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Move and accommodate: A solution to Haddock's puzzle

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1 Introduction

What licenses the use of a definite description? The formal and philosophical literature has approached this question in two ways. The *uniqueness approach* (Frege, 1892; Russell, 1905; Strawson, 1950) holds that we may use a definite determiner only if the property denoted by its complement holds of exactly one individual in some domain: Sentence (1) and (2) can only be true if there is exactly one king of France, and exactly one American governor, respectively. Since this is not the case in the actual world, the sentences are either false or (on most modern accounts) fall prey to a presupposition failure.

(1) The king of France is bald.

(2) Today, the American governor appeared on TV.

The *familiarity approach* (Christophersen, 1939; Heim, 1982; Groenendijk and Stokhof, 1991) holds that definite descriptions are anaphoric to a discourse referent that is already in the discourse context: A discourse like (3) is felicitous even given that there is more than one doctor in the universe. Within the familiarity approaches, Roberts (2003) contrasts the notions of *strong familiarity*, which usually involves explicit previous mention of the entity in question, and *weak familiarity*, where its existence need only be entailed in the linguistic or nonlinguistic context, for example on the basis of perceptually accessed information.

(3) There's a doctor in our little town. The doctor is Welsh. Roberts (2003)

Many actual accounts fall somewhere in the spectrum between the uniqueness and the familiarity approach. For example, Schwarz (2009) argues on independent grounds that there are two types of definites in natural language, and that each of them is characterized by one of the approaches mentioned.

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This paper discusses the use of *embedded definites*, or definite descriptions embedded in other definite descriptions, such as the following:

(4) a. the circle in the square
b. the rabbit in the hat — Haddock (1987)
c. the lady with the dog — Meier (2003)

Embedded definites pose a problem for all the approaches mentioned. On the uniqueness approach, they pose a problem because their uniqueness presupposition is weaker than expected. For example, it is possible to utter (5) in a context that contains more than one square. The sentence comes out as true in Fig. 1.

(5) The circle in the square is white.

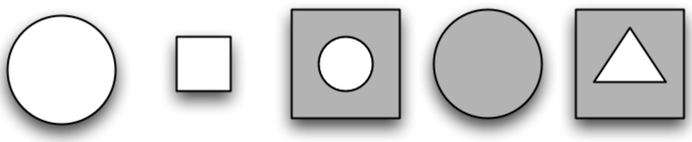


Figure 1: The basic example

Haddock's puzzle, as we will refer to it, consists in the fact that the inner definite *the square* does not introduce a presupposition to the effect that there is only one square (Haddock, 1987). We would expect such a presupposition because in general, definite determiners introduce uniqueness presuppositions on their syntactic complements and do not take surrounding material into account. For example, it is odd to utter any of the sentences in (6) in the context of Fig. 1. This is expected if the uniqueness presuppositions of *the* are computed with respect to their complements only. Otherwise, these sentences should be acceptable, because Fig. 1 contains exactly one circle in a square, exactly one small circle, and exactly one square on the right.

(6) a. The circle is in the square.
b. The circle is small.
c. The square is on the right.

Embedded definites also pose a problem for the familiarity approach. First, sentences like (5) can be uttered with respect to situations like Fig. 1 without any previous talk of circles and squares. This is unexpected under the strong familiarity approach, which requires that the referents of definite descriptions have been previously mentioned. The weak familiarity approach may look at first sight like it fares better, because it holds that definite descriptions are licensed whose referent is known by the extralinguistic context alone. But, like all other approaches, it too fails to account for the contrast between (5) and the sentences in (6), since Fig. 1 provides potential referents for the definite descriptions in all these sentences.

The problem for both approaches is compounded by the fact that even embedded definites introduce presuppositions. While sentence (5) is acceptable in Fig. 1 above, it is unacceptable in Fig. 2 below. The only difference between the two figures is the addition of a second circle-in-a-square pair. Apparently, sentence (5) introduces the presupposition that there is exactly one nested circle-in-a-square pair. This presupposition seems to arise from an interaction of the two definite descriptions, which is unexpected and problematic on either approach. Higginbotham (2006) playfully referred to the challenge of accounting for this interaction as "the simplest hard problem I know".

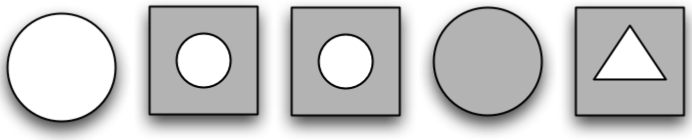


Figure 2: The scene from Fig. 1, with an additional nested circle-in-a-square shape

The claim of this paper is that embedded definites can, despite the appearances, be accounted for on the uniqueness approach. Far from being a surprise, we argue that the behavior of embedded definites is actually expected once two independent facts are taken into account: the ability of noun phrases to take scope, i.e., to be interpreted in a different place from their syntactic position, and the interaction of presuppositions and scope-taking elements. Specifically, we analyze embedded definites as a case of *inverse linking* (Gabbay and Moravscik, 1974; May, 1977): the embedded definite takes scope over the embedding one. The presupposition of the embedded definite is weakened as a result of the independently motivated process of *intermediate accommodation* (Kratzer, 1989; Berman, 1991). In our case, this process transfers the presupposition of the embedding definite into the restrictor of the embedded one.

Like other scope-taking processes, inverse linking is generally taken to be subject to locality constraints: if a syntactic island, such as a finite clause boundary, intervenes in the path of a scope-taking element, then the resulting reading is unavailable or degraded (Rodman, 1976). Since our account views embedded definites as cases of inverse linking, we predict that inserting an island into an embedded definite, all else being equal, should lead to a similar degradation. We report results from an online survey with 800 participants that confirm this prediction.

2 The Proposal

This section motivates and spells out our solution to Haddock's puzzle. We start from a naïve account of definites that implements the standard uniqueness approach and fails on embedded definites such as (5). We then add a simple implementation of intermediate accommodation and demonstrate how it correctly derives weakened presuppositions for embedded definites. Finally, we show that intermediate accommodation does not interfere with the interpretation of nonembedded definites such as (6).

We adopt a semantic notion of presupposition, according to which sentences have presuppositions that are compositionally computed from the denotations of their lexical items, in tandem with their assertions. The framework we use is fairly standard (see e.g. Karttunen and Peters, 1979; Muskens, 1996); an accessible introduction is found in Heim and Kratzer (1998). Sentences are interpreted as pairs of propositions: an assertion and a global presupposition, which is the conjunction of all the presuppositions provided by the lexical items in the sentence. Sentences whose global presupposition is true have the same truth value as their assertion; sentences where it is false lack a truth value. Denotations of lexical items that carry a presupposition are represented as partial functions that are undefined whenever this lexical presupposition is false. We write $\lambda x : \varphi \,.\, \psi$ for the partial function that is defined for all x such that its lexical presupposition φ holds, and that returns ψ wherever the function is defined. We write $\exists!$ for the generalized quantifier *exactly one*. The term $\iota x\ R(x)$ denotes the unique individual x such that $R(x)$ holds, and fails to denote if there is either no or more than one such individual (Hilbert and Bernays, 1939). With these conventions, the denotation of the word *the* can be represented as follows:

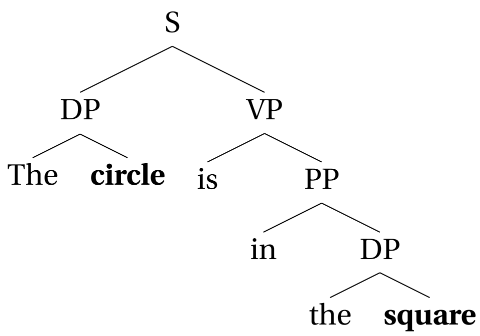
(7) $[\![\text{the}]\!] = \lambda R : [\exists! x\ R(x)] \,.\, [\iota x\ R(x)]$

What (7) says is that the word *the* is translated as a partial function which is defined on any predicate R that applies to exactly one entity, and that this partial function returns the unique entity of which R holds.

