Linguistic Inquiry Early Access Corrected Proof
https://doi.org/10.1162/ling_a_00467

(Im)possible Traces

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In this article, I argue that when movement maps onto a λ-bound variable (a "trace"), that variable must be of an individual semantic type, such as type *e* or type *d.* Thus, even though natural language has expressions of higher types, these expressions cannot be represented as traces. When an individual-type trace would not be able to semantically compose in the launching site of movement, the moved element is forced to syntactically reconstruct. The motivation for this constraint on traces comes from a detailed investigation of how DPs in their different semantic guises—entities, properties, and generalized quantifiers—are interpreted when they move. I then argue that strong definite descriptions exhibit the same type-based restriction—namely, they cannot occur in higher-type positions, which I take as evidence for the theory that traces *are* definite descriptions.

Keywords: reconstruction, traces, movement, syntax-semantics interface

1 Introduction

Movement has played an integral role in the development of linguistic theory. One of the pivotal discoveries about movement is that when an element moves, it leaves behind something in its launching site, traditionally a *trace* (Chomsky 1973), but more recently a full-fledged *copy* (Chomsky 1993, 1995). This dependency is standardly interpreted with one of two procedures. The first procedure is to convert the trace/copy into a variable bound by a λ-operator inserted immediately below the landing site (1a). The second procedure is to reconstruct, placing the moved element back in its launching site at LF (1b).

(1) [The book] [Alex read [the book]].

a. LF: [the book] [λ*x* [Alex read *x*]] *λ-bound variable*
b. LF: Alex read [the book] *Syntactic reconstruction*

This article is concerned with the nature of the λ-bound variable in (1a)—in particular, what kinds of semantic objects it can range over. Assuming the copy theory of movement, I will reappropriate the term *trace* to refer to this λ-bound variable. I argue that traces only range over individual semantic types, such as types *e* (entities) and *d* (degrees). Thus, even though natural

This article stems from my dissertation work in Poole 2017. Many thanks to Rajesh Bhatt and Kyle Johnson for extensive discussion, comments, and suggestions. Thanks also to Daniel Altshuler, Danny Fox, Tim Hunter, Stefan Keine, Angelika Kratzer, Andrew McKenzie, Barbara Partee, David Pesetsky, Maribel Romero, Peter Svenonius, Katia Vostrikova, Ellen Woolford, and two anonymous reviewers for helpful discussion and feedback, in addition to audiences at GLOW 40, WCCFL 35, the 2017 LSA Annual Meeting, Sinn und Bedeutung 22, UMass Amherst, UCLA, and USC, where portions of this work were presented. This material is based on work financially supported by the National Science Foundation Graduate Research Fellowship under NSF DGE-1451512.

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https://doi.org/10.1162/ling_a_00467

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language has expressions of higher types (e.g., properties (type $\langle e, t\rangle$)), these expressions cannot be represented as traces. I formulate this principle as the *Trace Interpretation Constraint* (TIC) in (2) (see also Chierchia 1984, M. Landman 2006).

(2) *Trace Interpretation Constraint (TIC)*
$*[\mathrm{XP}_1\ [\lambda f_\sigma\ [\ \ldots\ [f_\sigma]_1\ \ldots\ ]]]$, where σ is not an individual type.

Under the TIC, movement is tightly restricted in that it only has two possible semantic representations: an individual-type trace or reconstruction.[1] Consequently, when a higher-type expression moves, it is forced to reconstruct if an individual-type trace would be semantically incompatible with the launching site of movement (e.g., it is the wrong type).

The motivation for the TIC comes from the interpretation of DP-movement. Compared with other categories of expressions, DPs are special in that they come in three semantic guises: entities (type e), properties (type $\langle e, t\rangle$), and generalized quantifiers (type $\langle\langle e, t\rangle, t\rangle$); these guises are inherently linked by a set of functors provided by the type theory and the ontological structure of the entity domain (Partee 1986).[2] Given this inherent linking, DPs can (in principle) flexibly shift from one type to another. The empirical question underlying the investigation in this article is whether DPs can be represented as traces in all three of their semantic guises. There is already abundant evidence that entity traces exist; these are the canonical traces left by movement types like Quantifier Raising (QR). This article provides novel arguments that there are no generalized-quantifier traces and no property traces. The TIC straightforwardly captures this state of affairs. I also demonstrate that the TIC accounts for the well-known connectivity effects in VPs and APs (Barss 1986, Huang 1993, Heycock 1995, Takano 1995).

Work on the interpretation of movement has argued that traces are not simplex variables, as depicted in (1a); rather, they are more articulated objects, namely, *bound definite descriptions* (Sauerland 1998, 2004, Fox 1999, 2002, 2003; see also Engdahl 1980, 1986). I argue that the TIC provides novel support for this hypothesis. The argument involves the distinction between "weak" and "strong" definites (F. Schwarz 2009). Under this distinction, if traces are taken to be definite descriptions, then they would have to be strong definites, because only strong definites can facilitate the required bound interpretation. I show that strong definites cannot occur in environments where a DP must be a higher semantic type; only weak definites can. Thus, traces and strong definites have the same distribution with respect to semantic types, a fact that is captured under the hypothesis that traces *are* in fact (strong) definite descriptions. According to this proposal, then, the TIC is a manifestation of a more general constraint on definite descriptions.

The argumentation proceeds as follows. Sections 2 and 3 investigate the semantic type of traces in the domain of entities, arguing that generalized-quantifier traces (type $\langle\langle e, t\rangle, t\rangle$) and property traces (type $\langle e, t\rangle$), respectively, are not available in the grammar. These prohibitions

[1] I use the terms *reconstruction* and *syntactic reconstruction* interchangeably. The precise mechanism behind reconstruction (e.g., selective copy interpretation) is inconsequential for the purposes here.

[2] For simplicity, I treat properties in purely extensional terms, which reduces them to sets of entities. This treatment is overly simplistic (see Chierchia 1984), but it suffices for present purposes.

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against generalized-quantifier and property traces serve as the basis of the article's core proposal in section 4: the TIC. Section 5 uses the TIC to further probe the nature of traces; it argues that the TIC provides novel evidence that traces are strong definite descriptions. Section 6 briefly discusses functional questions, which at first glance might appear to contradict the TIC, but in fact do not. Section 7 concludes by discussing previous proposals about possible traces and then laying out several issues that emerge from the worldview of the TIC.

2 Against Generalized-Quantifier Traces

Generalized-quantifier (GQ) traces have featured prominently in the literature on reconstruction because they are able to achieve reconstructed scope without invoking syntactic reconstruction. For illustration, let us first get acquainted with *how many*–questions, which will be used throughout this article to probe the scope of *wh*-moved elements. What is crucial about *how many*–questions is that in addition to its *wh*-meaning, *how many* carries its own existential quantification, which can vary in scope (Kroch 1989, Cinque 1990, Cresti 1995, Rullmann 1995, Frampton 1999). For example, imagine that you are helping to organize a potluck. In this context, there are two ways to interpret the question in (3).[3] The first reading assumes that there is a certain set of people who should bring dessert and asks how many such people there are. This reading is appropriate if, say, you know that some of the people make tasty desserts and want them assigned to that task. On this reading, *how many* takes (wide) scope over *should*, and so the people being asked about are constant across the modal alternatives (3a); this is the surface-scope reading. The second reading assumes that a particular number of people should bring dessert without having any specific people in mind. This reading is appropriate if, say, you are concerned with there being enough dessert, but not necessarily with who brings it. On this reading, *how many* takes (narrow) scope below *should*, and so the people being asked about may vary across the modal alternatives (3b); this is the reconstructed-scope reading.

(3) [How many people]$_1$ should $\_\__1$ bring dessert?
  a. *Surface-scope (= wide) reading* — how many ≫ should
    For what number *n*: There are *n*-many (particular) people *x* such that it is necessary that *x* bring dessert.
  b. *Reconstructed-scope (= narrow) reading* — should ≫ how many
    For what number *n*: It is necessary for there to be *n*-many people *x* such that *x* bring dessert.

The standard analysis of (3) is that the surface-scope reading corresponds to an entity trace and the reconstructed-scope reading corresponds to syntactic reconstruction—the *wh*-semantics,

[3] The scope ambiguity in (3) might be taken as belonging to the A-movement step to Spec,TP. However, the same ambiguity exists for *how many*–questions targeting nonsubject positions: for example, *How many books should Alex read?* (see (27)). I use a *wh*-subject question for illustration because it makes the derivation for GQ traces in (7) simpler by sidestepping the issue of interpreting GQs in nonsubject positions, which, under standard assumptions, would require an intermediate movement step for purely type-related purposes.

