,* giving rise to the unspecific reading. It thus looks like no ↑ shift and no ensuing quantifier raising are needed.

The attentive reader will have noticed that the above pessimistic reasoning depends on the assumption that unspecific objects are (existential) quantifiers. On any other approach to unspecificity, there would have to be a conflict between the ordinary denotation of the indefinite object—an existential quantifier—and the opaque verb's demand for an unspecific object. Hence a coercion approach to the higher-order re-interpretation of indefinite objects could possibly be put to work on the basis of an alternative conception of unspecific objects. Given the one-one correspondence between existential quantifiers $\exists_P$ and their restrictions *P, properties* are the prime alternatives to quantifiers when it comes to playing the rôle of unspecific objects.[36] In fact, the exact match analysis is readily reformulated in terms of properties:

(50) *Exact Match Analysis of* seek *(type adaptation)*
For any property P, individual x, world w, and time t the following holds: $[\![\text{seek}']\!](P)\,(x)\,(w, t) = 1$ iff, for any worlds w' and times t', $(w, t)\ T_x\ (w', t')$ holds iff at (w', t'), the set of individuals found by x overlaps the extension of P.

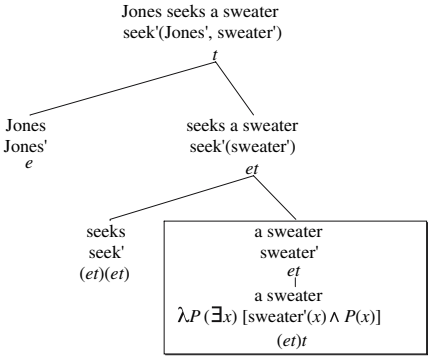
[36] The correspondence between quantifiers and properties is central to the theory of type shifting in Partee (1987). A treatment of properties as unspecific objects has already been given in Zimmermann (1993); the present approach will be compared to it in Sect. 5.5.

(50) preserves the substance of the earlier formulation (15) in that the relation defined here holds between a subject x and a property P at a given index (w, t) iff the relation defined in (15) holds between x and the existential quantifier $\exists p$. However, types have changed, which is why the opaque verb cannot be combined with the quantifier expressed by the object by functional application. The following shift may be used to repair the type mismatch:

(51) *Existential Lowering*
From $\mathcal{Q}$ of type $(et)t$ to $(\lambda x\ (\mathcal{Q}y)\ x = y)$ of type et

When applied to an existential quantifier $\exists_P$, the operation in (51) yields its restrictor P.[37] Existential Lowering may be used to bring the lexical analysis (50) in line with the generalized quantifier interpretation of the indefinite object:

(52)



In the highlighted part of this tree, the operation defined in (51) is applied to the quantifier expressed by the object to obtain a suitable argument for the opaque verb. This kind of type coercion appears necessary in order to derive the ordinary unspecific reading, which is what the analysis (52) boils down to. Arguably, the type conflict between verb and object is what triggers the application of this shift. However, Existential Lowering is not of any help when it comes to underspecific readings. Instead, we may adopt the strategy of the preceding subsection and lift the property expressed by the head noun to apply to unspecific objects. Following the version (50) of the exact match analysis, unspecific objects are properties, and thus the type lift needed here is considerably less complex than the ones envisaged in (39) and (40) above. In fact, the following operation mapping properties of individuals to the their sub-properties is all we need:

(53) *Property Lifting*
From N of type et to $[\lambda P\ P \sqsubseteq N]$ of type $(et)t$
–or, equivalently, to: $\lambda P\ (\exists Q)P = [\lambda x\ N(x) \wedge Q(x)]$

In order for (53) to be applicable to opaque verbs, we must still type-adapt the indefinite article to properties of unspecific objects, which is straightforward:

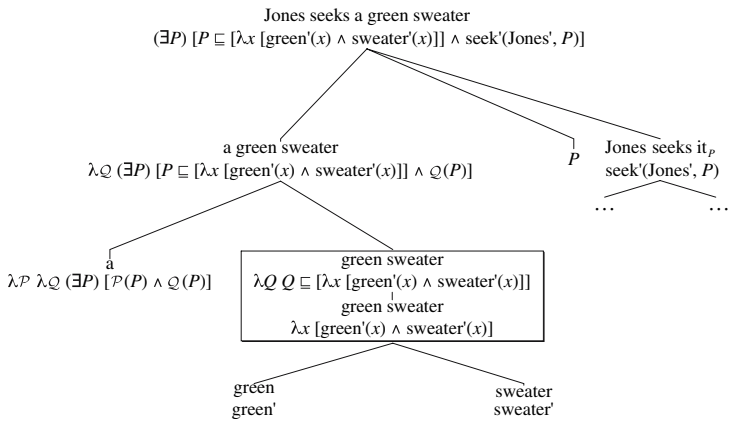
(54) $\mathrm{a}' = \lambda\mathcal{P}\ \lambda\mathcal{Q}\ (\exists P)\ [\mathcal{P}(P) \wedge \mathcal{Q}(P)]$

[37] Cf. Partee (1987: 126), where the operation is called *BE,* because it is based on Montague's (1970: 393) type-logical implementation of Quine's (1960: 152) analysis of the copula *be*.

4.3 Monotonicity revisited

We are finally in a position to give an account of the monotonicity inference (6) within an exact match analysis of *seek*. The relevant reading of the premiss is[38]:

(55)



The box again marks the place where a type shift occurs—this time the one defined in (53). Note that the adjective (which, for simplicity, I take to be intersective) modifies the noun before Property Lifting is applied so that, indeed, there is no need for a special higher-order modification construction. The conclusion of (6) can be derived in a parallel fashion, resulting in (56), which is a logical consequence of [the top formula in] (55):

(56) $(\exists P)\,[P \sqsubseteq \text{sweater}'(x) \wedge \text{seek}'(\text{Jones}', P)]$

(56) follows from (55) by the (assumed) Boolean structure of the space of properties: being a green sweater (=the meet of being green and being a sweater) is less general than being a sweater and thus any P that is less general than the former, is less general than the latter, by the transitivity of being less general; hence if P testifies the premiss, it is also a witness for the conclusion. In fact, using the alternative but equivalent formulation of the type shift (53), the inference from (55) to (56) turns out to be an instance of second-order Existential Weakening. It is obvious that the original inference (6), if construed in this way, is independent of the lexical analysis of *seek* and should therefore occur with all opaque verbs. I think this prediction is correct; an alleged counter-example will be discussed in Sect. 5.5.

[38] Though this is just what Condoravdi, Crouch, and van den Berg (2001a, 2001b) had proposed—albeit with a different motivation (which I will briefly address in Sect. 5.5)—I only became aware of this analysis in the discussion following my presentation of the monotonicity problem at the University of Texas (cf. the final note); the essential proposal—to use a higher-order re-interpretation—was made by Josh Dever, to whom I am deeply indebted. A year earlier, Tim Fernando (p.c., 2001) already suggested to me to replace unspecific readings by wide-scope higher-order quantification and an exact match analysis; at the time he did not convince me, because I was unaware of the Monotonicity Problem and thought of the higher-order formalization as a baroque way of forcing quantifier raising—*pace* May (1985).

Let us compare the underspecific readings of the exact match analysis to the *in situ* construals according to the Quine + Hintikka analysis (13). This is how the unspecific reading of the conclusion of (6) comes out according to the latter:[39]

(57) $[\![\text{seek}']\!]([\![\text{a}'(\text{sweater}')]\!])([\![\text{Jones}']\!])(w, t) = 1$
iff the property of being found by $[\![\text{Jones}']\!]$ is in the extension of $[\![\text{a}'(\text{sweater}')]\!]$ at (w', t'), for any worlds w' and times t' such that $(w, t)\ T_{[\![\text{Jones}']\!]}\ (w', t')$
iff for any worlds w' and times t' such that $(w, t)\ T_{\text{Jones}}\ (w', t')$, there is an object y such that y is a sweater in w' at t' and Jones finds y in w' at t'

Following the property version (50) of the exact match analysis, the truth conditions of the underspecific reading of the same sentence come out as follows:[40]

(58) $[\![(\exists P)\ [P \sqsubseteq \text{sweater} \wedge \text{seek}'(\text{Jones}', P)]]\!](w, t) = 1$
iff for some property $P \sqsubseteq [\![\text{sweater}']\!]$, $[\![\text{seek}']\!](P)[\![\text{Jones}']\!](w, t) = 1$
iff for some property P such that x is a sweater in w' at t' whenever $P(x)(w', t') = 1$ (for any index (w', t') and individuals x), it holds that any worlds w' and times t' satisfy the following condition: $(w, t)\ T_{\text{Jones}}\ (w', t')$ iff the set of individuals found by Jones in w' at t' overlaps the extension of P at (w', t')

A little bit of reflection and/or calculation—which I leave to the reader—shows that (57) and (58) are logically equivalent.[41]

Discounting specificity, there are two combinations of readings that make the monotonicity inference (6) go through. The first is the one we have just seen, i.e. from an underspecific premiss to an underspecific conclusion. Moreover, if the premiss receives its ordinary unspecific reading (derivable by way of Existential Lowering), then the conclusion also follows, albeit only on its underspecific reading—the ordinary unspecific reading being blocked by the exact match analysis of *seek*. And the latter does *not* follow from the underspecific reading (55) of the premiss either. Since the matter is of prime importance for the current approach to opacity, let us look at the alleged consistency of (45) in some detail. Here are the formal versions of the readings in question:

(45) Jones is looking for a green sweater, but Jones is not looking for a sweater.