In such a framework, the challenge consists in deriving the presuppositions of both embedded and non-embedded definites in a compositional way. Consider first the baseline case, a nonembedded sentence. Sentence (6a), repeated here as (8), presupposes that there exist exactly one circle and exactly one square.[1]

(8) The circle is in the square.

This presupposition is straightforwardly derived with the standard syntax and lexicon given in Fig. 3.



Word	Translation
the	$\lambda R : [\exists! x\ R(x)] \,.\, [\iota x\ R(x)]$
circle	$\lambda x.\text{circle}(x)$
is	$\lambda P.P$
in	$\lambda y.\lambda x.\text{in}(x, y)$
square	$\lambda x.\text{square}(x)$

Presupposition: $[\exists! x\ \text{circle}(x)] \wedge [\exists! y\ \text{square}(y)]$
Assertion: $\text{in}([\iota x\ \text{circle}(x)], [\iota y\ \text{square}(y)])$

Figure 3: The naïve account illustrated on nonembedded definites.

[1]This and all other presuppositions have to be relativized to the given context, to avoid presupposition failure due to shapes which are not shown in our pictures. Any implementation of the uniqueness approach must take this relativization into account somehow. We will largely ignore this issue in the following, since it is orthogonal to the phenomenon of embedded definites.

The formalization described so far models a naïve version of the uniqueness approach. Given the discussion in Sect. 1, it is unsurprising that it fails for embedded definites. For example, sentence (5), repeated below as (9), is incorrectly predicted to presuppose that there is exactly one square, and that this square is contained in exactly one circle. This prediction is illustrated in Fig. 4, which uses a standard syntax and the same lexicon as before; the word *white* is translated as $\lambda x.\text{white}(x)$. As we have seen, the predicted presupposition is too strong: sentence (9) is acceptable in Fig. 1, even though there is more than one square in that figure.[2]

(9) The circle in the square is white.

The problem is a consequence of an assumption left implicit in the naïve account: it was assumed that the semantic contribution (in this case, the uniqueness presupposition) of a definite determiner is determined exclusively by its complement. This assumption may have seemed justified in the case of nonembedded definites, but it can no longer be maintained. Rather, embedded definites force us to conclude that definite determiners make their semantic contribution in the context of the entire clause in which they appear. As we will see in Sect. 3, this fact has been recognized, but not explained, by previous authors.

We propose an explanation from a novel angle: Insofar as definite determiners act semantically on their clause rather than just on their complements, they are analogous to quantificational determiners (Barwise and Cooper, 1981). Based on this parallel, the null assumption is to expect definite and quantificational determiners to share other properties too, for example as regards their interaction with presuppositions. Specifically, we expect definite determiners to exhibit *intermediate presupposition accommodation* as quantificational determiners do. We use intermediate accommodation as a descriptive term for the phenomenon in which the presuppositions of the nuclear scope of a quantificational determiner are optionally accommodated into its restrictor (Kratzer, 1989; Berman, 1991).[3] For example, (10) displays intermediate accommodation because it quantifies only over those men that have a wife, rather than presupposing that every man has a wife.[4]

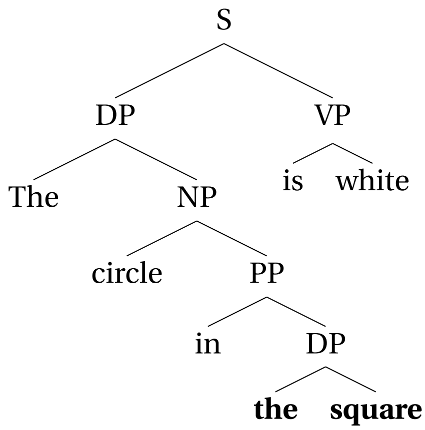
(10) Every man loves his wife. (van der Sandt, 1992)

The constraints on the availability of intermediate accommodation are not well understood. For example, von Fintel (1994), Sect. 2.4.3, offers examples illustrating that intermediate accommodation of the presuppositions supplied by definites is, in his words, "far from automatic". In the following, we will not attempt to model the constraints on intermediate accommodation of presuppositions supplied by definites. We base our claim on the fact that such accommodation is sometimes if not always pos-

[2]We assume that the predicates denoted by *circle* and *in the square* are conjoined via a *predicate modification* rule (see e.g. Heim and Kratzer, 1998) and that the result of this rule inherits the lexical presuppositions of the conjuncts.

[3]Intermediate accommodation is called local accommodation by some authors, e.g. von Fintel (1994). This is potentially confusing because the term local accommodation is used in most other work to refer to a separate phenomenon in which the presupposition is added to the assertive content of the *nuclear* scope, rather than the restrictor.

[4]See Beaver (2001) and Chemla (2009) for further discussion of similar examples.



Presupposition:	$[\exists! x\ \mathrm{circle}(x) \wedge \mathrm{in}(x, \iota y\ \mathrm{square}(y))]\ \wedge\ [\exists! y\ \mathrm{square}(y)]$
Assertion:	$\mathrm{white}([\iota x\ \mathrm{circle}(x) \wedge \mathrm{in}(x, \iota y\ \mathrm{square}(y))])$

Figure 4: The naïve account makes the wrong prediction for embedded definites.

sible, and therefore must be made available in principle by any formal account. The following attested example illustrates this fact, and shows that the presuppositions of definites can be accommodated intermediately in the same syntactic configuration as that of embedded definites.

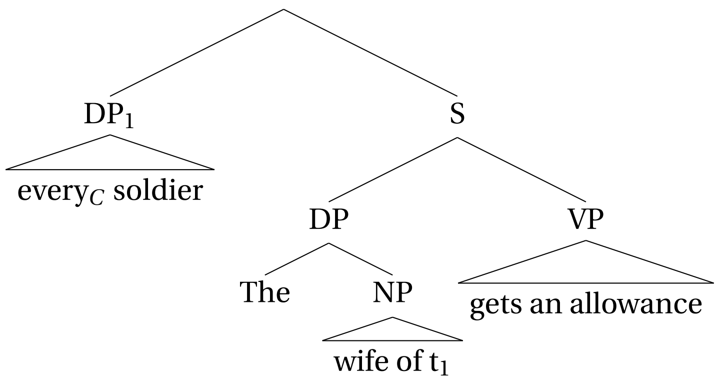
(11) On enlistment, **the wife of every soldier** receives from the government a separation allowance of $20 a month, recently increased to $25 a month.[5]

The highlighted noun phrase in (11) can be paraphrased as *the wife of every married soldier*. In other words, the restrictor of *every* is evaluated only with respect to those soldiers x for which the presupposition of *the wife of x* is satisfied. As a whole, (11) does not have the presupposition that every soldier has a wife. This is exactly what intermediate accommodation predicts, provided that the nuclear scope of *every* contains the term that corresponds to *the wife of x* and that this term projects a presupposition.

We will now extend our account to represent the scopal and presuppositional behavior of quantifiers exhibited by the last example. For this purpose, we equip our syntactic trees with a scope-shifting operation: Quantifier raising (QR) replaces quantifiers with a coindexed trace, and adjoins them at the closest node of type t (May, 1977; Heim and Kratzer, 1998). The trace is interpreted as a variable that is bound by the quantifier, and it does not introduce any presuppositions. Example (11) and other constructions we are concerned with are cases of inverse linking, that is, a quantificational determiner takes syntactic scope in the restrictor of another one but takes semantic scope over it. Inverse linking configurations have been variously analyzed as involving adjunction of the quantifier at either S (May 1977; Sauerland 2005 and others) or DP (e.g. May 1985; Barker 2001; see also Charlow 2009). Our analysis is compatible with either assumption. For concreteness, we assume here that quantifiers adjoin at S. This also simplifies the presentation, since adjoining at DP would require adjusting the type of the quantifier (Heim and Kratzer, 1998).

[5]Source: Sir Hebert Ames, Canada's War Relief Work. The Annals of the American Academy of Political and Social Science 1918, 79: 44. Available online through `books.google.com`.