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whatever they may be, holding constant.[4] Thus, the scope relations are isomorphic to the c-command relations at LF. Cresti (1995) and Rullmann (1995) argue, however, that if traces were permitted to be the semantic type of GQs ($\langle\langle e, t\rangle, t\rangle$), then modulating between entity and GQ traces would also be able to produce the two interpretations of (3). Under their proposal, both readings of (3) thus correspond to trace representations. Simplified derivations (not representing intensionality or the full question meaning) with entity and GQ traces are given in (6) and (7), respectively, assuming the common pieces in (4). Following Heim and Kratzer (1998), I assume (a) the semantic-composition rules for movement in (5), where g is the variable assignment function, and (b) that the λ-operator binding the trace is syntactically represented as a copied index, as in (4a). Note that for ease of exposition, I will represent traces as simplex variables until section 5, and the copied index will often be represented directly as a typed λ-operator, as in (8).

(4) a. LF: [how$_n$ many people] [1 [should [t_1 bring dessert]]]
 b. $[\![\text{how}_n \text{ many people}]\!] = \lambda P_{\langle e,t\rangle} \,.\, \exists x[\#x = n \wedge {}^*\textsc{people}(x) \wedge P(x)]$

(5) a. $[\![t_i]\!]^g := g(i)$ *Traces & Pronouns Rule*
 b. $[\![[i\ \phi]]\!]^g := \lambda x \,.\, [\![\phi]\!]^{g[i \to x]}$ *Predicate Abstraction*

(6) *Entity-trace derivation*
 a. $[\![[1 \text{ [should } [t_1 \text{ bring dessert]]]]}]\!] = \lambda y_e \,.\, \textsc{should}(y \text{ brings dessert})$
 b. $[\![\text{how}_n \text{ many people}]\!]\,([\![[1 \text{ [should } [t_1 \text{ bring dessert]]]]}]\!])$
 $= \exists x[\#x = n \wedge {}^*\textsc{people}(x) \wedge [\lambda y_e \,.\, \textsc{should}(y \text{ brings dessert})](x)]$
 $= \exists x[\#x = n \wedge {}^*\textsc{people}(x) \wedge \textsc{should}(x \text{ brings dessert})]$

(7) *GQ-trace derivation*
 a. $[\![[1 \text{ [should } [t_1 \text{ bring dessert]]]]}]\!] = \lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle} \,.\, \textsc{should}(\mathcal{Q}(\lambda z_e \,.\, z \text{ brings dessert}))$
 b. $[\![[1 \text{ [should } [t_1 \text{ bring dessert]]]]}]\!]\,([\![\text{how}_n \text{ many people}]\!])$
 $= \textsc{should}([\lambda P_{\langle e,t\rangle} \,.\, \exists x[\#x = n \wedge {}^*\textsc{people}(x) \wedge P(x)]](\lambda z_e \,.\, z \text{ brings dessert}))$
 $= \textsc{should}(\exists x[\#x = n \wedge {}^*\textsc{people}(x) \wedge [\lambda z_e \,.\, z \text{ brings dessert}](x)])$
 $= \textsc{should}(\exists x[\#x = n \wedge {}^*\textsc{people}(x) \wedge x \text{ brings dessert}])$

Romero (1997, 1998) and Fox (1999) argue against this semantic approach to reconstructed scope (sometimes called "semantic reconstruction") by showing that there is a correlation between the scope of a moved element and its Condition C connectivity. This correlation follows for free under syntactic reconstruction, but would need to be stipulated in a theory with GQ traces. I

[4] "Total" reconstruction of the *wh*-phrase goes against the simple view that the *wh*-phrase must be interpreted in Spec,CP in order to form a constituent question. However, most full-fledged proposals about constituent-question semantics do not require the *wh*-phrase to be interpreted in Spec,CP: the *wh*-morpheme splits from the rest of the *wh*-phrase at LF so that the two scope separately (Romero 1998, Heim 2019); the *wh*-phrase introduces a variable that is (selectively) bound by a question operator (Baker 1970, Rullmann 1995); the *wh*-phrase denotes a choice function that is existentially bound (Engdahl 1980, 1986, Reinhart 1997); or the *wh*-phrase introduces focus alternatives that "percolate" up the structure (Beck 2006, Beck and Kim 2006, Cable 2007, 2010, Kotek 2014, 2019). All of these proposals about the semantics of constituent questions are compatible with the claims in this article.

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review their arguments in section 2.1.[5] To their arguments, I add several novel arguments against GQ traces in section 2.2. Taken together, these arguments provide compelling evidence that GQ traces are ungrammatical (8).

(8) *No generalized-quantifier traces*
$*[\mathrm{DP}_1\ [\lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}\ [\ \ldots\ [\mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}]_1\ \ldots\ ]]]$

2.1 Previous Argument: Condition C Connectivity

Romero (1997, 1998) and Fox (1999) made the pioneering discovery that there is a correlation between reconstructed scope and Condition C connectivity (see also Heycock 1995). The correlation manifests as a blocking effect: if evaluating a moved element for Condition C in its launching site would result in a Condition C violation, reconstructed scope is blocked. For illustration, consider (9), where the moved element contains an R-expression that is coindexed with a pronoun that c-commands the launching site. If the moved element were evaluated in its launching site, it would thus violate Condition C. As discussed above, *how many* results in a scope ambiguity when it moves over another scope-bearing element. Crucially, (9) is scopally unambiguous, even though *how many* moves over the intensional operator *want*. The sentence only has the surface-scope reading in (9a), where it is assumed that there is a set of particular pictures that John wants the editor to publish, and the question is asking how many such pictures there are. This reading is appropriate in a context where, for example, John has several favorite pictures from his Sarajevo trip, and he wants those published. The sentence lacks the reconstructed-scope reading in (9b), where the question asks about the quantity of pictures that John wants the editor to publish, without having any particular pictures in mind. This reading would be appropriate in a context where, for example, John wants the editor to publish three pictures because then his commission will be sufficient to cover his bills, but the particular pictures do not matter.

(9) *Condition C connectivity forces surface scope*
[How many pictures [$_{\mathrm{RC}}$ that **John**$_2$ took in Sarajevo]]$_1$ does **he**$_2$ *want* the editor to publish __$_1$ in the Sunday Special?
(Romero 1998:96)
a. *Surface-scope (= wide) reading* how many $\gg$ want
✓For what number *n*: There are *n*-many (particular) pictures *x* that John took in Sarajevo such that John wants the editor to publish *x*.
b. *Reconstructed-scope (= narrow) reading* want $\gg$ how many
*For what number *n*: John wants the editor to publish in the Sunday Special (any) *n*-many pictures that John took in Sarajevo.

[5] Romero (1998:114–138) presents another kind of argument against GQ traces: a GQ trace cannot satisfy the focus condition in the standard analysis of VP-deaccenting (Rooth 1985, 1992), essentially because a GQ trace cannot be properly compared with a full-fledged DP. This argument, however, crucially relies on the assumption that GQ traces are necessarily simplex. A priori, the question of whether traces are simplex or articulated is orthogonal to the semantic type(s) of traces. Under an analysis where GQ traces are articulated (e.g., Lechner 2019), this particular argument from Romero no longer goes through.

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Compare (9) with (10), where the R-expression and the pronoun have been swapped, so that binding connectivity would not induce a Condition C violation. The reconstructed-scope reading becomes available again in (10).

(10) *Swapping the R-expression and the pronoun* ✓surface, ✓reconstructed
[How many pictures [$_{\text{RC}}$ that **he**$_2$ took in Sarajevo]]$_1$ does **John**$_2$ *want* the editor to publish ___$_1$ in the Sunday Special?
(Romero 1998:96)

(9) and (10) are a minimal pair; they differ only in whether evaluating the moved element in its launching site would violate Condition C. Romero (1997, 1998) and Fox (1999) thus conclude that what blocks the reconstructed-scope reading in (9) is Condition C connectivity. They demonstrate that this blocking effect can be produced in a variety of configurations involving both A-movement and Ā-movement.

If the mechanism for achieving reconstructed scope is syntactic reconstruction, then the correlation between reconstructed scope and Condition C connectivity follows without further ado; the same does not hold for GQ traces. Consider (9) again for illustration. Reconstructing the moved element back into its launching site at LF places the R-expression in the c-command domain of the coindexed pronoun, thereby violating Condition C and yielding ungrammaticality, as schematized in (11).[6] The reconstructed-scope reading is available in (10) precisely because Condition C is not at stake.