(59) $[\text{seek}'(\text{Jones}', \lambda x\ [\text{green}'(x) \wedge \text{sweater}'(x)]) \wedge \neg\ \text{seek}'(\text{Jones}', \text{sweater}')]$

(60) $[(\exists P)[P \sqsubseteq [\lambda x\ [\text{green}'(x) \wedge \text{sweater}'(x)]] \wedge \text{seek}'(\text{Jones}', P)] \wedge \text{seek}'(\varepsilon)(\text{Jones}', \text{sweater}')]$

(59) is the conjunction of the unspecific reading of the premiss of (6) with the negation of the unspecific reading (52) of the conclusion; (60) is the conjunction of the underspecific reading (55) of the premiss with the negated unspecific reading of the conclusion. Given the exact match analysis (50), both formulae are consistent. In fact, given that Jones may find sweaters of any colour, the first conjunct of (59)

[39] The final condition in (52) may be made more transparent by recasting it in logical symbolism: $[(\forall w')\ (\forall t')\ [\text{GOAL}_{w,\ t}(\text{j}, w', t') \rightarrow (\exists y)\ [\text{SWEATER}_{w',\ t'}(y) \wedge \text{FIND}_{w',\ t'}(\text{j}, y)\ ]]]$

[40] Again the symbolic version is slightly more transparent:
$(\exists P)\ [(\forall w')\ (\forall t')\ (\forall x)\ [\![P_{w',\ t'}(x) \rightarrow \text{SWEATER}_{w',\ t'}(x)] \wedge (\forall w')\ (\forall t')\ [\text{GOAL}_{w,\ t}(\text{j}, w', t') \leftrightarrow (\exists y)\ [\text{FIND}_{w',\ t'}(\text{j}, y) \wedge P_{w',\ t'}(y)]]]]]$

[41] That (58) implies (57) is obvious; in order to prove the reverse direction, one may instantiate (58) by $P = \lambda y\ \lambda t'\ \lambda w'\ [\text{GOAL}_{w',\ t'}(\text{j}, w', t') \wedge \text{SWEATER}_{w',t'}(y) \wedge \text{FIND}_{w',\ t'}(\text{j}, y)]$

implies the second one, and I take it that it is consistent, i.e. that it is possible for Jones to be satisfied just in case he finds a green sweater. Similarly, if Jones is after no matter which green cotton sweater, then both conjuncts of (60) will be true.

Hence (45) comes out as consistent under two readings.[42] However, it is clear what the source of all the trouble is; if it were not for *the unspecific reading* (52), the inference (6) would go through; and (45) would be inconsistent if it were not for the negation of the unspecific reading.

In fact, the unspecific exact match reading is quite odd anyway. The premiss of (6) just does not seem to express that Jones would be satisfied just in case he found any sweater whatsoever. For instance, under normal circumstances a garment soaked in anthrax powder would be un likely to satisfy his needs; and (61) would not be judged as true under such circumstances just because such an unhealthy piece of clothing would not satisfy Jones:[43]

(61) Jones is not looking for a sweater

Of course, Jones might stop looking for a sweater because he finds a contageous one without realizing it. In that case his search would be over, but it would not be successful: a poisened sweater was not what he was looking for. In other words, under normal circumstances, there is no exact match between finding a sweater and a successful end to Jones's search. Rather, the match concerns sweaters *of the right kind,* i.e. a property that is less general than the one expressed by *sweater.* Thus the richness of Logical Space offers an independent motive for banning the unspecific reading; in general there are far too many possible situations in which the success condition is met if it is only defined in terms of the restriction of the indefinite object. Rather, a further condition ought to restrict the intended objects of search—being free of poison, of the right kind of material, cosy, or what have you. The underspecific reading sneaks such a restriction into the truth conditions by demanding an exact match between the subject′s needs and some *sub-property* of the object′s restrictor. By bringing in the restrictor itself into the success condition, the unspecific reading, however, is more demanding—and consequently less adequate.[44]

The upshot of this observation is that we better eliminate the unspecific reading altogether, leaving unspecific searches to be described in terms of underspecific readings—which, as we have just seen, is equivalent to the ordinary unspecific reading based on the Quine + Hintikka account of *seek.* The property approach to unspecificity has no problem with disposing of the unspecific reading. We just have to do away with Existential Lowering (51) as a coercion strategy, or at least as one that is applicable to indefinite objects of opaque verbs. This would not bear on the underspecific reading, which may still be derived by—quantifier raising and—Property Lifting (53). This, then, leads to our motivation for switching from quantifiers as unspecific objects to properties. Given the otherwise identical analysis of the previous subsection, the apparent non-existence of the unspecific reading is a complete

[42] In view of later refinements of the exact match analysis (cf. Sect. 4.5), the above reasoning turns out to be simplistic. In particular, to show the consistency of (59) and (60), one would have to concentrate on situations in which Jones is not engaged in more than one search.

[43] I owe this example to Graeme Forbes (p.c., 2002). See Forbes (2003: 72) for a similar consideration.

[44] There may be a way of getting around this problem by somehow directly restricting the unspecific reading. For instance, a built-in context-dependence of the object′s restrictor may be a way to go. I leave this option open for further research.

mystery: expressing existential quantifiers, indefinites would be unspecific objects *par excellence,* combinable with the meanings of opaque verbs by the simplest semantic combination, functional application. On the contrary, and as we already noted at the end of the previous subsection, the very existence of underspecific readings is hard to explain if no type mismatch triggers the coercion process (53).

In my (possibly non-representative) experience, the elimination of unspecific exact match readings appears to square most speaker's intuitions about reports of unspecific searches. Yet some of us disagree with the judgments it is based on. Among them are those that perceive an ambiguity between underspecificity and unspecificity, as well as those that deny the existence of underspecific readings. I suspect that their dialects can be accomodated within the present approach by some re-setting of parameters. For instance, the ambiguity is easily accounted for by admitting Existential Lowering (51) as a relevant coercion strategy—just as we did until a paragraph ago; and underspecificity goes away by blocking Property Lifting (53) at the same time. Of course, it would have to be checked that these changes do not cause havoc when it comes to other examples and constructions; but I will leave these matters for further research and concentrate on those dialects in which sentences like (45) force a specific interpretation of (exactly) one of the conjuncts to preserve coherence.

4.4 Common objectives revisited

Having eliminated the unspecific readings, we are left with the specific and the underspecific ones. Since the latter are equivalent to the unspecific readings the classical approach assigns to indefinite objects of opaque verbs, one may wonder what the switch from Quine + Hintikka to the exact match analysis has bought us. Of course, the answer lies in the treatment of quantification over unspecific objects, which gave rise to the Monotonicity Problem. The critical example was:

(23) Jones is looking for something Smith is looking for.

The reading that led to the Monotonicity Problem is one according to which (23) reports Jones and Smith to be looking for the same unspecific object. Given our present reconstruction of unspecific objects, *something* must now quantify over properties rather than (existential) quantifiers—just like the underspecifically construed indefinites obtained by Quantifier Lifting. So in order to borrow the analysis given in Sect. 3.2, the higher-order interpretation of *something* must be adapted as in Table 4, where the abbreviation 'p' has been introduced as an *ad hoc* notation to stress the analogy between the right columns of Tables 1 and 4:[45]

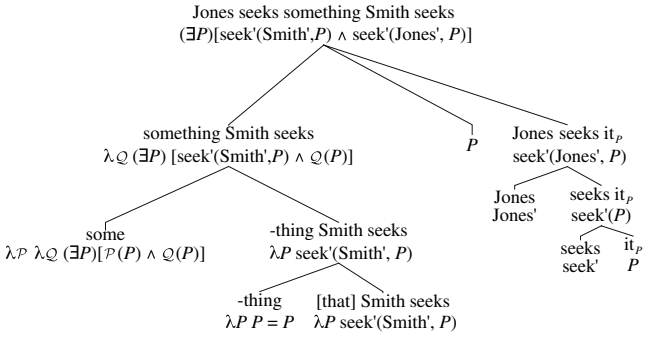
Table 4 Revised types and denotations of *some-thing*

	Lower Order		**H**igher Order
Something	*type*	$(et)t$ [$= pt$]	$(pt)t$
	denotation	$\lambda Q\ (\exists x)\ Q(x)$	$\lambda Q\ (\exists P)\ Q(P)$
Some	*Type*	$(et)\ ((et)t)$	$(pt)\ ((pt)t)$
	denotation	$\lambda P\ \lambda Q\ (\exists x)[P(x) \wedge Q(x)]$	$\lambda P\ \lambda Q\ (\exists P)\ [P(P) \wedge Q(P)]$
-thing	*Type*	et	Pt
	denotation	$\lambda y\ (y = y)$	$\lambda P\ (P = P)$

[45] Note that the ***H*** reading of *-thing* is equivalent to $\lambda P\ P \sqsubseteq [\lambda y(y = y)]$ and is therefore derivable from the ***L*** reading by Property Lifting (53).

We thus arrive at the following property-based formalization of (18):

(62)



The Monotonicity Problem is that, according to the classical approach to opacity, (23) is a semantic consequence of any pair of non-specific search reports about Smith and Jones. More generally, any monotonic lexical analysis of *seek* leads to the following schematic inference to a common objective (repeated from Sect. 3.3):

(CO) x is looking for a P.
y is looking for a Q.
$\therefore$ x is looking for something y is looking for.

Following the standard analysis, the inference goes through if the premisses are given an unspecific interpretation, whereas the conclusion receives a higher-order reading, with *something* quantifying over unspecific objects. The present approach avoids this problem. Although, as we saw in the previous subsection, the underspecific readings of the premisses essentially preserve the truth conditions of the old unspecific readings, they do not jointly imply the higher-order conclusion (62), as long as the latter is based on an exact match analysis. In logical notation, the relevant combination of readings of (CO) comes out as follows:

(CO*) $(\exists P')\ [P' \sqsubseteq P \wedge \text{seek}'(x, P')]$
$(\exists Q')\ [Q' \sqsubseteq Q \wedge \text{seek}'(x, Q')]$
$\therefore$ $(\exists N)\ [\text{seek}'(x, N) \wedge \text{seek}'(x, N)]$

It is obvious that (CO*) is not a valid inference pattern if seek′ is interpreted along the lines of the exact match analysis: standing in the seek′-relation to one unspecific object simply does not affect one's relation to other such objects, be they more general or not. And, to be sure, other combinations of readings do not make the alleged inference pattern any better. So the present analysis does solve the Monotonicity Problem.

The exact match interpretation of seek′ also blocks the special case of (CO) in which P and Q happen to denote the same property. Here is a case in point:

(63) Jones is looking for a sweater.
Smith is looking for a sweater.
$\therefore$ Jones is looking for something Smith is looking for.