As a stand-in for a more elaborate model of intermediate accommodation, we adopt a simple mechanism that applies after QR and that operates directly on logical subformulas. Our mechanism is illustrated in Fig. 5, which models a simplified version of (11). Following von Fintel (1994) and others, we assume that all determiners contain a free and uniquely named variable $C, C', \ldots$ which ranges over subformulas and which is interpreted conjunctively with the complement of the determiner. For example, *every*$_C$ is interpreted as $\lambda R \lambda N[\forall x\ (R(x) \wedge C) \rightarrow N(x)]$. When the sister node of a quantificational noun phrase whose free variable is C imposes a presupposition φ, then C may optionally resolve to φ. In this case, φ is not added to the global presupposition of the sentence.[6] Otherwise, C is trivially resolved to *true*. If C is resolved to a formula φ that contains a variable which is free in φ, we allow this variable to be bound from outside C. That is, the variable is not renamed, in contrast to beta reduction. This avoids the binding problem discussed by Karttunen and Peters (1979). As an example, in Fig. 5, the variable x introduced by the trace is free within C, but after presupposition accommodation it is bound by the quantifier introduced by *every soldier*. This treatment of intermediate accommodation is perhaps not very elegant, but it is not our concern here to provide a theory of intermediate accommodation per se. We adopt it here because it is simple and does not distract from our main goal. We leave it for future work to decide whether our account of embedded definites is compatible with attempts to reduce intermediate accommodation to independent principles, such as contextual domain restriction (von Fintel, 1994, 2006; Beaver, 2001, 2004) or anaphora resolution (van der Sandt, 1992; Geurts, 1999).



Presupposition: *none*
Assertion: $[\forall x\ (\text{soldier}(x)\ \wedge\ C) \rightarrow \text{gets-an-allowance}(\iota y\ \text{wife-of}(y, x))]$
where $C = [\exists! y\ \text{wife-of}(y, x)]$ — i.e., x is married

Figure 5: Intermediate accommodation in inverse linking: "The wife of every soldier gets an allowance"

Because of the parallels between definites and other quantifiers mentioned earlier, we assume that QR can apply to definite descriptions, and that they too contain a free variable C which can be resolved by intermediate accommodation. The assumption

[6]A more elaborate treatment may well add something similar to φ to the global presupposition even then. The question of exactly what is presupposed by a sentence with intermediate accommodation is controversial (Beaver, 2001; Singh, 2008).

that QR can apply to definites is independently motivated in accounts that assign definites the same type as quantifiers (e.g. Isac 2006), since QR is one strategy to resolve type mismatches of quantifiers in non-subject positions (though a type-shifting strategy is another option, see Heim and Kratzer 1998). However, our proposal is equally compatible with referential accounts of definites in the tradition of Frege (1892) and Strawson (1950) in which definites map predicates to individuals, as was implicitly assumed for example (7). In such accounts, we assume that QR can apply to definites to prevent presupposition failure.

Table 1 shows our entries for each account. In both cases, R stands for the predicate supplied by the complement of *the.* As in the case of quantifiers, the variable C is interpreted conjunctively with that predicate. On the quantificational account, R is a mnemonic for restrictor and N for nuclear scope. To simplify the discussion, we will refer to R as the restrictor as we discuss both accounts, even though this terminology is strictly speaking not appropriate in the case of the referential account.

Word	Translation
the$_C$ *(referential)*	$\lambda R : [\exists! x\, R(x) \wedge C].\, [\iota x\, R(x) \wedge C]$
the$_C$ *(quantificational)*	$\lambda R : [\exists! x\, R(x) \wedge C].\, [\lambda N.\, N(\iota x\, R(x) \wedge C)]$

Table 1: Proposed lexical entries for *the* on referential and quantificational accounts.

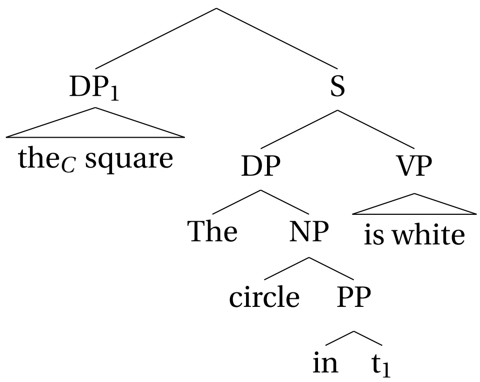
We can now formally model our explanation of Haddock's puzzle. The account as presented predicts that the presupposition of an embedded definite is weaker than that of a regular definite. The reason for this is that QR applies to the embedded definite. Since it takes scope above the embedding definite, the presupposition of that definite is accommodated into the restrictor of the embedded definite. Note that C in the lexical entries in Table 1 appears in the scope of the iota operator. So C resolved nontrivially (i.e. if intermediate accommodation takes place), the result is a weaker uniqueness presupposition than otherwise. This fact is the key to understanding why the presuppositions of embedded definites are weakened.[7]

Fig. 6 illustrates the application of our account to our example (5). QR raises the inner definite, *the square*, above the rest of the sentence, which imposes the presupposition "there is exactly one circle in x" on the referent of the trace. The C variable of the raised definite is resolved to that presupposition.[8] As a consequence, that presupposition is not added to the global presuppositions of the sentence. After resolving C,

[7]We are agnostic about whether this free variable C should also be used to account for the general context dependency of determiners and quantifiers mentioned in footnote 1, as in von Fintel (1994). If it turns out that C also plays this role, then this provides further motivation for the entries we propose in Table 1.

[8]The outer definite also contains a variable, call it C', but we omit it from the picture for clarity. Here is why this has no consequences for the predictions we make. The nuclear scope of the outer definite, *is white*, does not have any (relevant) presuppositions, so no intermediate accommodation takes place and C' gets resolved trivially. The outer definite stays *in situ* because there is no reason for it to move. On a quantificational account, this can be explained due to the absence of a type mismatch. On a referential account, movement can be seen as a strategy to repair presupposition failures, therefore there is no reason to do so in the contexts we consider. Whether the reading that would result from moving the outer definite is available is a question we do not consider in this paper.

the presupposition of the raised definite is weakened from "the number of squares is exactly one" to "the number of squares that contain exactly one circle is exactly one". Since there are no other determiners that could accommodate it, this surfaces as a global presupposition, i.e., the sentence will only have a truth value in models that satisfy it. In such a model, let x be the square that contains exactly one circle, and let y be the circle contained in x. The assertion of the sentence is that y is white. We see that our account correctly predicts that embedded definites have weakened presuppositions.[9]



Global presupposition: $[\exists! x\ \text{square}(x) \wedge C]$

Assertion: $\text{is-white}([\iota y\ \text{circle}(y) \wedge \text{in}(y, [\iota x\ \text{square}(x)\ \wedge\ C])])$
where $C = [\exists! z\ \text{circle}(z) \wedge \text{in}(z, x)]$

Figure 6: Embedded definites: "The circle in the square is white"

In the process of extending the naïve account, we have added two new devices to it: QR and intermediate accommodation. We now show that the extended account still makes the right predictions for nonembedded definites. Such cases are illustrated by our baseline sentence (6a), repeated here as (12). Note that (12) is not a case of inverse linking: the two noun phrases are not nested.

(12) The circle is in the square.

We have seen in Fig. 3 above that the naïve account predicts the correct presupposition for (12). That presupposition is shown in (13). It is obtained by conjoining the presuppositions supplied by the two definite descriptions.

(13) $[\exists! x\ \text{circle}(x)] \wedge [\exists! y\ \text{square}(y)]$

In our extended account, QR and intermediate accommodation are available. QR by itself does not change the presuppositions and truth conditions of (12), no matter how often we apply it: the two definite descriptions are scopally commutative, and the C

[9] As noted by a member of the CSSP conference audience, it is not clear whether the presupposition of (9) is indeed "the number of squares that contain exactly one circle is exactly one" or the slightly stronger "the number of squares that contain *at least one* circle is exactly one". This latter presupposition fails in a picture in which one square contains one circle and another square contains two circles. The account presented in the running text predicts the former presupposition. We leave this question for future work.

variables make no contribution because they are resolved trivially. By contrast, intermediate accommodation has the potential to change the overall presupposition. Nevertheless, it turns out that will not result in a different global presupposition. Consider first the case where QR has not applied. Since the lower definite description *the square* does not itself contain any embedded presuppositional items, its presupposition is not affected by intermediate accommodation, so it comes out as $[\exists! y\, \text{square}(y)]$. As for the presupposition of the higher definite, it starts out as $[\exists! x\, \text{circle}(x) \wedge C]$. If intermediate accommodation applies, C is resolved to the presupposition of the lower definite. The result is (14), which is truth-conditionally equivalent to (13).