(11) *Syntactic reconstruction and Condition C* Op ≫ DP
*~~[$_{\text{DP}}$ . . . R-exp$_1$ . . .]$_2$~~ . . . **pron**$_1$ . . . Op . . . [$_{\text{DP}}$ . . . **R-exp**$_1$ . . .]$_2$ . . .

With GQ traces, the moved element crucially remains in its landing site at LF. Hence, the R-expression in the moved element is *not* in the c-command domain of the coindexed pronoun, and there is no violation of Condition C, as schematized in (12). All else being equal, on a GQ-trace account (9) should have a reconstructed-scope reading, contrary to fact.

(12) *GQ traces and Condition C* Op ≫ DP
[$_{\text{DP}}$ . . . **R-exp**$_1$ . . .]$_2$ [$\lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}$ [. . . **pron**$_1$ . . . Op . . . $\mathcal{Q}$ . . .]]

[6] Two notes are in order here. First, for this analysis Condition C must be evaluated at LF (Lebeaux 1990, 2009, Chomsky 1995). Also, note that the moved element could in principle reconstruct to or leave a GQ trace in an intermediate position. This possibility does not affect the argument here, however, because any position below *want* (Op in (11)) is also in the pronoun's c-command domain.

Second, something needs to be said about why the R-expression in the lower copy does not invariably trigger a Condition C violation. The reason is likely tied to the relative clause. The standard explanation is that the relative clause can be countercyclically late-merged onto the moved element after movement, so that the lower copy never contains the offending R-expression (Lebeaux 1990, 2009). Crucially, Late Merge bleeds being able to reconstruct the higher copy because it would strand the relative clause without a host. Thus, if the higher copy is to reconstruct at LF, the relative clause must be first-merged in the lower copy. However, the claims in this article are not contingent on Late Merge being the explanation of Lebeaux effects, nor are they contingent on the argument-adjunct distinction that Lebeaux effects are claimed to exhibit. Alternative explanations of Lebeaux effects, such as Sportiche's (2016), are equally compatible with the claims made here.

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Crucially, there is nothing inherent about GQ traces that derives a correlation between scope and Condition C.[7] Romero and Fox thus argue that (a) reconstructed scope always involves syntactic reconstruction and (b) GQ traces must not be available in the grammar. If GQ traces were available—even as a supplement to syntactic reconstruction—they would overgenerate, producing the unattested reconstructed-scope reading in (9).

2.2 *New Arguments*

This section provides three novel arguments against GQ traces. Each argument follows the same logic: there is some phenomenon for which it has been independently argued that a trace representation is required, crucially for purposes unrelated to scope. If this trace were type $\langle\langle e, t\rangle, t\rangle$, the need for a trace representation would be satisfied and the derivation would semantically compose, but it would end up producing the wrong scope. That is, reconstructed scope is blocked in these cases. Therefore, if GQ traces were available in the grammar, then they would need to be blocked on an ad hoc basis in all of these cases in order to avoid overgeneration.

2.2.1 Antecedent-Contained Deletion It is standardly assumed that ellipsis is resolved in antecedent-contained deletion (ACD) by covertly moving the host (i.e., the DP hosting the ellipsis site) to a VP-external position (e.g., Sag 1976, Larson and May 1990, Fox 2002).[8] The resulting LF satisfies the parallelism requirement on ellipsis and avoids the infinite-regress problem (13).

(13) $[\text{Subj } [\lambda x_e \underbrace{[_{\text{VP}} \text{ V } x]}_{\text{antecedent VP}}]] \overbrace{[_{\text{DP}} \text{ NP } [_{\text{RC}} \lambda y_e \ldots \langle \underbrace{[_{\text{VP}} \text{ V } y]}_{\text{elided VP}} \rangle]]]}$

This analysis is independently supported by the fact that the host in ACD configurations obligatorily takes scope above VP (Sag 1976, Larson and May 1990). Consider the paradigm in (14). In the baseline in (14a), *every painting that Blanche painted* may scope above or below the intensional verb *want.* On the narrow-scope reading, Rose for example is an admirer of Blanche and has the "*de dicto*" desire to own any painting that Blanche has painted. On the wide-scope reading, Rose wants a particular set of paintings, all of which happen to have been painted by Blanche, possibly unbeknownst to Rose. The equivalent narrow-scope reading disappears in the ACD configuration in (14b). Only a wide-scope reading survives, where Rose wants a particular set of paintings, all of which Blanche also wants, possibly unbeknownst to Rose. In the absence of ellipsis in (14c), the narrow-scope reading reappears, where Rose has the desire to have any painting that Blanche also wants.

[7] The correlation between scope and Condition C could of course be stipulated; see Sternefeld 2001 and Ruys 2015 for such proposals. Such a modified version of GQ traces will, however, not address the arguments against GQ traces raised in section 2.2.

[8] Under Fox's (2002) analysis, the relative clause (RC) containing the ellipsis site is late-merged onto the host DP after it has moved. The arguments here are not contingent on ACD involving Late Merge; see also footnote 10.

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(14) a. *Baseline* ✓want ≫ ∀; ✓∀ ≫ want
Rose wanted every painting that Blanche painted.
b. *ACD* *want ≫ ∀; ✓∀ ≫ want
Rose wanted every painting that Blanche did Δ.
c. *No ellipsis* ✓want ≫ ∀; ✓∀ ≫ want
Rose wanted every painting that Blanche wanted.

The scope pattern in (14b) follows from mapping the covert movement step of the host out of VP onto a trace of type *e*; this is the familiar operation QR. Thus, movement of the host leaving an entity trace not only creates a suitable antecedent for ellipsis, thereby resolving the ACD, it also makes a nontrivial, correct prediction about the scope of the host. Against this backdrop, consider what would happen if the movement step instead mapped onto a trace of type $\langle\langle e, t\rangle, t\rangle$. As schematized in (15), a GQ trace would still provide a suitable antecedent for ellipsis, avoiding the problem of infinite regression.

(15) $[\text{Subj}\ [\lambda\mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}\ \underbrace{[_{\text{VP}}\ \text{V}\ \mathcal{Q}]}_{\text{antecedent VP}}]]\ \overbrace{[_{\text{DP}}\ \text{NP}\ [_{\text{RC}}\ \lambda x_e \ldots x\ [\lambda\mathcal{R}_{\langle\langle e,t\rangle,t\rangle}\ \underbrace{\langle[_{\text{VP}}\ \text{V}\ \mathcal{R}]\rangle}_{\text{elided VP}}]]]]}$

However, a GQ trace would fail to derive the scope pattern in (14b) because the host would be interpreted as taking scope inside VP.[9] In canonical cases of QR, a constraint like Scope Economy (Fox 2000) might be invoked to block the trace from being type $\langle\langle e, t\rangle, t\rangle$, since such a trace would not affect semantic interpretation. However, the purpose of the covert movement step in ACD is not to give the host a certain scope; this can be done without ACD, as in (14c). Rather, the movement is done to provide a suitable antecedent for ellipsis, for which traces of type *e* or $\langle\langle e, t\rangle, t\rangle$ would in principle suffice. Only a trace of type *e*, however, derives the scope facts in (14b). Thus, if GQ traces were available in the grammar, then some additional constraint would need to be invoked to block them in ACD.

2.2.2 Extraposition Williams (1974) observes that extraposition of an adjunct from a DP forces that host DP to take scope at least as high as the extraposition site, which Fox (2002) dubs *Williams's Generalization* (see also Fox and Nissenbaum 1999). For illustration, first consider the baseline sentence in (16), which is scopally ambiguous. On the first reading, I am looking for a picture from John's factory, and any such picture would satisfy my search; *a picture from John's factory* scopes below *look for*, in its base position. On the second reading, there is a particular picture from John's factory, and I am looking for that particular picture; *a picture from John's factory* scopes above *look for*, presumably via QR.

[9] To satisfy the parallelism conditions on ellipsis, the trace in the elided VP in the RC would need to be type $\langle\langle e, t\rangle, t\rangle$ as well. I assume that this GQ trace would correspond to an *intermediate* step of movement and that the final movement step to the RC edge maps onto an entity trace, with the semantic composition proceeding in the normal way. This kind of mixed-type chain is permitted under Rullmann's (1995) system of GQ traces: the intermediate entity trace—*x* in (15)—is type-lifted from *e* to $\langle\langle e, t\rangle, t\rangle$ via Partee's (1986) LIFT operator (see Rullmann 1995:185–191 for discussion).

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(16) *Baseline* ✓look for ≫ ∃; ✓∃ ≫ look for
I looked (*very intensely*) for [a picture **from John's factory**].
(Fox and Nissenbaum 1999:141)

Compare (16) with (17), where the adjunct *from John's factory* has been extraposed. (17) is not scopally ambiguous; it only has the wide-scope reading from (16).