Like the general pattern (CO*), the relevant construal of (63)—underspecific premisses, higher-order conclusion—is invalid:

(63*) $(\exists P)\,[P \sqsubseteq \text{sweater}' \wedge \text{seek}'(\text{Jones}', P)]$
$(\exists Q\,[Q \sqsubseteq \text{sweater}' \wedge \text{seek}'(\text{Smith}', Q]$
$\therefore$ $(\exists N)\,[\text{seek}'(\text{Jones}', N) \wedge \text{seek}'(\text{Smith}', N)]$

Appearences to the contrary, this is as it should be. For if Jones is looking for a red sweater and Smith is looking for a green sweater, the premisses in (63) are both true on their underspecific readings but the conclusion is not: Smith and Jones are looking for different things. Similar remarks apply to the following variations of (58) that may bring out the point more clearly:[46]

(64) Jones is looking for a sweater.
Smith is looking for a sweater.
$\therefore$ Jones is looking for the thing Smith is looking for.

(65) Jones is looking for a sweater.
Smith is looking for a sweater.
$\therefore$ Jones is looking for a sweater Smith is looking for.

Due to technical complications with higher-order readings of definite objects, I will have to skip the analysis of (64). However, the means of analyzing the relevant reading of (65) are available. As it turns out, though the conclusion does have an underspecific reading where a trace of type *et* is bound by the implicit relative pronoun, it is not implied by the underspecific readings of the premisses. Neither is the inference correct on any other combination of readings. Inspection of the details is left to the readers.

The above solution to the Monotonicity Problem crucially depends on the elimination of the ordinary unspecific reading; otherwise (CO) would have gone through. On the other hand, the exact match analysis was originally motivated by its non-monotonicity predictions for ordinary unspecific readings. Now we have given up the latter, the question arises which rôle, if any, the exact match analysis plays in the solution to the Monotonicity Problem. After all, the elimination of the unspecific reading was a result of the revision (50) of the exact match analysis (15), when quantifiers as unspecific objects gave way to properties. Clearly, analogous revisions can be formulated for the Quine + Hintikka analysis (13) and the success-oriented analysis (14).[47] However, as far as the former is concerned, this would not help in solving the Monotonicity Problem. For even after discarding the ordinary unspecific readings, the lexical upward monotonicity of the Quine + Hintikka analysis causes the property of being self-identical to be a common objective of all searches, thus validating (CO). Similarly, due to downward monotonicity, the success-oriented analysis (14) makes the property of being self-distinct a common objective of all searches, rendering the contribution of the object in underspecific search reports vacuous. Hence the non-monotonicity of the exact match analysis (15) is vital for the solution of the Monotonicity Problem in terms of underspecific readings.

It may be objected that the current approach merely blocks (CO) by making the conclusion too hard to satisfy, at least if x and y are distinct subjects. For it seems to be almost impossible for two persons to share a goal in the sense required by the

[46] The conclusion of (64) is reminiscent of the higher-order readings discussed in Moltmann (1997: 7), where objects of the form *the same thing* are considered.

[47] … or the varying attitudes analysis (16), which however I continue to ignore.

exact match analysis (15). There is something to this objection, to which I will turn in the course of the next subsection. But let me first list the main ingredients of the analysis of opacity proposed here:[48]

Properties as unspecific objects
Seek expresses a relation between a subject (the seeker) and a property (the unspecific object of search).
Exact match
The relation expressed by *seek* holds true if the seeker's goal is reached just in case (s)he finds a specific object with the unspecific object as a property.
Type coercion
The indefinite object is re-interpreted as (existentially) quantifying over unspecific objects that are more specific than the property expressed by its restrictor.

4.5 Refinements

As it stands, the exact match analysis (15) cannot be correct. Imagine Jones entering a clothes store in order to buy a green sweater for his son and a tie for himself. Clearly the premiss of (6) ought to come out true under the circumstances. However, according to (15), it would not: the indices complying with Jones's goals do not coincide with the indices at which he finds a sweater; rather, they coincide with the indices at which he finds both a sweater and a tie. The problem is not that, according to the exact match analysis, the object of *seek is* uniquely determined—it isn't.[49] The problem is that a subject may have two or more search objectives, each coming with its own success criteria. One may try to get out of this embarrassment by varying the relevant notion of a goal. I think there is a more natural way to go about. Seeking and trying are not just attitudes but rather actions based on, and individuated in terms of, both attitudes and activities.[50] In the case at hand this means that one should distinguish between the goal- directed activities Jones is carrying out in order to find a sweater and the goal-directed activities he is carrying out in order to find a tie. The difference may be intensional in that the two kinds of activities may happen to coincide, as it will typically be the case if neither goal is reached, but also if both are reached simultaneously. Even so the activities *would have* been different, *if* (say) the goals had not been reached simultaneously. In order to account for this interaction of attitude and activity, let us invoke *events*[51] in the evaluation of *seek* by having the accessibility relation T specify the indices at which a particular search act is successfully terminated; under the assumption that the agent depends on the act ε, a further relativization of T to the subject x is not needed:

[48] The analysis presented here also makes use of quantifier raising, which is not itself a type-coercion mechanism though it helps to make the syntactic input interpretable; cf. Heim and Kratzer (1998: 219).

[49] As a matter of fact, it never holds: if x stands in the relation expressed by *seek* to some property P, then x will also stand in that relation to the Boolean meet of P and the property of being found by x.

[50] An anonymous reviewer rightly objects that this observation does not generalize to stative opaque verbs like *need,* which however present the same problem to the analysis developed so far. I suspect that whatever holds of search events may also hold of states of desire, which would consequently have to serve as arguments of the predicate expressed by the verb.

[51] To be sure, that truth-conditions of search reports ought to depend on events in the sense of Davidson (1967) and Parsons (1990) has been noted before—to wit in Forbes (2003).

(66) *Exact Match Analysis of* seek *(Davidsonian refinement)*
For any property P, individual x, world w, and time t the following holds: $[\![\text{seek}']\!]\ (P)\ (x)\ (w, t) = 1$ iff there is a search act ε performed by x in w at t such that any worlds w' and times t' satisfy the following condition: $(w, t)\ T_{\varepsilon}\ (w', t')$ iff the property of being found by x overlaps the extension of P at (w', t').

According to (66), the truth conditions of a search report only depend on the *existence of* a certain kind of act. For the present purposes this narrow-scope policy will be sufficient. A more thorough analysis would employ an event *parameter* as an argument to the verb meaning. Presumably, such a treatment would be needed to cope with adverbial modification anyway, in which case the other analyses of *seek* would be in need of an event parameter too:

(67a) *Quine + Hintikka Analysis of* seek *(Davidsonian refinement)*
For any property P, individual x, world w, and time t the following holds: $[\![\text{seek}']\!]\ (P)\ (x)\ (w, t) = 1$ iff there is a search act ε performed by x in w at t such that the property of being found by x overlaps the extension of P at (w', t'), for any worlds w' and times t' such that $(w, t)\ T_{\varepsilon}(w', t')$.

(67b) *Success-Oriented Analysis of* seek *(Davidsonian refinement)*
For any property P, individual x, world w, and time t the following holds: $[\![\text{seek}']\!]\ (P)\ (x)\ (w, t) = 1$ iff there is a search act ε performed by x in w at t such that: $(w, t)\ T_{\varepsilon}\ (w', t')$, for any worlds w' and times t' such that the property of being found by x overlaps the extension of P at (w', t').

The notion of a search act is to be understood as applying to (possibly very complex) actions performed by subjects and directed at finding objects. More precisely, I take the accessibility relation T to satisfy the following

(SP) *Seeking Postulate*
If ε is a search act performed by an individual x in a world w at a time t, then:
- there are worlds w' and times t' such that $(w, t)\ T_{\varepsilon}\ (w', t')$, and
- for any such (w', t') there is an individual y such that x finds y in w' at t'.

The exact match analysis appears to be in need of yet another amendment. Suppose that Jones is looking for a green sweater while being under the impression that green sweaters are necessarily made of cotton—other materials allegedly being unsuitable for one reason or an other. It would then seem that, by looking for a green sweater, Jones is also looking for a green cotton sweater: any index complying with Jones's goals would have to be one at which the extensions of *a green sweater* and *a green cotton sweater* coincide. However, since Jones is looking for a green sweater, according to (66), the set *GS* of indices at which he finds one would have to coincide with the set *ST* of indices at which his search is successfully terminated. By the same token, since Jones is looking for a green cotton sweater, the set *GCS* of indices at which he finds a green cotton sweater would also have to coincide with *ST*. But then *GS* would have to coincide with *GCS,* which it does not: unbeknownst to Jones, Logical Space contains indices at which he finds a green sweater without finding a green cotton sweater. Again there is an obvious way out. For although $GS \neq GCS$, the two sets do coincide if restricted to Jones's background, i.e. to the indices that are compatible with what Jones takes to be the case. More generally, then, the match

between the goal and the indices at which the unspecific object applies to the specific objects found by the subject could be relativized to the latter's *doxastic perspective.* We thus arrive at the following revision of (66):

(68) *Exact Match Analysis of* seek *(tentative revision)*
For any property P, individual x, world w, and time t the following holds:
$[\![\text{seek}']\!](P)(x)(w, t) = 1$ iff there is a search act ε performed by x in w at t such that any worlds w' and times t' satisfy the following condition:
if $(w, t)\ B_x\ (w', t')$, then $(w, t)\ T_\varepsilon\ (w', t')$ iff the property of being found by x overlaps the extension of P at (w', t').

In (68), B is a subject-dependent accessibility relation that holds between indices (w, t) and (w', t') if, given what the subject believes in w at t, (s)he might be in w′ at t'.[52] From what was said in the previous paragraph, it is clear that the relations T and B are not independent of each other. More specifically, I take it that goals must be subjectively achievable, i.e. that any goal-compliant index must be in tune with what the subject takes to be possible:

(GP) *Goal Postulate*
If ε is a search act performed by an individual x in a world w at a time t, then:
- for any index (w', t') it holds that $(w, t)\ B_x(w', t')$, whenever $(w, t)\ T_\varepsilon\ (w', t')$.