(14) $[\exists! x\, \text{circle}(x) \wedge [\exists! y\, \text{square}(y)]]$

Now suppose QR is applied one or more times. No matter how often it is applied, one of the definites will end up in the syntactic scope of the other one. QR does not affect presuppositions, so if the order of the definites is the same as before QR, intermediate accommodation will once again result in the presupposition (14). If QR inverts the order of the definites, intermediate accommodation will result in the presupposition (15), which again is equivalent to (13). This explains why only inverse linking configurations result in weakened presuppositions.

(15) $[\exists! y\, \text{square}(y) \wedge [\exists! x\, \text{circle}(x)]]$

3 Comparison with Previous Accounts

In this section, we evaluate previous accounts of the problem of embedded definites. Haddock (1987) proposes a solution based on incremental processing; van Eijck (1993) models regular and embedded definites in a dynamic framework; and Meier (2003) argues that embedded definites are predicative and therefore devoid of presuppositions. Superficially, our proposal might look needlessly complicated because it relies on theories of the effects of QR and intermediate accommodation, which are not considered in the work reviewed in this section. We wish to emphasize, however, that these effects are well attested independently of embedded definites. So any accurate theory of language as a whole will of necessity predict them in some way. Our account simply relies on the null assumption, which is that these effects also occur in embedded definites.

3.1 Haddock (1987)

Haddock (1987) views the phenomenon of definiteness in a computational setting; the problem he considers is to parse embedded definites incrementally and to identify their referents on the fly. His solution to this problem is expressed in Combinatory Categorial Grammar (see e.g. Steedman 2000), a formalism that is well suited for incremental left-to-right evaluation. Semantic representations consist of constraints on variables and are built up incrementally in tandem with parsing. Each word contributes a constraint, and the syntactic rules specify how variables introduced by different words have equal referents. Simplifying somewhat, parsing a nested definite like *the circle in the square* generates the following representation:[10]

(16) unique(e_1) ; circle(e_1) ; in(e_1, e_2) ; unique(e_2) ; square(e_2)

This representation is thought of as being interpreted incrementally against a model by entertaining a candidate set of referents for each variable and successively narrowing it down. For example, when *circle*(e_1) is first introduced, the candidate set of e_1 contains all the circles in the model, but by the time all the constraints in (16) have been processed, the candidate set of e_1 contains only those circles that are contained in a square. The constraint *unique*(e_n) is a meta-constraint: it is true if and only if the candidate set for its variable is a singleton set. Unlike the other constraints, which are evaluated as soon as the words that generate them are read, Haddock stipulates that *unique*(e_n) is only evaluated "when the NP corresponding to the variable e_n is syntactically closed". In left-to-right evaluation, the inner and the outer NP of a nested definite are both closed at the same time, so the uniqueness constraints are both checked simultaneously, after all the other constraints in (16) have been processed.

Besides identifying the problem and realizing that the embedded definite is influenced by the larger embedding definite, the merits of Haddock (1987) consist in improving on previous computational treatments of definite reference, which would fail to find referents for embedded definites.[11] However, this early account does not provide any insight as to why there should be a contrast between embedded definites (9) and their nonembedded counterparts illustrated in (6). The system in Haddock (1987) models this contrast by requiring that the uniqueness constraints of definites are evaluated exactly at the time the NP that contains them has been processed entirely, rather than later. From a theoretical point of view, one would want to find an explanation for such a requirement, and not just stipulate it.

3.2 Van Eijck (1993)

In van Eijck (1993), embedded definites are analyzed only in passing as an example of the context dependency of the uniqueness presupposition of definite descriptions. The main purpose of his article is to propose semantic representations for definite and indefinite descriptions in a framework based on dynamic predicate logic (DPL, Groenendijk and Stokhof, 1991). When a DPL formula is interpreted, information about the values of variables is encapsulated in an assignment function that is passed sequentially from one subterm to the next. This allows quantifiers to bind variables introduced by pronouns in subsequent sentences. Predicates are interpreted as checks on the values of variables. In van Eijck's system, definites whose uniqueness presupposition is not met generate errors, implemented as special assignment functions which prevent the formula from having a truth value. As in the present work, definites are translated with a uniqueness-presupposing, variable-binding operator written as ι, but there is a difference. Roughly, while we let $\iota x : \varphi$ denote an individual, namely the

[10] Haddock's actual example uses the noun phrase *the rabbit in the hat* and has been adapted here.

[11] We were not able to consult Haddock (1988). As quoted in Dale and Haddock (1991), this work introduces the important observation that we can avoid an infinite regress in modeling the truth and felicity conditions of nested definites if the quantifiers introduced by the determiners are both given wide scope over the entire noun phrase.

unique individual x for which φ is true, for van Eijck the formula $\iota x : \varphi$ has a truth value: it is true just in case there is exactly one way of assigning a value to x that makes φ true. The translation of our basic example (9), based on van Eijck's translation of an analogous sentence, is shown in (17). The semicolon (;) is interpreted as an instruction to sequentially interpret its left-hand side and then its right-hand side.

(17) $\iota v_1 : (\text{circle}(v_1) ; \iota v_2 : (\text{square}(v_2) ; \text{in}(v_1, v_2))) ; \text{white}(v_1).$ van Eijck (1993)

Informally, (17) is interpreted as an instruction to do the following: Pick an entity at random and call it v_1; check that this entity is a circle; pick an entity at random and call it v_2; check that it is a square; make sure v_1 is in v_2; produce an error if any of the checks failed; produce an error if any other choice for v_1 or v_2 would not (!) have led to an error by now; finally, check if v_1 is white. (17) has a truth value if and only if there is a way to pick v_1 and v_2 that does not lead to an error, and its truth value is determined by whether or not the last check succeeds (i.e., whether v_1 is white).

Given van Eijck's system, (17) correctly captures the presupposition and the truth conditions of the nested definite in (9). However, van Eijck does not give a compositional procedure for translating syntactic structures into formulas. Without adopting an approach similar to ours, it is difficult to see how such a procedure could be given that would translate the syntax tree in Fig. 4 into the DPL formula (17). As we have seen in Fig. 4, the complement of the upper definite description is "circle in the square", while the complement of the lower definite description is "square". In the absence of movement and intermediate accommodation, the two instances of "the" would be translated as ι operators that apply to the denotations of their syntactic complements. In (17), the ι operator that corresponds to the lower definite description takes as its argument the formula (18), which corresponds to the words "square" and "in". Of these, the word "in" is not contained in the complement of the lower "the". The question why the lower "the" should be able to take a semantic argument that is not exclusively denoted by its syntactic complement is not addressed by van Eijck (1993). We regard this question as the core of Haddock's puzzle.

(18) $\text{square}(v_2) ; \text{in}(v_1, v_2)$

3.3 Meier (2003)

Meier (2003) is the only formal semantic work entirely devoted to embedded definites prior to this article. Meier argues that in a sentence like *The circle in the square is white*, the inner definite *the square* introduces no presupposition of its own, and that this is so because it is in a predicative rather than quantificational position (Partee, 1987). Meier notes that definites in predicative positions fail to license anaphora, as shown by the contrast between the predicative definite in (19a) and the non-predicative one in (19b):

(19) a. De Gaulle wasn't the greatest French soldier$_i$. #He$_i$ was Napoleon.
b. De Gaulle didn't meet the greatest French soldier$_i$. He$_i$ was already dead.