(17) *Extraposition* *look for ≫ ∃; ✓∃ ≫ look for
I looked for [a picture ___] *very intensely* **from John's factory**.
(Fox and Nissenbaum 1999:141)

Fox and Nissenbaum (1999) propose that extraposition involves a derivation in which the adjunct late-merges to the host DP after the host DP has undergone rightward movement to the extraposition site (18a).[10] The extraposition follows from where the pieces are pronounced: the adjunct is pronounced where it is merged and the host DP is pronounced in its base position. Crucially, Fox and Nissenbaum assume that the movement step maps onto a trace of type *e* (18b), which forces the host DP to take scope in the extraposition site, thereby deriving Williams's Generalization.

(18) a. [[$_{\text{VP}}$ look for [a picture]$_1$] [very intensely]] [~~a picture~~ from John's factory]$_1$
b. LF: [λx_e [[$_{\text{VP}}$ look for x] [very intensely]]] [a picture from John's factory]

Now, consider what would happen if the movement step instead mapped onto a GQ trace. A GQ trace would still allow for a Late Merge extraposition derivation, but it would fail to derive Williams's Generalization because the moved host DP would be interpreted as taking scope in its base position. As with ACD, invoking a constraint like Scope Economy would not explain why the trace in an extraposition derivation cannot be type $\langle\langle e, t\rangle, t\rangle$. Although we do not know precisely why adjuncts extrapose, it is unlikely that the reason is to give the host DP a particular scope, given that this scope can be achieved without extraposition, as in (16). Thus, if GQ traces were available in the grammar, then there would have to be some other constraint blocking them in extraposition.

2.2.3 Parasitic Gaps Adopting Nissenbaum's (2000) analysis, a parasitic gap is created by a null operator moving from the parasitic-gap position to the edge of the adjunct clause, which is interpreted as a λ-operator binding a variable located in the gap position—namely, a trace, as schematized in (19). This derived predicate then conjoins with the λ-abstraction independently created by the Ā-movement step in the matrix clause.

(19) [Op$_1$ [. . . t_1 . . .]] ⇝ LF: [λx_e [. . . x . . .]]

[10] The argument here against GQ traces is not contingent on Late Merge, only on extraposition involving movement of the host DP. Alternatively, the adjunct is merged in the base position of the host DP, the host DP with the adjunct moves, and the higher copy of the host DP is not pronounced (see, e.g., Sportiche 2016). Additionally, under Fox's (2002) analysis of ACD, where the ACD host is extraposed (i.e., undergoes QR), the ACD argument in section 2.2.1 would reduce to the extraposition argument being laid out here.

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Nissenbaum assumes that the trace in the parasitic gap is type *e*, but consider what would happen if the trace were instead type $\langle\langle e, t\rangle, t\rangle$. Because only elements of the same type may be conjoined, a GQ trace in the parasitic gap would require the trace of the matrix Ā-movement step to be a GQ trace as well. Both traces being type $\langle\langle e, t\rangle, t\rangle$ crucially makes the prediction that the moved element should be able to take reconstructed scope in both the matrix gap and the parasitic gap, as schematized in (20), where α and β represent scope-bearing operators.

(20) $[\text{DP}\ \underbrace{[[\lambda\mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}\ [\alpha \ldots \mathcal{Q}]]}_{\text{matrix clause}}\ \underbrace{[\lambda\mathcal{R}_{\langle\langle e,t\rangle,t\rangle}\ [\beta \ldots \mathcal{R}]]}_{\text{parasitic-gap adjunct}}]]$ $\alpha \gg \text{DP}; \beta \gg \text{DP}$

This prediction is difficult to test given independent constraints on parasitic gaps. Testing whether DP can scope below α is complicated, if not impossible, because parasitic-gap adjuncts attach to vP (Nissenbaum 2000). Consequently, α would need to be something within vP. The problem is that the obvious candidates for α (e.g., modals) are all located above vP. However, (21) tests whether DP can scope below β. The acceptability of (21) is independently degraded because the adjunct is a finite clause, and parasitic gaps prefer nonfinite clauses (Engdahl 1983). To the extent that (21) is acceptable, though, *how many people* cannot take scope below *want* in the adjunct. This hypothetical reading is paraphrased as follows: what is the number *n* such that there are *n*-many people that Alex blackmailed because in all of his doxastic alternatives, there are *n*-many people that Alex extorts for money. Such a reading might be used, say, in a context where Alex is blackmailing people in order to extort not them, but their spouses.

(21) ?[**How many people**]$_1$ did Alex blackmail __$_1$ [because he **wanted** to extort *pg* for money]?
✓how many ≫ want; *want ≫ how many

The absence of reconstructed scope in (21) reveals that (20), where the trace is type $\langle\langle e, t\rangle, t\rangle$, is not a possible LF for parasitic-gap constructions. However, the absence of reconstructed scope follows directly if the trace is type *e*, as in (19). Thus, if GQ traces were available in the grammar, then there would have to be a constraint blocking them in parasitic gaps.

2.3 Section Summary

Syntactic reconstruction and GQ traces produce the same interpretation under ordinary circumstances. Consequently, it is difficult to empirically distinguish between the two mechanisms. The crux of all the arguments in this section is that a grammar with GQ traces would have to restrict their distribution in a disparate set of environments in an ad hoc manner in order to avoid overgenerating interpretations. On the other hand, a grammar without GQ traces (22)—per the TIC—where reconstructed scope is only ever achieved via genuine syntactic reconstruction, does not face this problem and derives all of these restrictions in a unified way.[11]

[11] There is a weaker constraint that would derive (22): a trace must be the lowest semantic type compatible with its syntactic position (Beck 1996, Fox 1999). Such an account differs from the TIC in that it does not predict a ban on property traces. See section 7.1.1 for discussion.

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(22) *No generalized-quantifier traces*
$*[\mathrm{DP}_1\ [\lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}\ [\ \ldots\ [\mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}]_1\ \ldots\ ]]]$

3 Against Property Traces

Unlike GQ traces, property traces have received little to no attention in the literature. This section provides a novel argument that such traces of type $\langle e, t\rangle$ are unavailable in the grammar (23). This discovery supplies a crucial piece of the argument that the constraint on possible traces bans *any higher-type trace.*

(23) *No property traces*
$*[\mathrm{DP}_1\ [\lambda f_{\langle e,t\rangle}\ [\ \ldots\ [f_{\langle e,t\rangle}]_1\ \ldots\ ]]]$

The motivation for the ban on property traces comes from a series of observations about syntactic environments where a DP denotes a property. The four environments examined here are the pivot of an existential construction (24a), the color term of a change-of-color verb (24b), the name argument of a naming verb (24c), and predicate nominals (24d).[12] Despite their surface heterogeneity, what these four environments have in common is that they all require a DP of type $\langle e, t\rangle$.

(24) a. There is [**a potato**]$_{\langle e,t\rangle}$ in the pantry. *Existential constructions*
b. Megan painted the house [**magenta**]$_{\langle e,t\rangle}$. *Change-of-color verbs*
c. Irene called the cat [**Snowflake**]$_{\langle e,t\rangle}$. *Naming verbs*
d. Erika became [**a teacher**]$_{\langle e,t\rangle}$. *Predicate nominals*

For reasons of space, I will not review the arguments that DPs in these positions denote properties. The arguments come from the respective literatures on each of the constructions and thus are independent from the arguments here. Change-of-color verbs are textbook examples of resultatives, and under standard analyses, the color term denotes a property (e.g., Kratzer 2005). For predicate nominals, that they are properties is the standard analysis (e.g., Williams 1983, Partee 1986). For existential constructions and naming verbs, the arguments are somewhat more involved and come from McNally 1992, 1997, 1998 and Matushansky 2008, respectively.[13]

The argumentation in this section proceeds as follows. First, I set the stage by showing that movement types in English differ in whether they allow for scope reconstruction (section 3.1). Second, I apply these movement types to DPs in the property positions in (24), showing that only

[12] These four property positions belong to a larger movement-type asymmetry first observed by Postal (1994), which he links to these positions prohibiting "weak" pronouns like *it.* Discussing this movement-type asymmetry in full would take us too far afield, though see Poole 2017:chap. 2 for extensive discussion and for arguments against Postal's analysis of the asymmetry in terms of movement types leaving behind covert pronouns. For the way the analysis in this article accounts for the ban on pronouns, see footnote 33.