It is possible to account for Jones's confusion in terms of (GP) alone, i.e. without revision (68). For although according to (66), Jones′s (unique) search cannot be directed at *GS* and *GCS* at the same time, this only means that the *unspecific* readings of the reports in (69) could not both be true:

(69a) Jones is looking for a green sweater.

(69b) Jones is looking for a green cotton sweater.

But the unspecific readings we eliminated. What's left are *underspecific* readings, on which both (69a) and (69b) may be true given the circumstances. In fact, if all success indices of Jones's search act ε are such that he finds a green cotton sweater at them, then at all of them he finds something with the property P of being a sweater he finds at a success index of ε. Consequently, given that P is a sub-property of both *GS* and *GCS*, (69a) and (69b) come out true in these circumstances. More generally, in the presence of (GP), (66) suffices to guarantee that whenever a subject does not distinguish between two properties P and Q, then the (underspecific) report that [s]he is looking for some P will come out true just in case [s]he is looking for a Q.[53]

This observation is important when it comes to evaluating the account of (CO) given in the preceding subsection. Let us look at a particular case. (23)—repeated here for the last time—could be true even though Smith and Jones are not after exactly the same kind of sweater; in fact there need not be any sweater that fits both Smith's and Jones's needs—and yet the two may be truthfully reported to be looking for the same thing.

(23) Jones is looking for something Smith is looking for.

[52] Cf. Hintikka (1969).

[53] Given an index (w, t), subject x, and sub-property P' of P suach that, according to (66), $[\![\text{seek}']\!](P)(x)(w, t) = 1$, a property Q' can be constructed by restricting Q to the success indices of x's search.

In particular, Jones may be after something of size 42 whereas Smith, who is taller, needs size 48. Hence (70) would be true, where *Pn* is the property of being a green sweater of size *n:*

(70) $\text{seek}'(\text{Jones}', P_{42}) \wedge \text{seek}'(\text{Smith}', P_{44})$

(70) guarantees that both premisses of (63*), also repeated her, are true:

(63*) $(\exists P)\,[P \sqsubseteq \text{sweater}' \wedge \text{seek}'(\text{Jones}', P)]$
$(\exists Q)\,[Q \sqsubseteq \text{sweater}' \wedge \text{seek}'(\text{Smith}', Q)]$
$\therefore$ $(\exists N)\,[\text{seek}'(\text{Jones}', \text{N}) \wedge \text{seek}'(\text{Smith}', N)]$

Given that Smith's and Jones's goals do not entirely coincide, doubts might be raised as to the truth of the conclusion. However, although Smith's goals do not exactly match Jones's, there may still be a property of sweaters that does exactly match both, in the sense of the analysis—e.g. the property P_{fit} of being a green sweater that fits (the subject).[54] In other words, while (70) does not *per se* guarantee the truth of the conclusion of (63*), (71) does:

(71) $\text{seek}'(\text{Jones}', P_{\text{fit}}) \wedge \text{seek}'(\text{Smith}', P_{\text{fit}})$

The example shows that the conclusion of (CO) may come out as true on the perfect match analysis, even though the goals of *x* and *y* do not fully coincide. It is only required that they can be described in common terms, i.e. by way of a property that is doxastically equivalent to characterisations of the subjects' respective goals.

Before turning to various ramifications of the present approach to opacity, let me offer an equivalent re-formulation of the exact match analysis (66). Though slightly more complicated, it turns out to be particularly useful in Sect. 5.3, when it comes to interpreting bare plurals. The idea behind the present analysis has been that a non-specific report like (69a) is true if Jones is performing a search the success of which depends on him finding an object with a property *P* having which implies being a green sweater. As pointed out above, if such a property *P* verifies (69a), then so does the possibly more specific property *Q* of having *P* and being found by Jones. At any pertinent success index, then, Jones will find *some* object with that property *Q*. And since being *Q* implies being found by Jones, he will indeed have found *all* objects with property *Q* once his search is successful. Hence it ought to be possible to turn the exact match condition on P in (66) from an existential to a universal condition and, roughly, characterize success as finding all *Q* instead of some *P*. This idea can be made precise by introducing *partial properties* corresponding to partial functions from indices to truth values:[55]

(66*) *Exact Match Analysis of* seek *(partialized version)*
For any partial property *Q,* individual *x,* world *w*, and time *t* the following holds:

[54] A proper definition of P_{fit} would require a relational (*de se*) analysis of unspecificity, as indicated in footnote 11 above.

[55] Since properties are functions from individuals to propositions (sets of indices), partial properties ought to be partial functions from individuals to propositions—but they are not. Rather, a partial property *Q* in the sense envisaged here is a function from individuals to partial propositions (partial functions from indices to truth values) such that, for any individuals *x* and *y* and indices (w, t), $Q(\text{x})$ is defined for (w, t) iff $Q(y)$ is defined for *y*. This cumbersome definition could have been avoided by a Frege–Carnap account of properties as functions from indices to sets of individuals.

$[\![\text{seek}']\!](Q)(x)(w, t) = 1$ iff there is a search act ε performed by x in w at t such that any worlds w' and times t' satisfy the following condition: $(w, t)\ T_\varepsilon\ (w', t')$ iff at (w', t') every object in the extension of Q is found by x.

(66*) can be used to give a reformulation of the above analysis of opacity by having the indefinite object quantify over *partial sub properties* of the (non-partial) property expressed by the head noun. The following observation establishes the near-equivalence of the two formulations:

Proposition: *For any (non-partial) property N, individual x, world w, and time t the following holds: there is a property* $P \sqsubseteq N$ *satisfying (a) iff there is a non-empty partial property* $Q \sqsubseteq N$ *satisfying (b):*

(a) there is a search act ε performed by x in w at t such that any worlds w' and times t' satisfy the following condition: $(w, t)\ T_\varepsilon\ (w', t')$ iff the property of being found by x overlaps the extension of P at (w', t');

(b) there is a search act ε performed by x in w at t such that any worlds w' and times t' satisfy the following condition: $(w, t)\ T_\varepsilon\ (w', t')$ iff at (w', t') every object in the extension of P is found by x.

Sub-propertyhood $\sqsubseteq$ holds between partial properties just in case their extensions stand in the subset relation whenever both are defined. Similarly, the non-emptiness condition means that the extension must never be empty if defined. Apart from the latter condition—which will turn out to be negligible when the above Proposition is applied—(a) and (b) respectively correspond to the truth conditions of simple search reports according to (66) and (66*). Hence the Proposition—the verification of which is left to patient readers[56]—does boil down to the equivalence of the two approaches to underspecificity.

5 Further issues

5.1 Specific readings of indefinites

As to the specific readings of the sentences discussed, the present approach has nothing new to offer. Ever since Quine's pioneering work on opacity, it has been widely recognized that specificity can be dealt with in terms of quantifier scope, and I will follow this strategy here. Hence, as in the case of the underspecific reading, the indefinite object outscopes the opaque verb. However, instead of type-shifting the quantifier itself, a coercion mechanism locally applies to combine its trace with the verb. There are basically two possibilities of reconciling the trace of the unshifted quantifier with the argument type demanded by the opaque verb:[57]

(72) *Essential Lifting*
From y of type e to $[\lambda z\ (z = y)]$ of type et

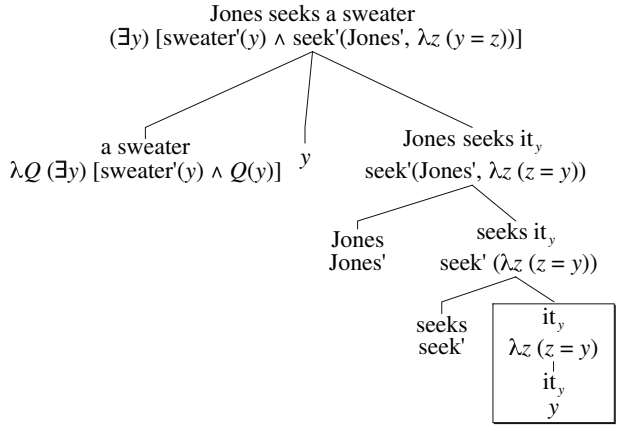
[56] In proving the '⇒', one may construct Q from a given P satisfying *(a)* by letting its extension at a success index be the set of objects in the extension of P and found by the subject—and undefined at all non-success indices. For '⇐' P is constructed from a given Q satisfying (*b*) in the same way—except that it has an empty extension at non-success indices.

[57] I am ignoring a treatment of specificity in terms of lexical indeterminacy discussed in Zimmermann (2005).

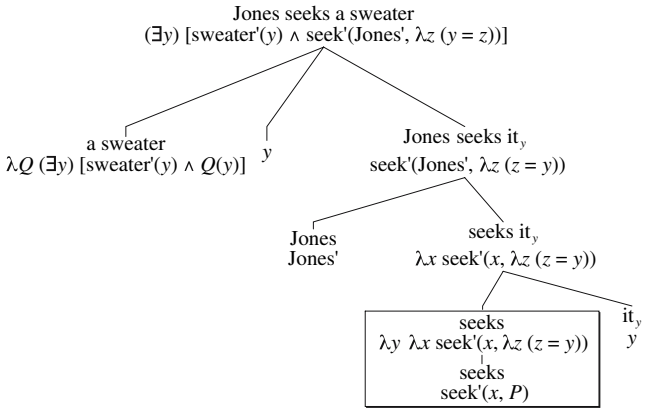
(73) *Argument Lowering*
From $\Re$ of type (*et*)(*et*) to [λy λx $\Re$ (x, λz (z = y))] of type *e*(*et*)

These two mechanisms lead to the same result when applied to simple search reports like the—now specifically interpreted—premiss of (1):

(74)



(75)



The highlighted portion of (74) shows how Essential Lifting (72) turns the individual-denoting trace variable '*y*' into a property term denoting the *essence* of an individual—the property of being identical to the individual denoted by '*y*'. In (75), Argument Lowering (73) has been applied to the opaque verb, leading to a binary first-order relation. Obviously, the result is the same. However, familiar arguments show that it is inadequate.[58] According to (74) or (75), Jones's goal is to find a specific individual; but for this to be the case, he would have to be acquainted with that individual's essence, which is beyond human capacity. Still, the specific reading may well be true, or so it seems. But then we will not bother to give a more careful formulation of its truth conditions here. Let it only be mentioned that it requires the

[58] See Lewis (1981) for relevant considerations.

type shift to occur with the verb, not the object (trace). The analyses of specific readings below will thus be formulated in terms of Argument Lowering; though equally inadequate, it lends itself more easily to repair than Essential Lifting.[59]

One of the most striking differences between the specific and the underspecific reading is that, unlike the former, the latter blocks the inference pattern of *Existential Impact*:

($\exists$) x is looking for a P.
$\therefore$ There is at least one P.