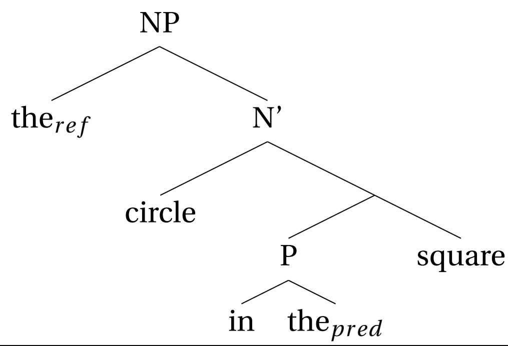
Observing that the embedded definites in (20) fail to license anaphora, she concludes that they are also in predicative position.

(20) a. The rabbit in the hat$_i$ was grey. #It$_i$ was black.
b. The lady with the dog$_i$ is a princess. #It$_i$ is extremely big.

Meier observes that Haddock's puzzle does not arise with relational nouns. Specifically, she reports that "The destruction of the city occurred at midnight" is odd if there are two cities, of which one was destroyed, and a small village was also destroyed. She observes that the examples in (21), which are built around relational nouns, license anaphora, in contrast to the examples in (20).

(21) a. The encounter with the bear$_i$ was terrifying. It$_i$ was extremely big.
b. The journalist's book$_i$ appeared in 1993. He wrote it$_i$ on a train.

Meier therefore assumes that definites embedded by a nonrelational noun have a separate lexical entry (the$_{pred}$) than other definites (the$_{ref}$). She postulates the syntax and lexical entries shown in Fig. 7.



Word	Translation
the$_{ref}$	$\lambda R : [\exists! x\, R(x)].\ [\iota x\, R(x)]$
circle	$\lambda x.\text{circle}(x)$
in	$\lambda D_{\langle et,et\rangle}.\lambda P_{\langle et\rangle}.\lambda Q_{\langle et\rangle}.\lambda x.Q(x) \wedge [\exists y\, D(\lambda z.\text{in}(x,z) \wedge P(z))(y)]$
the$_{pred}$	$\lambda P.\lambda x.P(x)\ \wedge\ [\forall y\, P(y) \rightarrow x = y]$
square	$\lambda x.\text{square}(x)$

Figure 7: Meier (2003).

From these entries, we obtain the prediction that the meaning of the N' constituent *circle in the square* is as follows:

(22) $\lambda x[\text{circle}(x)\ \wedge\ [\exists y\, \text{in}(x,y) \wedge \text{square}(y)\ \wedge\ [\forall y'\, (\text{in}(x,y')\ \wedge\ \text{square}(y')) \rightarrow y = y']]]$

This predicate is true of any circle that is contained in exactly one square. The predicate is defined on all entities, that is, it does not introduce any presuppositions. Assuming that the outer definite presupposes that this predicate applies to exactly one entity, a sentence like (9), *The circle in the square is white*, is predicted to presuppose that the number of circles that are contained in exactly one square is exactly one.

We see problems both with the syntactic and with the semantic claims of this account. As illustrated in Fig. 7, the account in Meier (2003) starts from the assumption that the words "in" and "the" form a syntactic constituent. This requires her to formulate needlessly complicated lexical entries for these words. Meier adduces German contraction phenomena, such as *in* + *dem* = *im*, as evidence for this nonstandard syntax. While German determiner contraction is indeed sensitive to the properties of the definite determiner (it is only licensed when the determiner is not anaphoric, as shown by Schwarz 2009), this in itself does not constitute evidence for the constituent structure proposed. It is well known that phonological contraction can happen across constituent boundaries, so contraction does not constitute evidence for a nonstandard constituent structure. For example, *wanna*- or *to*-contraction (Chomsky and Lasnik, 1977; Postal and Pullum, 1982) is possible across constituent boundaries, and in fact even across NP traces (23a) and PRO (23b).

(23) a. I'm [going [to stay]]. → I_i'm [gon- [t_i -na stay]].
b. I want [PRO [to stay]]. → I wanna stay. (Boeckx, 2000)

Moreover, the extraction tests in (24) are compatible with the standard constituent structure and not with the one proposed by Meier. We conclude that the standard constituent structure is the correct one.

(24) a. [What $]_1$ is the circle in t_1?
b. *[What $]_1$ is the circle in the t_1?

Turning to the semantic claims of Meier (2003), we doubt that the inner definite fails to introduce any presuppositions, and we also doubt that (22) is the correct denotation of the N' constituent. In essence, Meier's account predicts that the N' constituent "circle in the square" means "circle in exactly one square". But the two are clearly different in meaning and felicity conditions, as shown in the following minimal pair:

(25) a. Every circle in the square is white.
b. Every circle in exactly one square is white.

Sentence (25a) has a presupposition that is absent from sentence (25b), namely, that there is exactly one square in total. Clearly, this presupposition is introduced by the embedded definite. Moreover, for (25a) to be true, there has to be a square that contains every circle. In contrast, (25b) is also compatible with a scenario in which different circles are contained in different squares, as long as no white circle is contained in more than one square.[12]

Finally, we disagree with the factual claim that motivated Meier's proposal, namely that definites embedded under nonrelational nouns fail to license anaphora. This was supposed to be shown by her examples in (20) above, in contrast to the examples with relational nouns in (21). However, this contrast is not a minimal pair. The examples in (21) contain several factors absent from (20) that make it easier for the hearer to establish the anaphoric link in question. First, in (21), selectional restrictions help the hearer quickly rule out coindexings other than the one in question. For example, both rabbits and hats can be black (20a), but only bears and not encounters can be big

[12]We also doubt that an embedded definite like *the circle in the square* presupposes that the number of circles that are contained in *exactly* (rather than at least) one square is exactly one, as Meier predicts. Her presupposition is satisfied in a scenario where one circle is contained in one square, and another circle is contained in two (nested) squares. It seems that the noun phrase *the circle in the square* fails to refer in such a scenario. This objection is similar to one that is faced by our own account, see fn. 9.

(21a). Second, the examples are not equivalent from the point of discourse coherence (Mann and Thompson, 1988): Intuitively, the discourses (21a) and (21b) are coherent because the second sentence elaborates on the first; the discourses in (20a) are less coherent because the second sentence stands in contrast to the first or introduces an unrelated fact. It is known that discourse coherence affects anaphoric links across sentences (Kehler, 2002), especially when the potential antecedent is embedded under a quantificational element (Wang et al., 2006).[13] We conjecture that absence of selectional restrictions and low discourse coherence contribute to the degraded status of the examples in (20). Once these factors are controlled for, anaphoric reference to an embedded definite is possible:

(26) The rabbit in the hat$_i$ was satisfied. It$_i$ was much roomier and more comfortable than the other hats.

This example differs from (20a) in its tighter selectional restrictions (a rabbit can be black, but it cannot be roomy) and in its higher discourse coherence: the second sentence elaborates on the first, rather than standing in contrast to it.

Summing up this section, we conclude that none of the previous accounts of the phenomenon of embedded definites is satisfactory.[14] In the remainder of the paper, we consider a prediction that is inherent in our movement-based proposal and that provides further evidence to distinguish between the accounts.

4 The Locality Prediction

In this section, we introduce a prediction that sets apart our analysis from the other proposals summarized in the previous section. Since the prediction arises from syntactic locality conditions that affect QR, we will refer to it as the *Locality Prediction*. This prediction is not shared by accounts like those mentioned in the previous section, because neither of them relates Haddock's problem to scope shifting processes. In this section, we first introduce the relevant constraints on QR that give rise to the locality prediction. We then spell out in detail how the prediction is derived. The locality prediction then arises from the interaction of the constraints on QR and principles that determine the choice between definite and indefinite determiners. As we argue, the prediction is expected to be subtle in relevant examples. For this reason, we set aside the empirical test of the prediction for Sect. 5. The goal of this section is only to show how the locality prediction arises from the premises of our account.

Since Rodman (1976), it has been known that scope shifting processes are subject to locality restrictions. In fact, cases of the type Rodman discussed are directly relevant for our problem since they concern a constraint on inverse linking. Specifically, Rodman

[13] Psycholinguistic factors also militate against anaphoric reference to an embedded definite. For example, the preference for resolving pronouns to subjects arguably favors the embedding definite over the embedded one, as does the preference for resolving pronouns to the first mentioned antecedent in the sentence (e.g. Frederiksen, 1981; Gernsbacher and Hargreaves, 1988).