[13] If the pivot of an existential construction is taken to denote a GQ, as is commonly assumed following Barwise and Cooper (1981), and not a property, as McNally (1992, 1997, 1998) argues for, then the arguments presented in this section about existential constructions could alternatively be taken as further arguments against GQ traces, rather than as arguments against property traces.

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movement that reconstructs can target them, which categorically precludes some movement types (section 3.2). Third, I argue that this pattern follows from the unavailability of property traces in the grammar (section 3.3).

3.1 Movement Types and Scope Shifting

Movement types vary in the effect that they have on the scope of the moved element. In particular, some movement types obligatorily shift the scope of the moved element to the landing site of movement, while others allow for scope reconstruction, thereby shifting scope only optionally. Let us consider the scopal properties of three movement types in English that target DPs: topicalization, *wh*-movement, and QR.

3.1.1 Topicalization Topicalization of DPs in English obligatorily shifts scope. (AP-fronting and VP-fronting—sometimes considered "topicalization"—are discussed in section 4.2.) For illustration, first consider the interpretation of the baseline sentence in (25), which has both narrow-scope and wide-scope readings of *some student* with respect to *every teacher.*[14]

(25) *Every teacher* liked **some student** in the first week.
 a. *Narrow-scope reading* $\forall \gg \exists$
  For every teacher *x*, there is some student *y* such that *x* liked *y*.
 b. *Wide-scope reading* $\exists \gg \forall$
  There is some student *y* such that for every teacher *x*, *x* liked *y*.

In a scenario where the student is a different student for each teacher, only the narrow-scope reading in (25a) is true. Crucially, topicalizing *some student* bleeds the narrow-scope reading in (25a), as shown in (26).

(26) [**Some student**]$_1$, *every teacher* liked $\_\__1$ in the first week. $*\forall \gg \exists$; $\checkmark\exists \gg \forall$

The only possible interpretation of (26) is the wide-scope reading in (25b), where *some student* takes surface scope in the landing site of topicalization, above *every teacher.* Consequently, (26) is true if and only if there is a single student that every teacher likes. In sum, topicalization obligatorily shifts scope and does not allow for scope reconstruction.[15]

[14] A few disclaimers: First, this behavior is notably distinct from other movement types called "topicalization" in other languages (e.g., German V2-fronting), which typically allow for scope reconstruction. Second, "topicalization" should be taken as a movement type and not be conflated with topichood. Third, in English, topicalization is string-identical to focus movement and Y-movement (modulo prosody), at least the latter of which allows for scope reconstruction (Ross 1967, Prince 1981). It is possible to control for this issue using question-answer scenarios that license topicalization but not the other two movement types. The relevant facts concerning topicalization and property positions hold when such controls are in place. I do not include the data here for reasons of space; see Poole 2017:15–31, 48–51.

[15] A reviewer points out that topicalization in English does allow reconstruction for variable binding, as shown in (i). I leave this asymmetry for future research.

(i) . . . But [the paper that he$_1$ gave to Mrs. Brown]$_2$, I don't think [any man]$_1$ would want her to read $\_\__2$. (Moulton 2013:254)

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3.1.2 Wh-*Movement* As discussed in section 2, *wh*-movement optionally shifts the scope of the moved DP (see (3)). Another example illustrating this property is given in (27), which has both surface-scope and reconstructed-scope readings of *how many.*

(27) [**How many books**]$_1$ *should* Alex read ___$_1$ this summer?
  a. *Surface-scope (= wide) reading* how many ≫ should
    For what number *n*: There are *n*-many (particular) books *x* such that it is necessary that Alex reads *x* this summer.
  b. *Reconstructed-scope (= narrow) reading* should ≫ how many
    For what number *n*: It is necessary for there to be *n*-many books *x* such that Alex reads *x* this summer.

The scope ambiguity in (27) is the result of the fact that *wh*-movement allows for scope reconstruction and thus only optionally shifts scope.

3.1.3 Quantifier Raising QR shifts scope and does not allow for scope reconstruction (e.g., Fox 2000). In what follows, I will diagnose QR by looking at scope relations. I will assume that the mere presence of a quantificational DP does not itself require QR; that is, quantificational DPs can be interpreted in situ. I will return to this point in section 3.3.

3.2 Property Positions

Under a ban on property traces, there is no trace representation for property-denoting DPs. This makes two predictions about how movement should interact with property positions, given in (28). In this section, I show that both of these predictions are borne out.

(28) a. *Scope prediction*
    Movement that targets a DP in a property position must reconstruct.
  b. *Movement-type prediction*
    Movement types that cannot reconstruct cannot target DPs in property positions.

In what follows, I examine reconstruction through the lens of quantifier scope. In order to determine whether reconstruction is obligatory, it is necessary to look at cases where reconstruction *eliminates* an interpretation that would have only been possible by not reconstructing. Scope reconstruction provides such cases because if a movement step is forced to reconstruct, then it will lack a surface-scope reading. Other kinds of reconstruction effects only allow one to deduce whether reconstruction is possible, not whether it is obligatory. For instance, consider reconstruction for referential opacity in (29).

(29) *Reconstruction for referential opacity*
  $\lambda w_0 \ldots \cancel{\text{DP}_{w_0/*w_1}} \ldots \lambda w_1 \ldots \text{DP}_{w_0/w_1}$

Reconstruction in (29) allows the DP to be evaluated at w_1, but it also allows the DP to be evaluated at w_0. As a result, reconstruction *extends* the range of possible interpretations, which makes it impossible to distinguish optional from obligatory reconstruction. The same line of rea-

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soning applies to pronominal variable binding as well. Therefore, reconstruction effects other than scope reconstruction are set aside here.[16] To streamline the discussion, I also set aside binding connectivity here, but see section 7.2 for discussion.

3.2.1 Existential Constructions *Wh*-movement can target the pivot of an existential construction (30b), but topicalization (30c) and QR (30d) cannot.[17] This confirms the movement-type prediction for existential constructions, because the two movement types that obligatorily shift scope and cannot reconstruct—namely, topicalization and QR—also cannot target the pivot, that is, the property position.

(30) a. There is **a potato** in the pantry. *Baseline*
b. **What**$_1$ is there ___$_1$ in the pantry? Wh-*movement*
c. *[**A potato**]$_1$, there is ___$_1$ in the pantry. *Topicalization*
d. There *must* be **someone** in his house. *QR:* ✓must $\gg \exists$; *$\exists \gg$ must

Even though *wh*-movement can ordinarily shift scope, when it targets the pivot of an existential construction, scope shifting is rendered impossible. The *wh*-movement instead must reconstruct, as shown in (31), where *how many* must take scope below *should.*

(31) [How many questions]$_1$ should there be ___$_1$ on the exam?
*how many $\gg$ should; ✓should $\gg$ how many

To better appreciate this fact, let us compare the existential construction in (31) with its copular-construction counterpart in (32), where *how many* is able to take scope above or below *should.* The logically possible reconstructed-scope and surface-scope readings of (31) and (32) are given in (33).

(32) *Copular counterpart of (31)* ✓how many $\gg$ should; ✓should $\gg$ how many
[How many questions]$_1$ should ___$_1$ be on the exam?

(33) a. *Reconstructed-scope (= narrow) reading* should $\gg$ how many
For what number n: It is necessary for there to be n-many questions x such that x are on the exam.
b. *Surface-scope (= wide) reading* how many $\gg$ should
For what number n: There are n-many (particular) questions x such that it is necessary that x are on the exam.

Consider the appropriateness of (31) and (32) in two different scenarios where I am a TA and the professor is preparing the final exam. In the first scenario, she wants to know the number of questions that I think the exam should have so that the grading is manageable; the identity of the

[16] Note that for property positions, reconstruction for referential opacity and variable binding are indeed possible—as a ban on property traces predicts—but the data are not given here for reasons of space.
[17] The observation that QR cannot target the pivot of an existential construction comes from Williams 1984; see also Heim 1987 and Frampton 1999. The contrast between *wh*-movement and topicalization for property positions was first observed by Postal (1994); see also footnote 12.

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questions does not matter at this point. Both (31) and (32) are appropriate in this context because they both have the narrow-scope reading in (33a). In the second scenario, the professor has asked me to pick out from a workbook the questions that I think should be on the exam. She wants to know the number of questions I have selected so she can gauge the amount of time the exam room should be reserved for. Thus, she is asking about the cardinality of a set that exists in the actual world, the set of questions that I have picked. While the copular construction in (32) is appropriate in this context, the existential construction in (31) is not. This contrast reflects that (32) but not (31) has the wide-scope reading in (33b) where *how many* scopes above *should.* This difference follows from the fact that *wh*-movement cannot shift scope when it targets a DP in a property position, thereby forcing a narrow-scope, reconstructed reading of *how many.* This confirms the scope prediction for existential constructions.