Both the failure and the correctness of ($\exists$) are readily explained. On the underspecific reading of the premiss, ($\exists$) fails because a sub-property Q of P that testifies the premiss need not be instantiated; it just has to match Jones's needs. On the specific reading, though, the individual that testifies the premiss must satisfy two conditions: its essence must match Jones's needs, but it must also itself instantiate P; in particular, then, it would have to be a witness to the conclusion. This difference between the two readings would be brought out more clearly in a logical notation that marks substitution resistance: in the formalization of the underspecific reading, P occurs intensionally; its position in the specific reading is purely extensional. In that respect the present analysis follows the usual explanation of the ambiguity in terms of scope.

5.2 Definite descriptions

So far we have only considered indefinites as objects to opaque verbs. Yet, as Quine has already observed, [60] definite descriptions appear to give rise to ambiguity too:

(76) Jones is looking for the boss.

According to one construal of (76), Jones's search is directed at the property B of being the unique individual that is identical to the boss (of a contextually given business). According to another construal, he would be looking for a particular person, and the speaker identifies that person as the unique individual that happens to have property B without Jones necessarily knowing this. Interestingly, on the second construal, but not on the first one, the object of (76) may be replaced by a co-extensional description *salva veritate.* It is therefore natural to extend the ambiguity between underspecific and specific readings to definite descriptions as objects. Indeed, according to the Russellian account (77), [61] definite descriptions *are* existential quantifiers, viz. ones coming with particular uniqueness restrictions:

(77) $\text{the}' = [\lambda P\, \lambda(Q)\exists y)\, [[\underline{\lambda y}\ \underline{(\forall z)}\ \underline{[P(z)}\ \underline{\leftrightarrow(z} \equiv \underline{y)}]](y) \wedge Q(y)]]$

One may thus expect the following Russellian explication of the perceived ambiguity:

(78) $(\exists P)\ [P \sqsubseteq [\lambda y\ (\forall z)\ [\text{boss}'(z) \leftrightarrow (z = y] \wedge \text{seek}'(\text{Jones}', P)]]$ underspecific

(79) $(\exists y)\ [(\forall z)\ [\text{boss}'(z) \leftrightarrow (z = y)] \wedge (\exists P)\ P \sqsubseteq [\lambda z\ z = y] \wedge \text{seek}'(\text{Jones}', P)]$ specific

[59] See Sect. 3 of Zimmermann (2005), where a reformulation of Argument Lowering along the lines of Kaplan (1968) is given.

[60] Quine (1960: 152).

[61] Russell (1905). I am relying on the generalized quantifier version due to Montague (1970: 393).

(78) and (79) are indeed adequate formalizations of (76), provided that seek′ is construed according to the exact match analysis (66), or (66*). In the case of (79), I cannot fully substantiate this claim, because that would involve a more differentiated analysis of attitudes *de re* than the above naive treatment allows for. On the other hand, it is easy to see that (79) is true just in case there is precisely one boss and the corresponding indefinite report (76′) is true according to the construal given in the previous subsection. Hence any improvement of that approach to specificity should carry over to (78), provided the latter comes out as the specific reading of (76).

(76′) Jones is looking for the boss.

Concerning (78), one may wonder whether quantification over less general properties than unique identifications is really needed to account for reports on non-specific searches. However, the close analogy to the interpretation of indefinites pays off once we consider unspecific objects that are not instantiated in the actual world. Here is a pertinent scenario. Suppose Jones goes to a bar and meets a lady who he feels attracted to and therefore would like to see again. Due to some misunderstanding, he erroneously believes her to be the boss of the company he wants to make business with; as a matter of fact it is worker-owned. On the following day, when paying a visit to the company, his first objective is to find the boss. (76) is clearly true of this scenario, and certainly not on its specific reading (79). But note that under the circumstances, it is not true that Jones is engaged in a search that is successful just in case he finds the (one and only) boss of the company: all his success-indices are such that the boss he finds is the lady he met the night before, and hence a possible situation in which he finds the boss who happens to be a bearded hag would not be what he is after. Hence there is no perfect match between Jones's goal and the property of being the boss. Rather, his search aims at finding the lady boss who he has met the night before, who has a certain outward appearence, a pleasant voice, etc. In other words, the possible situations that satisfy his desires are such that he finds someone who instantiates a sub-property of being the boss—just as the underspecific reading (78) would have it.

(79) can be directly derived by inserting the Russellian formula (77) into the specificity construal given in the previous subsection. In order to obtain (78), the uniqueness condition must apply at the individual level, not the property level, and it must apply to the original restrictor of the noun, which could be achieved by brute force, e.g. by the following rather outlandish type adaptation:

(80) $\text{the}' =$
$\lambda\mathcal{P}\ \lambda\mathcal{Q}\ (\exists N)\ (\exists P)\ [(\forall Q)\ [\mathcal{P}(Q) \leftrightarrow (Q \sqsubseteq N)] \wedge P \sqsubseteq (\lambda y\ (\forall z)\ [N(z) \leftrightarrow (z = y)])$
$\wedge\ \mathcal{Q}(P)]$

Although, as the reader may verify, (80) can be used to derive (78) as a reading of (76), I think there are a more natural ways to achieve the same result. Instead of treating the definite article as a quantifier, it may be interpreted as forming individual concepts. Since this 'Fregean' strategy is at odds with the present 'Russellian' interpretive framework,[62] I leave the details to the reader.

[62] In the present framework the only index-dependent objects are the truth values of propositions (cf. fn. 10), which is why there are no individual concepts. Kaplan' s (1975) method of transposing Frege-Churches (with individual concepts) to Russellia (the land of no individual concepts) does not preserve types and is thus of no help here.

As an alternative strategy, one may analyze the definite article as an existential determiner that applies to properties that have undergone a uniqueness test.[63] Since the details of such an analysis are beyond the scope of this paper, I leave it to another occasion.

5.3 Bare Plurals

In his dissertation, Greg Carlson pointed out a surprising asymmetry between singular in definites and bare plurals:[64]

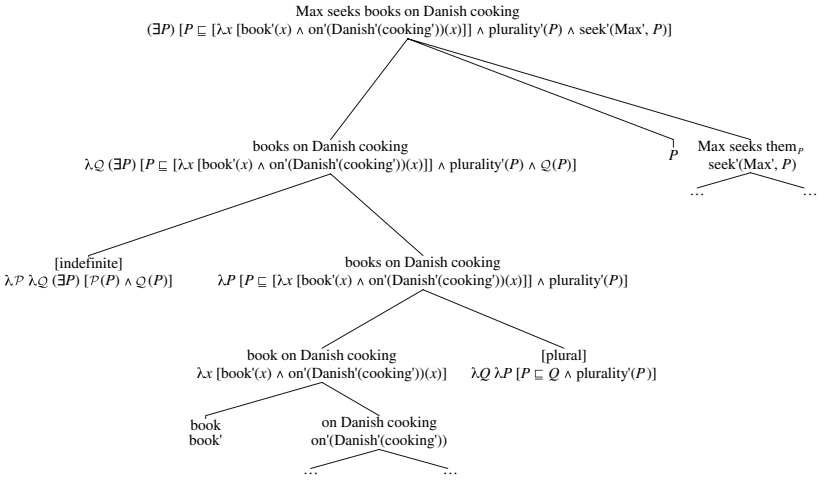
(81a) Max is looking for a book on Danish cooking.

(81b) Max is looking for books on Danish cooking.

Like (81a), (81b) has a non-specific reading; in fact, the two readings are hard to tell apart. This observation appears to speak in favour of a traditional analysis of bare plurals as the plural analogues of singular indefinites. However, in contrast to (81a), (81b) does not have a specific reading.

The present approach to opacity offers a natural explanation of Carlson's asymmetry. It turns on the exact type assignment. If singular indefinites express existential quantification over individuals, then plural indefinites ought to be existential quantifiers over pluralities of individuals. What, then, is the type of a plurality of individuals? If pluralities of individuals were themselves individuals, then bare plurals would be of the same type as singular indefinites and thus ought to induce the same ambiguity. If, on the other hand, pluralities were properties of individuals (with sets of individuals as their extensions), then bare plurals could quantify over the object argument of an opaque verb. This suggests the following account of (81b):

(82)



[63] In a more thorough treatment of definite descriptions one could implement this test as a presupposition. However, since I want to steer clear from the projection problem, uniqueness and existence will be dealt with conjunctively, in the spirit of Russell (1905).

[64] Carlson (1977: 9), example (10); I omitted the emphasis on the opaque predicate.

The obvious interpretation of the second-order predicate plurality' implicit in the interpretation of the plural feature is:

(83) $\text{plurality}' = \lambda P \,\Box\, (\exists x)\, (\exists y)\, [P(x) \wedge P(y) \wedge x \neq y]$

Given this interpretation, (81b) comes out as reporting that Max stands in the seek′-relation to a property that is necessarily instantiated by more than one book. Given the perfect match analysis (66), this would be consistent with Max′ search being successful even if he only finds one book—as long as there are two books of the desired kind around: (66) only requires him to find one token from the plurality he stands in the seek′-relation to. This is clearly wrong: if Max is looking for books, he will not content himself with a single one. On the other hand, if Max is looking for *a* book, one should be enough for him.