[14] Chris Piñón (p.c.) points out that quantification over pairs is a further intuition one might try to pursue. The idea would be to interpret *the circle in the square* as something paraphrasable as 'the x of the pair (x, y) such that x is a circle in y and y is a square'. While the intuition is clear, an account along these lines would also require independent motivation of all the assumptions it relies on.

observed that inverse linking is degraded or impossible in subject relatives containing an object quantifier. The examples in (27) and (28) illustrate this constraint: In both cases, inverse linking is possible in example a, and the examples are chosen in such a way that the inverse linking interpretation is pragmatically preferred. The b-examples, on the other hand, do not permit an inversely linked interpretation. Because inverse scope is not available, only a surface scope interpretation is easily available. The two b-examples are pragmatically odd because the surface scope interpretation conflicts with our world knowledge.

(27) a. An apple in every basket is rotten.
b. #An apple that is in every basket is rotten.

(28) a. The wife of every soldier attended the ceremony.
b. #The woman who married every soldier attended the ceremony.

The relevant syntactic configuration is a difference of locality. In both (27a) and (28a), the universal quantifier is embedded in a PP that is either adjoined or an argument of the head noun of the outer DP. In (27b) and (28b), on the other hand, the universal quantifier is the object of a relative clause that is attached to the head noun of the outer DP. Rodman's generalization is that the object of a relative clause cannot take scope over the DP that the relative clause is attached to.[15] Assuming QR as the scope shifting process, Rodman's generalization is captured as a syntactic constraint on the application of QR. In syntactic terminology, such a restriction is referred to as an *Island Effect* (Ross, 1968). Specifically, the effect in (27) and (28) can be described as the following: Subject relative clauses are islands for QR of the object.

The investigation of island effects in syntax is an area of active research (see e.g. Cecchetto 2004). However, as far as we can see, the issues that are under debate do not affect our locality prediction. For the locality prediction to arise, it is sufficient if there is a consistent effect of syntactic configuration on the applicability of QR. This is widely accepted by current research in the field. One current discussion is important for the predicted strength of the effect due to locality: A number of researchers have found that, in many cases, island phenomena are gradient effects rather than all or nothing. Specifically, Snyder (2000) shows satiation effects for some island effects in English. Furthermore, islands vary across languages. Rizzi (1982) and, more specifically, Engdahl (1997) argue that subject relative clauses in Swedish are not islands for some types of overt movement.[16] Though these studies did not look directly at QR, but instead at instances of overt movement, the results lead us to expect that the effect of locality on QR also may be gradient, and therefore more difficult to detect. This is indeed what we found. For this reason, we demonstrate our prediction by a large-scale survey.

The examples in (29) illustrate the locality prediction entailed by our analysis. (29a) was discussed in Section 2 above. Recall that part of our account of (29a) was QR of the definite description *the square* to a position with clausal scope. In (29b), however, the definite *the square* occurs inside of a subject relative clause. As in the examples above, we expect the subject relative clause to make QR of the definite description more diffi-

[15] The subject of a relative clause can, at least in some cases, take scope above the outer DP that the relative clause is attached to (see for example Hulsey and Sauerland 2006).

[16] Engdahl attributes the original observation to Andersson (1974) and Allwood (1976).

cult in (29b) than it is in (29a).

(29) a. The circle in the square is white.
b. #The circle that is in the square is white.

While some native speakers perceive the predicted contrast in (29), others describe both examples as perfect. Our experimental evidence in the next section shows that there is indeed a contrast between the two sentences in (29) in the expected direction. However, it would not be suitable for an experiment to directly compare the relative acceptability of (29a) and (29b), since (29b) is longer and may therefore be perceived to be more difficult and less acceptable than (29a).

In the experiment, we instead compare definite with indefinite descriptions. The experiment then tests the interaction of the locality prediction with the pragmatic licensing of definite and indefinite determiners. The basic principle we assume for the licensing of the indefinite determiners is described by Hawkins (1981) and Heim (1991). Since Heim's version ties into the theoretical assumptions about presuppositions that we assume, we follow her account in the following. Heim's account is based on the general principle of *Maximize Presupposition* (see also Sauerland 2008). The effect of this principle is that the presupposition-less indefinite determiner is blocked in case the presupposition of a definite determiner is satisfied in the same position. The principle is motivated by the complementary distribution of definite and indefinite determiners in examples like (30):

(30) a. The capital of France is pretty.
b. #A capital of France is pretty.

In examples like (29), the prediction of Heim's proposal is more intricate because Maximize Presupposition is predicted to interact with the possibility of QR, though Heim does not discuss this possibility. Consider the indefinite version of (29) in (31). We assume that the indefinite is licensed only if replacing it with a definite in the same logical form representation would lead to a presupposition failure. That is, Maximize Presupposition does not compare representations in which QR has applied with representations in which it has not applied. As we have seen in Sect. 2, our proposal entails that in the scenario represented by Fig. 1, the presupposition of the definite can be fulfilled only in a logical form representation where it has undergone QR. The prediction for (31a) depends therefore on whether QR of the indefinite *a square* to a clausal position is optional or obligatory. We assume that it is optional because we have found no empirical difference in acceptability between (29a) and (31a) in pilot testing that we have done so far.[17] If QR is optional, two logical form representations are predicted to be generated for (31a): one where the indefinite takes clausal scope and a second one where it remains *in situ*. In the former, the indefinite determiner could be replaced with a definite determiner without causing a presupposition failure, and therefore the indefinite should be blocked by Maximize Presupposition. In the latter representation, however, the same replacement would lead to a presupposition failure since it would

[17] Higginbotham (2006) reports relevant introspective judgments where the indefinite version is ungrammatical, while the definite is not. Therefore it seems possible that our pilot testing on this matter was not sensitive enough to detect the difference.

result in the structure shown in Fig. 4. So (31a) is predicted to be acceptable: Maximize Presupposition does not rule it out.

(31) a. The circle in a square is white.
b. The circle that is in a square is white.

In the case of (31b), the prediction of our account is more straightforward because QR to a position outside of the relative clause is discouraged by the island effect. Replacing the indefinite with a definite determiner is predicted to lead to a presupposition failure on any representation of (31b) that does not violate the island. In this way, the indefinite determiner is expected to be licensed as well.

In sum, our account makes a novel locality prediction. Specifically, there should be a greater contrast in acceptability between (29b) and (31b) than between (29a) and (31a). This prediction sets apart our account from the previous accounts discussed in Sect. 3. The experiment described in the following section confirms that the locality prediction is indeed correct.

5 Experiment

To test the locality prediction described in the previous section, we conducted an online experiment. We used the online marketplace Amazon Mechanical Turk (MTurk, `www.mturk.com`) to design and conduct the study and to recruit and pay subjects. We chose this method over others because it allowed us to test a large number of subjects in a convenient and low cost manner.

The experiment was designed to directly compare definite and indefinite versions of the two critical sentences. We created a three-part questionnaire that is reproduced in the Appendix. The first part asked for demographic information including the participants' gender, native language, country of residence, and year of birth. The second part consisted of instructions, a picture, and four test sentences. The picture was the one in Fig. 1 above. The sentences each contained a drop-down box presenting both an definite and an indefinite determiner. The subjects were instructed that the test sentences were intended as descriptions of the picture, and that they should in each case choose the determiner that fits best and sounds most natural. The third part of the questionnaire gave the participants an opportunity to provide us with feedback.

There were four versions of the questionnaire, which differed only with respect to the experimental items. In each case, the experimental item was the third of the sentences presented. The other three sentences acted as distractors and did not differ across versions of the questionnaire.[18] The two experimental items are shown here:

[18]For technical reasons, it was impossible to randomize the order of the sentences or of the items in the drop-down boxes. To simulate the latter, half of the questionnaires contained drop-down boxes with a definite as the topmost item, and the other half had an indefinite as the topmost item.

No-island condition:	The circle in	**Select** the a	square is white.
Island condition:	The circle that is in	**Select** the a	square is white.