Further confirmation of the scope prediction comes from negative islands, which independently block reconstruction into them (e.g., Rullmann 1995). Since a negative island forces a moved DP to take wide scope and the pivot position forces a moved DP to take narrow scope, the two should be mutually exclusive. This prediction is borne out, as shown in (34a). Compare (34a) with a nonproperty position in (34b), where movement out of a negative island is indeed possible. (The same fact can be shown with *wh*-islands, which also block reconstruction.)

(34) a. *[How many books]$_1$ aren't there ___$_1$ on the table?
b. [How many tables]$_1$ aren't there books on ___$_1$?

3.2.2 Change-of-Color Verbs *Wh*-movement can target the color term of a change-of-color verb (e.g., *paint*, *turn*, and *dye*) (35b), but topicalization cannot (35c).

(35) a. Megan painted the house **magenta**. *Baseline*
b. [**What color**]$_1$ did Megan paint the house ___$_1$? Wh-*movement*
c. ***Magenta**$_1$, Megan painted the house ___$_1$. *Topicalization*

There is no general prohibition against topicalization targeting color terms. They can otherwise undergo topicalization, as shown in (36). The prohibition applies exclusively to those color terms that are arguments of change-of-color verbs.

(36) {Green / That color}$_1$, he never discussed ___$_1$ with me.
(Postal 1994:164)

Moreover, QR cannot target the color term of a change-of-color verb (37a). Compare this with QR targeting the object (37b), which is indeed possible.[18]

(37) a. *A (#different) contractor* painted the house **every color**. $\checkmark\exists \gg \forall$; $*\forall \gg \exists$
b. *A (different) contractor* painted **every house** that ugly green. $\checkmark\exists \gg \forall$; $\checkmark\forall \gg \exists$

[18] I include *different* to bias toward the inverse-scope reading. The #-mark indicates that *different* is infelicitous if the sentence is uttered out of the blue, because it lacks the inverse-scope reading that would require QR. There is a felicitous reading of (37a) in which *different* is interpreted as different with respect to something previously mentioned in the discourse (e.g., another contractor), but this reading is not relevant here because it does not involve inverse scope.

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Thus, (37a) is true if and only if there is a single contractor, who incidentally did lots of painting, but not if there is a different contractor for each color. This confirms the movement-type prediction for change-of-color verbs.

Turning to the scope prediction, when *wh*-movement targets the color term of a change-of-color verb, it must reconstruct. Therefore, (38) only has the reconstructed-scope reading in (38a), and extraction from negative islands is outright ungrammatical (39a), thereby confirming the scope prediction for change-of-color verbs.

(38) [How many colors]$_1$ should Megan paint the house ___$_1$?
  a. *Reconstructed-scope (= narrow) reading* — should ≫ how many
   ✓For what number *n*: It is necessary for there to be *n*-many colors *x* such that Megan paints the house *x*.
  b. *Surface-scope (= wide) reading* — how many ≫ should
   *For what number *n*: There are *n*-many (particular) colors *x* such that it is necessary that Megan paints the house *x*.

(39) a. *[How many colors]$_1$ did no one paint their house ___$_1$?
  b. [How many houses]$_1$ did no one paint ___$_1$ lime green?

3.2.3 Naming Verbs The same pattern is observed for naming verbs and predicate nominals, so here the discussion will be more compact. *Wh*-movement (40b) can target the name argument of a naming verb (e.g., *name*, *call*, and *baptize*) but topicalization (40c) and QR (40d) cannot. As with color terms, there is no general prohibition against topicalization targeting names, as shown in (41). Finally, when *wh*-movement targets the name argument of a naming verb, it must reconstruct; thus, (42) only has a narrow-scope reading of *how many*. This confirms the movement-type and scope predictions for naming verbs.

(40) a. Irene called the cat **Snowflake**. — *Baseline*
  b. [**What name**]$_1$ did Irene call the cat ___$_1$? — Wh-*movement*
  c. ***Snowflake**$_1$, Irene called the cat ___$_1$. — *Topicalization*
  d. *A (#different) child* called the cat **every nickname**. — *QR:* ✓$\exists \gg \forall$; *$\forall \gg \exists$

(41) Raphael$_1$, we never discussed ___$_1$ as a possible name for him.
  (Postal 1994:164)

(42) [How many nicknames]$_1$ should Irene call the cat ___$_1$?
  *how many ≫ should; ✓should ≫ how many

3.2.4 Predicate Nominals *Wh*-movement (43b) can target predicate nominals, but topicalization (43c) and QR (43d) cannot. Furthermore, when *wh*-movement targets a predicate nominal, it must reconstruct, as shown in (44). This confirms the movement-type and scope predictions for predicate nominals.

(43) a. Erika became **a teacher**. — *Baseline*
  b. [**What (kind of teacher)**]$_1$ did Erika become ___$_1$? — Wh-*movement*

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c. *[**A math teacher**]$_1$, Erika became ___$_1$. *Topicalization*
d. *A (#different) student* became **every kind of teacher**. *QR:* $\checkmark\exists \gg \forall$; $*\forall \gg \exists$

(44) [How many kinds of teacher]$_1$ should Erika become ___$_1$?
*how many $\gg$ should; $\checkmark$should $\gg$ how many

3.3 Putting Together the Pieces

The data from the previous section showed that (a) movement that targets a DP in a property position must reconstruct, and that (b) movement types that cannot reconstruct cannot target DPs in property positions. Descriptively, these facts indicate that the representation of scope-shifting movement is incompatible with property positions, hence the requirement to reconstruct. Crucially, the representation of scope-shifting movement is a *trace*, and property positions would require property traces. Taken together, then, I argue that these data indicate that movement cannot map onto a trace ranging over properties (45).

(45) *No property traces*
$*[\mathrm{DP}_1\ [\lambda f_{\langle e,t\rangle}\ [\ \ldots\ [f_{\langle e,t\rangle}]_1\ \ldots\ ]]]$

It should be noted that when the moved DP is type $\langle e, t\rangle$, a property trace is difficult—if not impossible—to detect because it would not affect the moved DP's scope. The crucial case then is when the moved DP quantifies over properties, that is, type $\langle\langle\langle e, t\rangle, t\rangle, t\rangle$. Here, a trace of type $\langle e, t\rangle$ would allow the moved DP to have the shifted-scope readings that were shown above to be unavailable. Therefore, we can draw the conclusion that property traces are unavailable across the board.[19]

A grammar without property traces (45), per the TIC, straightforwardly derives the behavior of movement targeting DPs in property positions: There is no trace representation compatible with property positions because traces of type $\langle e, t\rangle$ are prohibited, and a trace of some other type—in particular type e, the relevant individual type allowed by the TIC—would result in a semantic-type mismatch and would therefore be ungrammatical (46). Reconstruction obviates this problem by placing the moved DP back in its launching site at LF. If a DP would not ordinarily violate the type requirement of property positions—that is, if it has an $\langle e, t\rangle$ meaning—then it will not do so under reconstruction either (47).

(46) $*[\mathrm{DP}\ \lambda x_e\ \ldots\ [\ \ldots\ [x_e]_{\text{prop-pos}}\ \ldots\ ]]$
type-e trace

(47) $[\cancel{\mathrm{DP}_1}\ \ldots\ [\ \ldots\ [\mathrm{DP}_1]_{\text{prop-pos}}\ \ldots\ ]]$
reconstruct

[19] The alternative analysis is that a property trace is unavailable only for DPs of type $\langle\langle\langle e, t\rangle, t\rangle, t\rangle$. This analysis is less principled and requires a more ad hoc stipulation than the analysis I am proposing here, wherein all property traces are banned.

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According to this analysis, then, property positions are an instance where movement *must reconstruct* in order to avoid a semantic-type mismatch that would occur if a trace were used.