This is where the reformulation (66*) of the perfect match analysis comes into play: according to it, the Max of (81b) would have to find all instances of the property in question for his search to be successful; and since that property is a plurality, he will have to find more than one.[65] On the other hand, the Max of (81a) contents himself with one book, which means that the property to which he stands in the seek′-relation is a *singularity* in the following sense:

(83′) $\text{singularlity}' = \lambda P \,\Box\, (\exists x)\, (\forall y)\, [P(y) \leftrightarrow y = x]$

The singularity condition (83′) may be the contribution of the singular feature, or else part of the meaning of the singular indefinite article; another option is to obtain plurality by a default mechanism triggered by the absence of a singular feature. I will the matter open.[66] In any case, both plurality and singularity imply non-emptiness. As a consequence, and given the Proposition mentioned at the very end of Sect. 3, (82), is true just in case there is a sub-property of the property expressed by *book on Danish cooking* that satisfies (83) and to which Max stands in the seek′-relation according to (66); an analogous remark applies to the singular counterpart of (82). I suspect that it is also possible to account for certain downward monotone objects like *at most three books in* a similar fashion, i.e. by suitably restricted existential quantification over non-empty (partial) properties; but I will leave these matters future investigation.

5.4 Coordinated objects

The following inference from non-specifically read premisses is easily captured, provided that *and* is assigned a straightforward type-shifted interpretation, as in (85).

(84) Jones is looking for a candle.
Jones is looking for a match.
∴ Jones is looking for a candle and a match.

(85) $\text{and}' = \lambda\Sigma_{qt}\lambda\Pi_{qt}\lambda\mathcal{Q}_{\text{q}}[\Sigma(\mathcal{Q}) \wedge \Pi(\mathcal{Q})]$

[65] Hence (83) must be understood as a condition of partial properties P defined only for indices at which P is defined. The necessity operator thus comes with an implicit definedness condition.

[66] Cf. Sauerland (2004).

Given (85), the conclusion of (84) comes out as equivalent to the conjunction (86) of the two premisses, as the reader may care to verify. It should be noted that (86) does not say that Jones is engaged in a single search for two objects, which may be rendered as (87), if we avail ourselves of the lexical decomposition of *seek*:

(86) $[(\exists P)\ [P \sqsubseteq \text{candle}' \wedge \text{seek}'(\text{Jones}', P)] \wedge (\exists Q)\ [Q \sqsubseteq \text{match}' \wedge \text{seek}'(\text{Jones}', Q)]]$
$[\equiv\ [(\exists P)\ [P \sqsubseteq \text{candle}' \wedge \text{try}'(\text{Jones}', (\exists y)\ [P(y) \wedge \text{find}'(\text{Jones}', y))]] \wedge$
$(\exists Q)\ [Q \sqsubseteq \text{match}' \wedge \text{try}'(\text{Jones}', (\exists z)\ [Q(z) \wedge \text{find}'(\text{Jones}', z))]]$

(87) $(\exists P)\ (\exists Q)\ [P \sqsubseteq \text{candle}' \wedge Q \sqsubseteq \text{match}' \wedge \text{try}'(\text{Jones}', [(\exists y)\ [P(y) \wedge \text{find}'(\text{Jones}', y)] \wedge (\exists z)\ [Q(z) \wedge \text{find}'(\text{Jones}', z)]])$

According to the present analysis, (86) is true if Jones is both engaged in a search ε that is successful just in case he finds some particular kind of candle, and in a search ε′ that is successful iff he finds a particular kind of match. Since the possibility of finding only one of the desired objects cannot be excluded, either of ε and ε′ may be successful without the other one; in particular, then, $\varepsilon \neq \varepsilon'$. According to the perfect match analysis (66) of *seek,* (87) is true if Jones is performing a search act ε″ that is successful just in case he finds both a candle and a match. Since there are possible situations in which he finds only one of the desired objects, either of ε and ε′ may be successful without ε″ being successful; in particular, then, $\varepsilon' \neq \varepsilon'' \neq \varepsilon$. So the truth of the premisses in (84) does not by itself guarantee the truth of (87). In order to achieve that effect, one would need the background assumption that the two distinct searches Jones is engaged in according to the premisses add up to one combined search he performs. The principles governing such cumulations of searches depend on the exact nature of the underlying event ontology with which I do not want to concern myself here. But even if (87) can be shown to follow from (86), it is by no means obvious that it also constitutes a separate reading of the conclusion of (84). Though technically implementable once the eventuality parameter is allowed to occur in logical forms (and not just in spelt out lexical entries as I have been assuming for simplicity), such a reading would create problems when it comes to the inverses of (84):

(88a) Jones is looking for a candle and a match.
∴ Jones is looking for a candle.

(88b) Jones is looking for a candle and a match.
∴ Jones is looking for a match.

These inferences look as cogent as (84). And they come out on the reading (86) of the premiss (and an underspecific reading of the conclusions); obviously they also come out valid on a double specific reading (with a specific conclusion), as well as on various mixed readings (with varying conclusions). This seems right: there is no way of understanding the premiss that does not imply each conclusion (on at least one reading). However, (87) does not imply any of them (on any reading); if Jones's search is only successful in case he finds both a candle and a match, then he does not have to be engaged in a search that is successful just in case he finds some particular kind of candle. And this time no general assumptions about the structure of events will turn the non sequitur into a valid

inference. For the general pattern (89) underlying (88) contradicts the perfect match analysis. More precisely, if we attribute to the schema (89) a reading (89′), then that reading only satisfies the inference pattern (90) on the monotonicity condition (91):

(89) x is looking for a P and a Q.
(89′) $[(\exists P')\ (\exists Q')\ [P' \sqsubseteq P \wedge Q' \sqsubseteq Q \wedge \text{try}'(x, (\exists y)\ (\exists z)\ [\ P(y) \wedge Q'(z) \wedge \text{find}'(x, y) \wedge \text{find}'(x, z))]$

(90a) $\underline{\text{x is looking for a } P \text{ and a } Q.}$
$\therefore$ x is looking for a P.

(90b) $\underline{\text{x is looking for a } P \text{ and a } Q.}$
$\therefore$ x is looking for a Q.

(91) $(\forall x)\ (\forall P)\ (\forall Q)\ [\![P \sqsubseteq Q \wedge \text{seek}'(x, P)] \rightarrow \text{seek}'(x, Q)]$

Given a reading (89′) of the premiss, the pattern (90) taken in its full generality, implies (91). For if x stands in the relation seek′ to $P \sqsubseteq Q$, then any situation in which x finds a (particular kind of) P will be a situation in which x finds a particular kind of Q; hence (89′) is true, and thus, by (90b), x would thus also stand in the relation seek′ to Q. Obviously the argument turns on the possibility of instantiating P and Q by the same individual y found by x. So the following revision of (89′) suggests itself as a possible reading of (89) that does report the subject to be engaged in a single search:

(89″) $[(\exists P')\ (\exists Q')\ [P' \sqsubseteq P \wedge Q' \sqsubseteq Q \wedge \text{try}'(x, (\exists y)\ (\exists z)\ [P'(y) \wedge Q'(z) \underline{\wedge\ x \neq y} \wedge \text{find}'(x, y) \wedge \text{find}'(x, z))]$

The difference between the two purported readings of (89) lies in the underlined conjunct: according to the (89″), subject x is after finding two *distinct objects.* I see no reason why such a reading should not be in accordance with the perfect match analysis. In fact, I suspect that it would come out of a thorough treatment of (possibly non-Boolean) plural conjunction.[67] But I cannot go into these matters here. Suffice it to say that no scoping mechanism for the event parameter would be needed in order to derive (89′) as based on a plural reading of the conjoined object in (89).

Yet another reading of conjunctively coordinated objects becomes available when their head nouns express compatible properties:

(92) Jones is looking for a companion and a lover.

(93) Smith is looking for a good restaurant, and a cheap one.

(92) and (93) each can be understood as reporting Jones to be looking for just one individual—someone who would be both a companion and a lover, and a good and a cheap restaurant, respectively. It is not obvious how to derive these readings. Maybe the conjunction applies to the existentially lowered conjuncts, which are then property-lifted; however, existential quantification would still have to be added by yet another type shift. The same combination could help explain the ambiguity in:

(94) Jones is looking for a candle or a match.

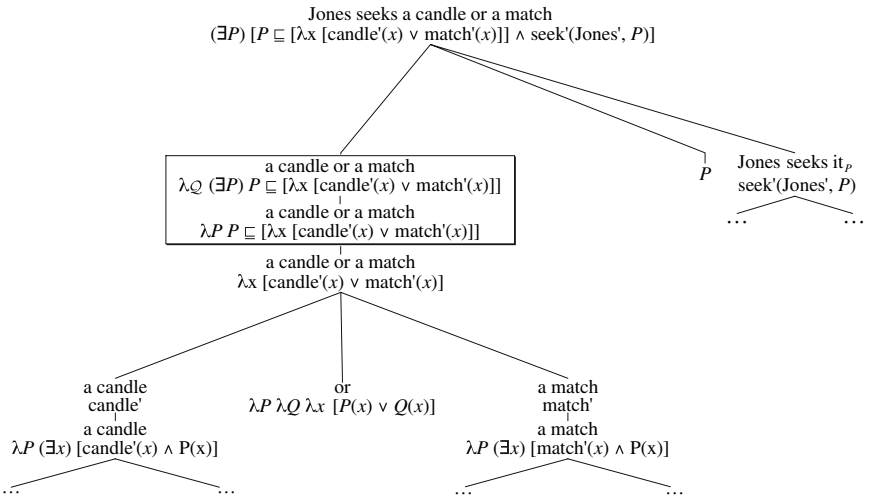
[67] I suppose the (non-) Booleanity of plural conjunction, addressed in Winter (2001), is orthogonal to the present problem. In any case, there would have to be some *proviso* to ensure the distinctness of the denotations of the conjuncts.

On one construal, (94) is equivalent to (95), which could be accounted in terms of a disjunctive analogue (85):[68]

(95) Jones is looking for a candle or Jones is looking for a match.