In the experiment, the participants were asked to choose one of the determiners from the drop-down box. This choice was recorded by the MTurk system and we used the summary report provided by the MTurk system for our data analysis.

A total of 1200 participants participated in the survey at a total cost of about $38 (about 3 cent per answer). We decided not to restrict the survey to native speakers, because this might have encouraged MTurk workers interested in participating to lie about their native language. Instead, we subsequently filtered the results and kept only native speakers who grew up and now live in the US by their own report in the demographic part of our survey. We furthermore removed repeat participants and incomplete answers, leaving us with data from 797 participants.

Overall, the result confirms the locality prediction made by our account. In reporting our results, we added the results from the two items that differed only with respect to the order of presentation of the two determiners in the drop-down box. Thus summarized, the result of the experiment is the following for the condition without island:

The circle in	the	85.5%	(N = 336)	square is white.
	a	14.5%	(N = 57)	

For the condition with an island, we obtained the following result:

The circle that is in	the	76.2%	(N = 308)	square is white.
	a	23.8%	(N = 96)	

As shown, subjects chose the definite determiner more frequently in the condition without an island than in the condition with an island. The chi-square test shows that the effect is significant ($\chi^2 = 11.0088$ (1 degree of freedom); $p < 0.001$). We interpret this effect as indicating that subjects are indeed sensitive to an island effect of the subject relative clause when it comes to licensing the definite determiner *the*. Even in the second condition, where the relevant determiner occurs inside of an island, still more than 75% of subjects preferred the definite determiner over the indefinite. We interpret this fact as indicating that the island effect of the subject relative clause is relatively weak.

6 Conclusion

In this paper, we have provided a solution to what we call *Haddock's puzzle*: the problem of accounting for the unexpectedly weak presuppositions of definite descriptions that are embedded in other definite descriptions (Haddock, 1987).

Our solution to Haddock's puzzle, described in detail in Sect. 2, relies entirely on independently motivated assumptions: namely, that definite descriptions can undergo scope shifting operations in the same way quantificational noun phrases do, and that intermediate accommodation can move presuppositions from the sister node of such a noun phrase into its denotation. Applied to the example *the circle in the square*, we assume that the definite *the square* can move to a position where its sister node is the definite *the circle in* t_1, with t_1 a variable bound by *the square*. In this configuration, the sister node of *the square* presupposes that there is a unique item that (i) is a circle and (ii) contains that square. When this presupposition is accommodated into *the square*, this definite is restricted to squares that are contained by a circle.

To the best of our knowledge, our account is the first solution to Haddock's puzzle that is derived entirely from independently established assumptions. Furthermore, our proposal makes a novel locality prediction (Sect. 4) that sets it apart from other approaches to the puzzle. The prediction stems from the role played by QR in our account. Like other movement operations, QR is known to be degraded in island environments, so our account predicts that the presupposition-weakening effect should be less clearly observable in embedded definites that are separated by an island. As reported in Sect. 5, we tested this prediction experimentally by using a subject relative clause as an island environment. We found that in a context that satisfies only the weaker presupposition, participants asked to choose between a definite and an indefinite were indeed less likely to insert a definite into the island environment *the circle that is in __ square* than into the control environment *the circle in __ square*. However, this island must be characterized as weak, because participants still inserted a definite more often than an indefinite, even though they had to violate the island to do so.

While some of our readers might perhaps have expected a more dramatic confirmation of our locality prediction, the weakness of the observed island effect is in fact expected, because independent research has established the weakness of island effects in general (see Sect. 4). The explanandum is therefore not the weakness of the observed effect, but its presence, for which previous accounts do not provide an explanation.

Our proposal has at least one broader implication. Specifically, it relies on the assumption that definite descriptions can undergo QR or other scope shifting operations. QR of definites has been controversially discussed and evidence for it is hard to come by, since definites generally do not exhibit scope ambiguities with other quantifiers (Isac, 2006). Our findings support the view that definite descriptions are not always interpreted *in situ*. However, it is important to note that definite descriptions may be conceived of as undergoing QR regardless of their type (Glanzberg, 2007). So our findings do not conclusively show that they have the type of quantifiers and do not resolve the old debate between referential (Frege, 1892; Strawson, 1950; Kaplan, 1972) and quantificational (Russell, 1905; Barwise and Cooper, 1981; Neale, 1990; Isac, 2006) accounts of definites. Moreover, to account for our experimental finding that definites and indefinites are not in complementary distribution, we have assumed that QR of definites is optional. This is compatible with the position that definites are of quantificational type only if type mismatches of nonsubject definites can be resolved by strategies other than QR, such as type-shifting (Heim and Kratzer, 1998).

Finally, there is one additional facet of Haddock's puzzle to which our account does not directly extend. Namely, Meier (2003) observes that Haddock's puzzle does not arise with relational nouns. Within the account that we provided, Meier's observation would follow if either relational nouns created islands for QR of their complements or if the presupposition of a relational definite could not be accommodated in intermediate positions. At present, we have no solid evidence to decide whether either of these possible accounts of Meier's effect is correct, and we leave the matter up to future work.

Appendix: Experimental Materials

Demographic Questions:

1. Are you male or female? [Choices offered: male/female]
2. What year where you born in?
3. What is/are your native language or languages?
4. In which country have you spent the majority of your life from birth till age ten?
5. Are you left-handed or is one of your blood-relatives (father, mother, brothers, sisters, grandparents, aunts, uncles) left-handed? [Choices offered: I am right-handed, and so are all my blood-relatives. / I myself or at least one of my blood-relatives is left-handed.]

Complete Instructions:

1. Below, we show you a picture and a few sentences. Each sentence is meant to describe some part of the picture.
2. In each sentence a word is replaced by a dropdown menu. Please select the word that fits best into the sentence, keeping in mind that it should be accurate and sound natural.
3. Please answer according to your own feeling for the language. We're interested in natural everyday English, i.e. in what you feel sounds right, not in what other people have taught you about it.
4. We're interested in your spontaneous reactions. If you can't decide, go with your first reaction. Once you've completed this HIT [Human Intelligence Task – a term which refers to this questionnaire in the context of MTurk], please submit it right away. Do not go back over it to change your answers.

[The following are three fillers and a test sentence, where the material in parentheses stands for drop-down menus implementing the forced-choice condition:]

1. The grey circle is (between/left of) two squares.
2. The big square that contains the triangle is (on/to) the right.
3. [four different versions of the test sentence as discussed in the text]
4. The big squares are (grey/black).

Text used in part three of the survey:

1. OK, you're almost done. We're very interested in any comments on this HIT you might have. Please leave some comments for us:

2. Important: We will only accept one HIT per worker. Please do not submit additional HITs like this one, or you might not get paid for any of them.

References

Allwood, Jens, 1976. The complex NP constraint as a non-universal rule and some semantic factors influencing the acceptability of Swedish sentences which violate the CNPC. In Stillings, J. (ed.), *University of Massachusetts Occasional Papers in Linguistics II*. Amherst, MA.

Andersson, Lars-Gunnar, 1974. *Topicalization and relative clause formation*. Gothenburg Papers in Theoretical Linguistics 25.

Barker, Chris, 2001. Integrity: a syntactic constraint on quantificational scoping. In Megerdoomian, K. and L. Bar-El (eds.), *Proceedings of WCCFL 20*, pp. 101–114. Somerville, MA: Cascadilla Press.

Barwise, Jon and Robin Cooper, 1981. Generalized quantifiers and natural language. *Linguistics and Philosophy*, 4:159–219.

Beaver, David I., 2001. *Presupposition and assertion in dynamic semantics*. Stanford, CA: CSLI.

———, 2004. Accommodating topics. In Kamp, Hans and Barbara H. Partee (eds.), *Context-dependence in the analysis of linguistic meaning*. Amsterdam, Netherlands: Elsevier.

Berman, Steven R., 1991. *On the semantics and logical form of wh-clauses*. Ph.D. thesis, University of Massachusetts, Amherst, MA.

Boeckx, Cedric, 2000. A note on contraction. *Linguistic Inquiry*, 31:357–366.

Carlson, Gregory N. and Francis Jeffry Pelletier (eds.), 1995. *The generic book*. Chicago, IL: University of Chicago Press.