A consequence of the ban on property traces is that quantificational DPs in property positions cannot be interpreted via QR, since the requisite trace is unavailable. Therefore, they must be interpreted in situ. Fully addressing this issue is beyond the scope of this article. However, as a proof of concept, a sketch of how this in-situ semantic composition might work is given in (48) for existential constructions, where *there is* stands in for the existential component of the meaning that combines with a property.[20]

(48) There was*n't* **every kind of doctor** (at the convention). $\checkmark \neg \gg \forall$; $*\forall \gg \neg$
  a. LF: [NEG [there-is [every kind of doctor]]]
  b. $[\![\text{there is}]\!] = \lambda P_{\langle e,t\rangle} \,.\, \exists x_e[P(x)]$
  c. $[\![\text{every kind of doctor}]\!] = \lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle} \,.\, \forall K_{\langle e,t\rangle}\, [\textsc{doctor-kind}(K) \rightarrow \mathcal{Q}(K)]$
  d. $[\![\text{there isn't every kind of doctor}]\!] = \neg\, [\![\text{every kind of doctor}]\!]\,([\![\text{there is}]\!])$
  $= \neg\forall K_{\langle e,t\rangle}\, [\textsc{doctor-kind}(K) \rightarrow \exists x_e[K(x)]]$

The quantificational pivot in (48) is interpreted in situ, without QR or any kind of special type shifting. The analysis sketched in (48) extends to the other three property positions if we adopt small-clause structures for them (as has been independently proposed in Stowell 1981, 1983, Kratzer 2005, and Matushansky 2008, among other works); this is schematized in (49).

(49) a. [a contractor [paint [$_{SC}$ [the house]$_{\langle\langle e,t\rangle,t\rangle}$ [every color]$_{\langle\langle\langle e,t\rangle,t\rangle,t\rangle}$]]] (= (37a))
  b. [a child [call [$_{SC}$ [the cat]$_{\langle\langle e,t\rangle,t\rangle}$ [every nickname]$_{\langle\langle\langle e,t\rangle,t\rangle,t\rangle}$]]] (= (40d))
  c. [become [$_{SC}$ [a student]$_{\langle\langle e,t\rangle,t\rangle}$ [every kind of teacher]$_{\langle\langle\langle e,t\rangle,t\rangle,t\rangle}$]] (= (43d))

Thus, while I leave fleshing out the details to future research, there is no principled obstacle to interpreting quantificational DPs in property positions in situ.

4 The Trace Interpretation Constraint

4.1 Proposal

As mentioned at the outset, DPs come in three semantic guises—entities, properties, and generalized quantifiers—and they can, with some restrictions, flexibly shift from one type to another (Partee 1986). The previous two sections have argued that traces cannot be types $\langle\langle e, t\rangle, t\rangle$ and $\langle e, t\rangle$. Therefore, of the three possible semantic types for DPs, only traces of type e are allowed. In light of this, I propose that the bans on GQ traces and property traces are products of a more general prohibition against *all* traces of higher semantic types, which I formulate as the *Trace Interpretation Constraint* (TIC) in (50) (= (2)).[21]

[20] (48) is more acceptable with what is called a coda (e.g., *at the convention*), but the semantics of the coda is complicated (see McNally 1992, 1997), so I exclude it from the sketch in (48) for the sake of simplicity.

[21] There must be something that rules out the grammar using an individual-type trace, but lifting its type—for example, so that it can be used in property positions (see also F. Landman 2004). Otherwise, the TIC would effectively be vacuous—a constraint in name only—because it could always be circumvented under the surface. The data in sections 2 and 3 would also be unexpected. I will take it for granted here that traces cannot be type-shifted.

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(50) *Trace Interpretation Constraint (TIC)*
$*[\mathrm{XP}_1\ [\lambda f_\sigma\ [\ \ldots\ [f_\sigma]_1\ \ldots\ ]]]$, where σ is not an individual type.

According to the TIC, traces may only range over individual (i.e., primitive) semantic types, such as type *e* for entities and type *d* for degrees.

In sections 2 and 3, we saw three different restrictions: from section 2.1, reconstructed scope is blocked if evaluating the moved element in its launching site at LF would violate Condition C (Romero 1997, 1998, Fox 1999); from section 2.2, an entity trace is obligatory even in instances where, in principle, a GQ trace should be possible as well; and from section 3, movement out of property positions obligatorily reconstructs. The TIC provides a unified account of all of these restrictions. It attributes them to the ungrammaticality of higher-type traces, specifically of types $\langle\langle e, t\rangle, t\rangle$ and $\langle e, t\rangle$. However, the details differ in each case, reflecting different repercussions of the TIC, so let us consider each case in turn.

First, recall from section 2.1 that syntactic reconstruction and GQ traces both produce reconstructed-scope interpretations. The difference between the two mechanisms is that reconstruction correctly predicts that reconstructed scope is sensitive to Condition C, and GQ traces do not (Romero 1997, 1998, Fox 1999). Without additional stipulations, GQ traces thus overgenerate reconstructed-scope readings. According to the TIC, GQ traces are unavailable in the grammar, hence cannot be used to produce reconstructed-scope interpretations. Consequently, to achieve reconstructed scope, the grammar must employ reconstruction, thereby yielding the observed correlation between scope and Condition C.

Second, section 2.2 discussed cases where movement must map onto a trace representation: ACD resolution, extraposition, and parasitic-gap formation. Crucially, both entity traces and GQ traces would in principle satisfy the need for a trace representation. That is, the movement step would serve its intended purpose, and the derivation would semantically converge. However, in each of these cases the moved element obligatorily takes scope in its *landing* site. GQ traces fail to predict this scope shifting. They would permit a trace representation in which the moved element takes scope in its *launching* site. Under the TIC, however, the only available trace representation is an individual-type trace. Accordingly, if a trace representation must be used to achieve some purpose, then the moved element will necessarily take scope in its landing site.

Third, under the TIC, movement is tightly restricted in how it can be interpreted. It only has two possible semantic representations: an individual-type trace and reconstruction. This restrictiveness has a crucial consequence: if an individual-type trace would be incompatible with the launching site of movement, reconstruction is forced. Property positions are such a case: traces of type *e* are type-incompatible with property positions, which require expressions of type $\langle e, t\rangle$. Therefore, the only option for interpreting movement that targets a DP in a property position is to reconstruct. I discuss another such case—namely, movement of VPs and APs—in section 4.2. Another way of framing this point is that traces are prohibited in positions that require a higher-type expression, such as property positions. This generalization, stated in (51), will be relevant in section 5.3.

(51) Higher-type positions prohibit traces (and thus require reconstruction).

It is important here to emphasize that the TIC is not a constraint on movement itself, and it also never drives movement. Movement takes place in the syntax—for whatever reason—and the TIC

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restricts how the resulting dependency may be interpreted. The only case where the TIC yields outright ungrammaticality is when (a) an individual-type trace is incompatible with the launching site of movement and (b) reconstruction—for reasons not yet understood—is independently blocked. This is what happens, say, when topicalization targets a DP in a property position: because property positions require reconstruction and topicalization cannot reconstruct, the movement is ungrammatical (see section 3.2).

The discussion so far has not touched on intermediate landing sites, but only in order to simplify the exposition. To generate the unavailable readings and sentences in sections 2 and 3, it would be necessary for at least one of the steps in the movement chain to map onto a higher-type trace. The argumentation against higher-type traces is not fundamentally changed by which step in the chain does so. The TIC blocks higher-type traces wherever they might occur and thus blocks them in intermediate positions as well.

Finally, the argumentation here has focused on the entity domain (i.e., DPs), but the TIC is formulated more generally to include all semantic types. For example, the TIC allows traces of type *d* (degrees) and type *s* (situations/worlds), but not type $\langle d, t\rangle$ (a property of degrees) or type $\langle\langle s, t\rangle, \langle s, t\rangle\rangle$ (a modal). Extending the TIC to all semantic types seems to make the right empirical cut, given what we know about the semantics of movement thus far: First, though not anywhere near as ubiquitous as traces of type *e*, individual-type traces are used to some extent in other ontological domains. For instance, traces of type *d* are widely used in analyses of degree constructions (e.g., Heim 1985, 2000, Bhatt and Pancheva 2004). To the best of my knowledge, though, there are no (explicit) proposals for higher-type traces in these other domains.[22] Second, in the case of moving a CP, where we might expect movement to leave a propositional trace (type $\langle s, t\rangle$), Moulton (2015) independently argues that such movement in fact leaves a trace of type *e*. Neither of these points, of course, is itself evidence for the absence of higher-type traces in these other domains, but it is very suggestive and highlights the need for further research.

That notwithstanding, prohibiting higher-type traces for all semantic types does have an immediate empirical upshot outside of the data in sections 2 and 3—namely, with VP- and AP-movement. I now turn to this topic.

4.2 *VP- and AP-Movement*

It is well-known that movement of VPs and APs displays binding-theoretic connectivity effects that movement of ordinary DPs does not (Barss 1986, Huang 1993, Heycock 1995, Takano 1995).[23] This contrast is illustrated in (52) and (53) for Conditions A and C, respectively. In (52),

[22] There are analyses that *use* higher-type traces in these other domains, for example, in the semantics literature. However, there are no proposals explicitly claiming that such traces *must* exist and that syntactic reconstruction would not work equally well.