However, (94) may also be understood as reporting a single search activity of Jones's, one that successfully terminates once Jones has found a particular kind of candle or a particular kind of match. This reading is not easily captured on the current approach; but it may be covered by the combination of type shifts just indicated:

(96)



The highlighted part makes use of an otherwise unnecessary and possibly over-generating operation of Existential Closure. Moreover, (96) also involves the equally dubious operation of Existential Lowering (51), discussed and dismissed in Sect. 4.2 above. Another reason why (96) may arouse suspicion is that it is implied by either of its disjuncts. While this may be explained away by familiar Gricean reasoning, the impression that the purported implicature is virtually impossible to cancel is not so easily dismissed. A non-Boolean interpretation of *or* thus seems to fare better here.[69] Though the details of such an approach are certainly delicate, the following remarks should indicate that it is not so wide of the mark. The idea is to interpret *or* as presenting a conjunctive list of alternatives within an independently given space:

(97) $\text{or}' = \lambda p_{\text{t}}\, \lambda q_{\text{t}}\, \lambda \Gamma_{tt}\, (\exists p')\, (\exists q')$
$[\Box\, [p' \rightarrow p] \wedge \Box\, [q' \rightarrow q] \wedge \Diamond p' \wedge \Diamond p' \wedge \Diamond\, [p' \wedge q'] \wedge \Box\, [\text{B}_\Gamma \leftrightarrow [p' \vee q']]]$

According to (97), (binary) clausal *or* combines the two propositions expressed by the disjuncts with a sentential operator, which may be expressed overtly or else left

[68] As noted in Partee and Rooth (1983), this reading is not derivable in the classical approach of Montague (1973), which has no problem in predicting the one in (96) below.

[69] Forbes (2003: 60ff.) arrives at a similar conclusion, tracing back the idea of non-Boolean *or* to Makinson (1984); the following sketch is inspired by Geurts (2005), a derivative of Zimmermann (2000); I have made several simplifications for presentational reasons.

implicitly epistemic. The entire *ensemble* expresses that the base of the operator, i.e. the set of worlds it quantifies over, [70] can be (bi-) partitioned in a way that each the disjunct is implied by one of the cells. Without going into the general motivation behind (97), let me directly type-adapt it to make it applicable to cases like (94):

(98) $\text{or}' = \lambda\Sigma_{qt}\ \lambda\Pi_{qt}\ \lambda\Gamma_{(et)t}\ (\exists P' \sqsubseteq P)\ (\exists Q' \sqsubseteq Q)\quad [\Diamond\ (\exists x)\ P'(x) \wedge \Diamond\ (\exists x)\ Q(x) \wedge \neg\ \Diamond\ (\exists x)\ [P'(x) \wedge Q'(x)] \wedge \Box\ (\forall x)\ [\text{B}_\Gamma\ (x) \leftrightarrow [P'(x) \vee Q'(x)]]$

With (98), the higher-order readings of the disjuncts in (94) may be directly coordinated and quantified into the matrix *John is looking for P.* Under the assumption that the base of the matrix is *maximal* (in the obvious and usual sense[71]), (94) then comes out as:

(99) $(\exists P' \sqsubseteq \text{match}')\ (\exists Q' \sqsubseteq \text{candle}')\quad [\Diamond\ (\exists x)\ P'(x) \wedge \Diamond\ (\exists x)\ Q'(x) \wedge \neg\ \Diamond\ (\exists x)\ [P'(x) \wedge Q'(x)] \wedge max_p\ \text{seek}'(\text{Jones}', P) \sqsubseteq \lambda x\ [P'(x) \vee Q'(x)]]$

The formula roughly says that being an intended object of Jones's search amounts to being either a special kind of candle or a special kind of match. This looks adequate. Moreover, given the non-emptiness constraints on the disjuncts—typical of the modal approach to disjunction—the unintuitive inference from the disjuncts to the disjunction is blocked. I hope that these remarks suffice to convince the reader that the non-Boolean approach to (129) is worthy of further exploration—but not here and now.

5.5 Some other verbs

So far I have only been concerned with one opaque verb, viz. *seek.* Yet, as indicated in Sect. 1, the analysis developed here is meant as analysis of opacity (as characterized there) in general. In this section I will take a brief look at some further cases, among them some that may be expected to cause trouble for the present approach.

To begin with, the analysis directly carries over to those verbs that can be paraphrased in terms of a propositional attitude. The very first example given in this paper is a case in point. Relying on the paraphrase *be obliged to give,* the following analysis of *owe* is straight-forward:[72]

[70] If the operator happens to be a standard modality, its base should coincide with the *modal base* in the sense of Kratzer (1991). In general a canonical definition of *base* may be given in terms of generalized quantifier theory. For instance, the notion of a *main base* as defined in Lerner and Zimmermann (1983: 295) may be adapted.

[71] If the base is determined as indicated in the previous footnote, one needs assume that the intended object of search is unique, i.e. that at the success indices Jones only finds one object.

[72] As Ron Artstein (p.c., 2000) observed, (100)—or (101), for that matter—cannot be the whole story about owing: a bank clerk might have an obligation to give me a certain sum without actually owing it to me. According to (100), the indirect object of *owe* is transparent. The analysis could be easily adapted so as to accommodate to opacity if need be. As noted in Sect. 1.3 of Zimmermann (2005), there appears to some dialectal variation in this respect.

(100) *Perfect Match Analysis of* owe
For any property P, world w, time t, and individuals x and z the following holds: $[\![\text{owe}']\!](z)(P)(x)(w, t) = 1$ iff there is an obligation ω that x has in w at t such that for all worlds w' and times t' it holds that ω is fulfilled in w' at t' iff there is an individual y given to z by x at t' in w' such that $P(y)(w', t') = 1$.

It is obvious that (100) can be obtained by strengthening the truth conditions typical of a Quine + Hintikka account:

(101) *Quine + Hintikka Analysis of* owe
For any property P, world w, time t, and individuals x and z the following holds: $[\![\text{owe}']\!](z)(P)(x)(w, t) = 1$ iff there is an obligation ω that x has in w at t such that for all worlds w' and times t' where and when ω is fulfilled, there is an individual y given to z by x at t' in w' such that $P(y)(w', t') = 1$.

Apart from the additional argument corresponding to the indirect object, (101) closely resembles the Quine + Hintikka analysis (69a) of *seek* given in Sect. 4.5. And it is plagued with the Monotonicity Problem, subsuming any two distinct debts under one common obligation, as the reader is kindly invited to verify.

Since the analysis of opacity proposed here predicts that monotonicity is a matter of logical form, opaque verbs that block upward monotonicity inferences, and a fortiori ones that invite downward monotonicity inferences, would come as a surprise. The expectation appears to be borne out. In particular, the (transitive) verb *prevent,* which has been claimed to be downward entailing in its right argument, [73] does invite upward monotonic inferences:

(102) Jones prevented a fire disaster.

(103) Jones prevented a disaster.

(104) Jones prevented a disastrous earthquake.

(102) may be true if Jones extinguished the flames before they could spread. Given such a scenario, there would not have been a particular disaster that Jones prevented; in fact, there might not have been any disaster whatsoever. So transitive *prevent* is clearly opaque, allowing for an non-specific reading of an indefinite object. Moreover it appears that (102) cannot be true without (103) being true, thus confirming the present analysis. And the same kind of scenario may be used to illustrate the falsehood of (104). In particular, then, (103) does not imply (104), i. e. downward monotonicity does not hold, as expected by the analysis proposed here. To complete it, let me sketch a lexical entry[74]:

[73] Condoravdi et al (2001a: 164). The authors offer negative polarity as a diagnostic for downward monotonicity, thereby relying on the classical analysis of Ladusaw (1979). Nevertheless, as far as logical form is concerned, the analysis they come up with is the same as the present one, and hence attributes upward monotonicity to the object position of opaque verbs.

[74] Something similar to conditions *(a)* and *(b)* in (105) has been proposed in Condoravdi et al. (2001a: 167; 171f.) as part of the truth conditions.

(105) *Lexical Analysis of* prevent
For any property P, individual x, world w, and time t, the following holds:
$[\![\text{prevent}']\!](P)(x)(w, t) = 1$ iff there is an act ε performed by x in w at t such that the following two conditions hold:
(a) the extension of P in w at t is empty;
(b) the extension of P in w' at t is non-empty for any w' that minimally differs from w in that x does not perform ε in w' at t.

Condition (b) expresses a causal dependence between the non-existence of certain objects and the subject's unspecified act in terms of a common reconstruction of counterfactuality:[75] according to (105) and the present analysis, (102) says that, had it not been for some activity of Jones's, a fire disaster would have occurred. This looks correct. If so, the object position of *prevent* is not downward monotone. To see this, one may consider Jones who has prevented a fire disaster by closing the windows and extinguishing the flames in time. Had he not done that, a fire disaster would have happened that would have killed between 1 and 10 persons. Hence Jones stands in the relation characterized in (105) to the property F of being a fire disaster. And maybe he also stands in that relation to the properties K_1 and K_{10} of being a fire disaster that kills one person and 10 persons, respectively. To be sure $K_1 \sqsubseteq F$ and $K_{10} \sqsubseteq F$. But then we also have $K_{110} \sqsubseteq F$ even though a fire disaster killing 110 persons would not have ensued had Jones acted less prudently. Hence there is a sub-property of F to which Jones does not stand in the relation expressed by *prevent* according to (105). Consequently, given (105), *prevent* does not create downward monotonicity.

Although (105) was not derived by strengthening a corresponding Quine + Hintikka analysis of *prevent,* it does contribute the non-monotonicity needed in explaining the observations made in connection with (102)–(104). I contend that similar, causal analyses can be given of verbs of creation that are intensional and yet appear to be transparent in that they do not seem to involve unspecificity. Here is a case in point:[76]

(106) *Lexical Analysis of* paint
For any property P, individual x, world w, and time t, the following holds:
$[\![\text{paint}']\!](P)(x)(w, t) = 1$ iff there are an individual y and a painting act ε performed by x in w at t such that the following two conditions hold:
(a) $P(y)(w, t) < P(y)(w, t')$, for some t' after t;
(b) $P(y)(w, t') = 0$ for any w' and t' such that t' is after t and w' minimally differs from w in that x does not perform ε in w' at t.