Cecchetto, Carlo, 2004. Explaining the locality conditions of QR: Consequences for the theory of phases. *Natural Language Semantics*, 12:345–397.

Charlow, Simon, 2009. Can DP be a scope island? In *Proceedings of the Student Session of ESSLLI 2009*.

Chemla, Emmanuel, 2009. An experimental approach to adverbial modification. In Sauerland, Uli and Kazuko Yatsushiro (eds.), *Semantics and Pragmatics: From Experiment to Theory*, pp. 249–263. Basingstoke, UK: Palgrave Macmillan.

Chomsky, Noam and Howard Lasnik, 1977. Filters and control. *Linguistic Inquiry*, 8:425–504.

Christophersen, Paul, 1939. *The articles: A study of their theory and use in English.* Copenhagen, Denmark: Munksgaard.

Dale, Robert and Nicholas J. Haddock, 1991. Generating referring expressions involving relations. In *Proceedings of the Fifth conference on European chapter of the Association for Computational Linguistics*, pp. 161–166. Association for Computational Linguistics.

van Eijck, Jan, 1993. The dynamics of description. *Journal of Semantics*, 10:239–267.

Engdahl, Elisabeth, 1997. Relative clause extractions in context. *Working Papers in Scandinavian Syntax*, 60:51–79.

von Fintel, Kai, 1994. *Restrictions on quantifier domains.* Ph.D. thesis, University of Massachusetts, Amherst, MA.

———, 2006. What is presupposition accommodation, again? MIT Manuscript.

Frederiksen, John R., 1981. Understanding anaphora: Rules used by readers in assigning pronominal referents. *Discourse Processes*, 4:343–347.

Frege, Gottlob, 1892. Über Sinn und Bedeutung. *Zeitschrift für Philosophie und philosophische Kritik, NF 100*, pp. 25–50.

Gabbay, Dov M. and J.M.E. Moravscik, 1974. Branching quantifiers, English and Montague Grammar. *Theoretical Linguistics*, 1:139–157.

Gernsbacher, Morton Ann and David J. Hargreaves, 1988. Accessing sentence participants: The advantage of first mention. *Journal of Memory and Language*, 27:699–717.

Geurts, Bart, 1999. *Presuppositions and pronouns*, vol. 3 of *Current research in the semantics/pragmatics interface.* Amsterdam, Netherlands: Elsevier.

Glanzberg, Michael, 2007. Definite descriptions and quantifier scope: Some Mates cases reconsidered. *European Journal of Philosophy*, 3:133–158.

Groenendijk, Jeroen and Martin Stokhof, 1991. Dynamic predicate logic. *Linguistics and Philosophy*, 14:39–100.

Haddock, Nicholas J., 1987. Incremental interpretation and combinatory categorial grammar. In *Proceedings of IJCAI-87.*

———, 1988. *Incremental semantics and interactive syntactic processing.* Ph.D. thesis, University of Edinburgh, UK.

Hawkins, John A., 1981. *Definiteness and indefiniteness: A study in reference and grammaticality prediction.* London, UK: Croom Helm.

Heim, Irene, 1982. *The semantics of definite and indefinite noun phrases.* Ph.D. thesis, University of Massachusetts, Amherst, MA.

———, 1991. Artikel und Definitheit. In von Stechow, Arnim and Dieter Wunderlich (eds.), *Semantik: Ein internationales Handbook der zeitgenössischen Forschung (Semantics: An international handbook of contemporary research)*, pp. 487–535. Berlin, Germany: de Gruyter.

Heim, Irene and Angelika Kratzer, 1998. *Semantics in Generative Grammar*. Oxford, UK: Blackwell.

Higginbotham, James, 2006. The simplest hard problem I know. In *Between 40 and 60 Puzzles for Krifka*. Berlin, Germany: Zentrum für allgemeine Sprachwissenschaft.

Hilbert, David and Paul Bernays, 1939. *Grundlagen der Mathematik*. Berlin, Germany: Springer.

Hulsey, Sarah and Uli Sauerland, 2006. Sorting out relative clauses. *Natural Language Semantics*, 10:111–137.

Isac, Daniela, 2006. In defense of a quantificational account of definite DPs. *Linguistic Inquiry*, 37:275–288.

Kaplan, David, 1972. What is Russell's theory of descriptions? In Pears, David (ed.), *Bertrand Russell*, pp. 227–244. New York, NY: Doubleday.

Karttunen, Lauri and Stanley Peters, 1979. Conventional implicature. In Oh, C. and D. Dinneen (eds.), *Presupposition*, vol. 11 of *Syntax and Semantics*, pp. 1–56. New York, NY: Academic Press.

Kehler, Andrew, 2002. *Coherence, reference, and the theory of grammar*. Stanford, CA: CSLI Publications.

Kratzer, Angelika, 1989. Stage-level and individual-level predicates. In Bach, Emmon, Angelika Kratzer, and Barbara Partee (eds.), *Papers on Quantification*, pp. 147–221. Amherst, MA: GLSA, University of Massachusetts. Reprinted in Carlson and Pelletier (1995).

Mann, William C. and Sandra A. Thompson, 1988. Rhetorical structure theory: Toward a functional theory of text organization. *Text*, 8:243–281.

May, Robert, 1977. *The grammar of quantification*. Ph.D. thesis, Massachusetts Institute of Technology, Cambridge, MA.

———, 1985. *Logical form: Its structure and derivation*. Cambridge, MA: MIT Press.

Meier, Cecile, 2003. Embedded definites. In van Rooy, Robert (ed.), *Proceedings of the Fourteenth Amsterdam Colloquium*, pp. 163–168. Amsterdam, Netherlands: ILLC / University of Amsterdam.

Muskens, Reinhard, 1996. *Meaning and partiality*. Studies in Logic, Language and Information. Stanford, CA: CSLI Publications.

Neale, Stephen, 1990. *Descriptions*. MIT Press.

Partee, Barbara H., 1987. Noun phrase interpretation and type-shifting principles. In Groenendijk, Jeroen (ed.), *Studies in Discourse Representation Theory and the Theory of Generalized Quantifiers*, pp. 115–143. Foris: Dordrecht.

Postal, Paul M. and Geoffrey K. Pullum, 1982. The contraction debate. *Linguistic Inquiry*, 13:122–138.

Rizzi, Luigi, 1982. *Issues in Italian syntax*. de Gruyter.

Roberts, Craige, 2003. Uniqueness in definite noun phrases. *Linguistics and Philosophy*, 26:287–350.

Rodman, Robert, 1976. Scope phenomena, "movement transformations", and relative clauses. In Partee, Barbara (ed.), *Montague Grammar*, pp. 165–176. San Diego, CA: Academic Press.

Ross, John R., 1968. *Constraints on variables in syntax*. Ph.D. thesis, Massachusetts Institute of Technology, Cambridge, MA.

Russell, Bertrand, 1905. On denoting. *Mind (New Series)*, 14:479–493.

van der Sandt, Rob A., 1992. Presupposition projection as anaphora resolution. *Journal of Semantics*, 9:333–377.

Sauerland, Uli, 2005. DP is not a scope island. *Linguistic Inquiry*, 36:303–314.

———, 2008. Implicated presuppositions. In Steube, Anita (ed.), *The Discourse Potential of Underspecified Structures*, pp. 581–600. Berlin, Germany: Mouton de Gruyter.

Schwarz, Florian, 2009. *Two types of definites in natural language*. Ph.D. thesis, University of Massachusetts, Amherst.

Singh, Raj, 2008. Economy and intermediate accommodation. Handout.

Snyder, W., 2000. An experimental investigation of syntactic satiation effects. *Linguistic Inquiry*, 31:575–582.

Steedman, Mark, 2000. *The syntactic process*. MIT Press.

Strawson, P. F., 1950. On referring. *Mind*, 59:320–344.

Wang, Linton, Eric McCready, and Nicholas Asher, 2006. Information dependency in quantificational subordination. In Turner, Ken and Klaus von Heusinger (eds.), *Where semantics meets pragmatics*, pp. 267–306. Elsevier.

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