The idea behind (106) is that, in order for a subject x to paint a portrait, there has to be some object y (a piece of canvas, say) to which x applies paint and which becomes a portrait, i.e. (a) y was not a portrait before x applied paint to it, and (b) y would not have become a portrait if x had not applied paint to it. Again, the argument position of paint′ comes out as nonmonotonic, but upward monotonicity inferences like (107) are predicted to be correct (under the natural lexical asumption that self-portrait′ is a sub-property of portrait′):

[75] Stalnaker (1968), Lewis (1973).

[76] Note that (106) accounts for one reading of *paint* only; cf. Zimmermann (2006) for other readings and relations among them.

(107) Vincent painted a self-portrait.
∴ Vincent painted a portrait.

(107′) $(\exists P)[P \sqsubseteq \text{self-portrait}' \wedge \text{paint}'(\text{Vincent}', P)$
∴ $(\exists P)\,[P \sqsubseteq \text{portrait}' \wedge \text{paint}'(\text{Vincent}', P)$

Though this seems correct, there remains the problem that verbs of creation do not induce the ambiguity characteristic of other opaque verbs. In fact, indefinites in their object positions are just as specific (in the sense employed here) as in ordinary transparent verbs. This intuition is corroborated by the fact that they are accessible to discourse and donkey anaphora:

(108a) Vincent painted a picture. It was a self-portrait.
(108b) Whenever a Dutchman paints a picture, it is a portrait of his spouse.

If *paint* is analysed as an opaque verb, the fact that the underlined indefinites and pronouns in (108) can be construed as coreferential appears a mystery; which I will not resolve here.

Let me finally turn to the closely related resultative verbs, which do not allow for (upward) monotonicity inferences, even though they could be given a lexical analyzed in close analogy to the above treatment of verbs of creation—witness the following analysis of (one reading of) the speech act verb *proclaim*:

(108) *Lexical Analysis of* proclaim
For any property P, individuals x and y, world w, and time t, the following holds:
$[\![\text{proclaim}']\!]\,(\text{P})(y)(x)(w, t) = 1$ iff there is a proclamation ε performed by x in w at t such that the following two conditions hold:
(a) $P(y)(w, t) < P(y)(w, t')$, for some t' after t;
(b) $P(y)(w, t') = 0$ for any w' and t' such that t' is after t and w' minimally differs from w in that x does not perform ε in w' at t.

(108) differs from (106) in two details only: the (somewhat vague) specification of the event parameter (painting versus proclamation), and the rôle played by the affected object, which is an argument of proclaim′ but existentially quantified away in the analysis of paint′. Still, the latter difference appears to correlate with monotonicity behaviour. For the following kind of inference is invariably bad with resultative verbs:

(109) Giuseppe proclaimed Italy a republic.
∴ Giuseppe proclaimed Italy a state.

In the light of (109), the present analysis of opacity should not be carried over to resultatives, which instead ought to be construed as expressing non-monotone attitudes towards propositions denoted by the small clauses they embed.

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References

van Benthem, J. (1995). *Language in action* (2nd ed.). Cambridge, MA. MIT Press

Buridanus, J. (1977). *Sophismata.* Stuttgart. Frommann-Holzboog [originally Paris 1350; English translation: *Sophisms on Meaning and Truth.* New York 1966: Appleton-Century-Crofts.

Burton, S. (1995). Six issues in choosing a husband: Possessive relations in the lexical semantic structures of verbs. Rutgers University dissertation.

Carlson, G. N. (1977). Reference to kinds in English. University of Massachusetts dissertation.

Condoravdi, C., Crouch, D., & van den Berg, M. (2001a). Preventing existence. In *Proceedings of the international conference on formal ontology in information systems*. (pp. 162–173). Ogunquit, Maine.

Condoravdi, C., Crouch, D., & van den Berg, M. (2001b). Counting concepts. In *Proceedings of the 13th Amsterdam colloquium*. (pp. 67–72). Amsterdam.

Cooper, R. (2005). Austinian truth, attitudes and type theory. *Research on Language and Computation*, 3, (pp. 333–362)

Davidson, D. (1967) The logical form of action sentences. In N. Rescher (Ed.), *The logic of decision and action*, (pp. 81–95). Pittsburgh: University of Pittsburgh.

Forbes, G. (2003). Meaning postulates, inference, and the relational/notional ambiguity. *Facta Philosophica*, *5*, 49–74.

Geach, P. (1965). A medieval discussion of intentionality. In Y. Bar-Hiliel (Ed.), *Logic, methodology and philosophy of science*. (pp.425–433). Amsterdam. North Holland.

Geach, P. (1967). Intentional identity. *Journal of Philosophy*, *64*, 627–632.

Geurts, B. (2005). Entertaining alternatives: Disjunctions as modals. *Natural Language Semantics*, *13*, 383–410.

Grice, P. (1989). *Studies in the way of words*. Cambridge, MA: Harvard University Press.

Heim, I., & Kratzer, A. (1998). *Semantics in generative grammar.* Oxford: Blackwell

Hintikka, J. (1969). Semantics for propositional attitudes. In J. W. Davis et al. (Eds.), *Philosophical logic*, (pp. 21–45). Dordrecht: Reidel

Kaplan, D. (1968). Quantifying in. *Synthese*, *19*, 178–214.

Kaplan, D. (1975). How to Russell a Frege-Church. *Journal of Philosophy*, *72*, 716–729.

Kratzer, A. (1991). Modality. In A. von Stechow & D. Wunderlich (Eds.), *Semantics.* (pp. 639–650). Berlin: De Gruyter.

Ladusaw, W. (1979). *Polarity sensitivity as inherent scope relations*. University of Texas dissertation.

Larson, R., den Dikken, M., & Ludlow, P. (1999). Intensional transitive verbs and abstract clausal complementation. Ms. SUNY at Stony Brook. [http://semlab2.sbs.sunysb.edu/Users/rlarson/itv.pdf].
Lasersohn, P. (1999). Pragmatic halos. *Language*, *75*, 522–551.
Lerner, J.-Y., & Zimmermann, T. E. (1983). Presupposition and quantifiers. In R. Bäuerle et al. (Eds.), *Meaning, use, and interpretation of language*. (pp. 290–301). Berlin: De Gruyter.
Lewis, D. (1973). *Counterfactuals.* Oxford: Blackwell
Lewis, D. (1979a). Attitudes *de dicto* and *de se. Philosophical Review*, *88*, 513–543.
Lewis, D. (1981). What puzzling Pierre does not believe. *Australasian Journal of Philosophy*, *59*, 283–289.
Makinson, D. (1984) 'Stenius' approach to disjunctive permission. *Theoria*, *50*, 136–147.
May, R. (1985). *Logical form. Its structure and derivation*. Cambridge, Mass, MIT Press.
Moltmann, F. (1997). Intensional verbs and quantifiers. *Natural Language Semantics*, *5*, 1–52.
Montague, R. (1969). On the nature of certain philosophical entities. *Monist*, *53*, 159–195.
Montague, R. (1970). Universal grammar. *Theoria*, *36*, 373–398.
Montague, R. (1973). The proper treatment of quantification in ordinary English. In J. Hintikka et al. (Eds.), *Approaches to natural language.* (pp. 221–242). Dordrecht: Reidel.
Moschovakis, Y. (1974). *Elementary induction on abstract stuctures*. Amsterdam: North-Holland Press.
Parsons, T. (1990). *Events in the semantics of English: A study in subatomic semantics.* Cambridge, MA: MIT Press.
Partee, B. (1987). Noun phrase interpretation and type shifting principles. In J. Groenendijk et al. (Eds.), *Studies in discourse representation theory and the theory of generalized quantifiers*. (pp. 115–143). Berlin: De Gruyter.
Partee, B., & Rooth, M. (1983). Generalized conjunction and type ambiguity. In R. Bäuerle et al. (Eds.), *Meaning, use, and interpretation of language*. (pp. 361–383). Berlin: De Gruyter.
Quine, W. V. O. (1956). Quantifiers and propositional attitudes. *Journal of Philosophy*, *53*, 177–187.
Quine, W. V. O. (1960). *Word and object.* Cambridge, MA: MIT PRess
van Rooy, R., & Zimmermann, T. E. (1996). An externalist account of intentional identity. In K. von Heusinger & U. Egli (Eds.), *Proceedings of the Konstanz workshop 'reference and anaphorical relations'*. (pp. 123–136). Arbeitspapier Nr. 79 der Fachgruppe Sprachwissenschaft, Universität Konstanz. [http://www.uh.uni-konstanz.de/kops/volltexte/2000/508/pdflap079 7.pdf]
Russell, B. (1905) On denoting. *Mind*, *14*, 479–493.
Sauerland, U. (2004). A new semantics for number. In R. Young & Y. Zhou (Eds.), *Proceedings of SALT*, (Vol. 13). Cornell University.
Stalnaker, R. (1968). A theory of conditionals. In N. Rescher (Ed.), *Studies in logical theory* (pp. 41–55). Oxford: Blackwell
Stalnaker, R. (1999). *Context and content.* Oxford: Oxford University Press
von Stechow, A. (2001). Temporally opaque arguments in verbs of creation. In B. Cecchetto et al. (Eds.), *Semantic interfaces: reference, anaphora, aspect*. (pp. 278–319). Stanford: CSL.
Winter, Y. (2001). *Flexibility principles in Boolean semantics.* Cambridge, MA: MIT Press.
Zalta, E. N. (1988). *Intensional logic and the metaphysics of intentionality* Cambridge, MA: MIT Press.
Zimmermann, T. E. (1993). On the proper treatment of opacity in certain verbs. *Natural Language Semantics*, *1*, 149–179.
Zimmermann, T. E. (2000). Free choice disjunction and epistemic possibility. *Natural Language Semantics*, *8*, 255–290.
Zimmermann, T. E. (2005). Coercion vs. indeterminacy in opaque verbs. In R. Kahle (Ed.), *Intensionality*, (pp. 217–265). Natick, MA: AK Peters
Zimmermann, T. E. (2006). Quaint paint. In H.-M. Gärtner et al. (Eds.), *Between 40 and 60 puzzles for Krifka.* Internet publication [http://www.zas.gwz-berlin.de/40-60-puzzles-for-krifka/pdf/zimmermann.pdf]