[23] VPs and APs are traditionally considered "predicates," which might make them seem identical to property positions. However, given the VP-Internal Subject Hypothesis, VPs/APs are not actually predicates, because all of their arguments are saturated internally. This holds true even if the external argument is severed from the verb, in which case both VP and vP denote propositions (Kratzer 1996). Thus, even though I will argue that VPs/APs and DPs in property positions obligatorily reconstruct because of the TIC, it is important to recognize that they are not one and the same phenomenon.

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an anaphor in a moved DP may have an antecedent in the clause where it originates or in the clause it moves to (52a), but an anaphor in a moved AP or VP may only have an antecedent in the clause where it originates (52b–c).

(52) *Condition A connectivity*
   a. $[_{\text{DP}}$ Which picture of **herself**$_{2/3}]_1$ does **Sophia**$_2$ think that **Rose**$_3$ admired $\_\__1$?
   b. $[_{\text{AP}}$ How proud of **herself**$_{*2/3}]_1$ does **Sophia**$_2$ think that **Rose**$_3$ is $\_\__1$?
   c. $[_{\text{VP}}$ Criticize **herself**$_{*2/3}]_1$, **Sophia**$_2$ thinks that **Rose**$_3$ will not $\_\__1$.
   (based on Heycock 1995:548)

In (53), an R-expression in a moved DP does not result in a Condition C violation when a coindexed pronoun c-commands the launching site of movement (53a), but an R-expression in a moved VP or AP does (53b–c).[24]

(53) *Condition C connectivity*
   a. $[_{\text{DP}}$ Which allegations about **Sophia**$_2]_1$ do you think that **she**$_{2/3}$ denied $\_\__1$?
   b. $[_{\text{AP}}$ How proud of **Sophia**$_2]_1$ do you think that **she**$_{*2/3}$ is $\_\__1$?
   c. $[_{\text{VP}}$ Criticize **Sophia**$_2]_1$, you think that **she**$_{*2/3}$ will not $\_\__1$.
   (based on Heycock 1995:548–549)

The consensus in the literature is that VPs and APs obligatorily reconstruct, while DPs do so only optionally (modulo independent factors that might force or block reconstruction).[25] Because VPs and APs obligatorily reconstruct, they are always evaluated for binding theory in their base position. Thus, in (52b–c) the only possible antecedent for *herself* is *Rose*, and in (53b–c) *Sophia* is necessarily c-commanded by *she*, thereby violating Condition C. Moved DPs, on the other hand, can be evaluated for binding theory in either their launching site (i.e., by reconstructing) or their landing site (i.e., by using a trace). Consequently, in (52a) either *Rose* or *Sophia* may antecede *herself—Rose* from the launching site and *Sophia* from the landing site.[26] In (53a), the moved DP can be evaluated in its landing site, so that *Sophia* is not c-commanded by *she*, thus obeying Condition C.

The TIC provides a straightforward explanation for why this reconstruction is obligatory. VPs and APs denote higher-type expressions. Under the simplest assumptions, they denote propo-

[24] There is some disagreement in the literature about whether moved DPs exhibit Condition C connectivity and if they do, when precisely they do so (e.g., Adger et al. 2017, Bruening and Al Khalaf 2019, Stockwell, Meltzer-Asscher, and Sportiche 2021). However, this disagreement does not extend to VPs and APs, for which the judgments about Condition C are sharper and more agreed-upon, so this contention does not affect what is at hand.

[25] Note that in English, fronting VPs and APs (outside of questions) must be different from topicalizing DPs, even though both are commonly called "topicalization," because the former must reconstruct and the latter cannot (see section 3.1). This is supported by the fact that in English (a) fronting of DPs is itself not a uniform phenomenon (Ross 1967, Prince 1981) and (b) fronted VPs/APs and topicalized DPs seem to have different prosodies and meanings.

[26] Technically, when the moved DP is being evaluated for Condition A in its "landing site," it is in fact being evaluated in its intermediate position at the edge of the embedded CP, a position from which *Sophia* c-commands *herself* within its binding domain (e.g., phase).

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sitions ($\langle s, t\rangle$). Taking into account tense and aspect, they might also be taken to denote predicates of times ($\langle i, \langle s, t\rangle\rangle$), predicates of events ($\langle v, \langle s, t\rangle\rangle$), or some amalgam thereof. Nevertheless, what is crucial is that VPs and APs are of *some* higher type. As a result, the TIC does not permit traces that could represent VPs and APs, because they would have to be higher-type traces, which the TIC prohibits. Without licit trace representations, movement of VPs and APs is thereby forced to reconstruct, which accounts for the binding connectivity effects in (52) and (53) as a side effect of the more general principle in (51).

There is not sufficient space here to do justice to the alternative accounts of why VPs and APs must reconstruct (e.g., Heycock 1995, Takano 1995). In short, these other analyses are in principle compatible with the TIC. However, if the TIC holds, as I have argued here on independent grounds, they become unnecessary.

5 Traces as Definite Descriptions

Thus far, this article has depicted traces as simplex variables (54a). Numerous works on the interpretation of movement, however, have argued that traces are in fact *bound definite descriptions* (54b) (Sauerland 1998, 2004, Fox 1999, 2002, 2003), an idea that can be traced back to the seminal work of Engdahl (1980, 1986). As definite descriptions, traces are more articulated than simplex variables because they contain content, namely, an NP restrictor. I will refer to this hypothesis as *traces-as-definites.*

(54) a. *Traces as simplex variables*
[**every cat**] [1 [a child adopted $\boldsymbol{t_1}$]]
b. *Traces as bound definite descriptions*
[**every cat**] [1 [a child adopted [**the cat 1**]]]
($[\![\text{the cat 1}]\!]^g = \iota x[\textsc{cat}(x) \wedge x = g(1)]$, where $\exists! y[\textsc{cat}(y) \wedge y = g(1)]$)

The most well-known approach for achieving the LF in (54b) is *Trace Conversion* (Fox 1999, 2002, 2003). Trace Conversion involves applying two processes at LF to the lower copy of a movement step: inserting a variable (55a) and replacing the determiner with a definite determiner (55b). The inserted variable denotes an identity function over an index, and it conjoins with the predicate denoted by the NP. The index is bound by the λ-operator introduced below the landing site of movement, in the same manner as a simplex-variable trace (see (4)–(6)). The result is a bound definite description.

(55) *Trace Conversion*
a. *Variable Insertion*
(Det) Pred $\rightarrow$ (Det) [[Pred] [$\lambda y \,.\, y = g(n)$]]
(where g is the assignment)
b. *Determiner Replacement*
(Det) [[Pred] [$\lambda y \,.\, y = g(n)$]] $\rightarrow$ the [[Pred] [$\lambda y \,.\, y = g(n)$]]
(Fox 2002:67)

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For the purposes of this article, it is inconsequential exactly *how* the LF in (54b) is achieved—that is, traces do not need to be literally "converted"—but I will assume Trace Conversion (i.e., an LF process) in the interest of concreteness.[27]

The impetus behind traces-as-definites has by and large been the copy theory of movement. If the copies in the launching and landing sites of movement were to both be interpreted as is, (a) there would be no semantic connection between the two—they would effectively be repetitions—and (b) in many cases, the semantic composition would not converge, due to semantic-type mismatches. By interpreting the lower copy as a bound definite description, the grammar is making the most minimal change possible that would render the structure interpretable.

This section argues that the TIC provides a new kind of evidence for traces-as-definites. It tests a prediction: if traces are definites, then the TIC should be reflected (in some capacity) with definites as well. I show that this prediction is borne out. The argumentation rests on a not-widely-recognized connection between traces-as-definites and the weak/strong-definite distinction drawn by F. Schwarz (2009): if traces are definites, then they must belong to a certain class of definites known as *strong definites* (section 5.1). I show that strong definites cannot occur in environments where a DP must be a higher semantic type—the same positions that ban traces under the TIC (section 5.2). Thus, traces and strong definites have the same distribution with respect to semantic types. This parallel is captured under the hypothesis that traces *are* just definites. Against this backdrop, the TIC is a manifestation of a more general constraint on strong definite descriptions (section 5.3).

5.1 Traces and the Weak/Strong-Definite Distinction

F. Schwarz (2009) argues that there are two types of definite descriptions: *weak* definites, which encode situational uniqueness, and *strong* definites, which are anaphoric.[28] The distinction between weak and strong definites manifests morphosyntactically in some languages, though not in English. For example, in German the determiner in weak definites must contract with prepositions whenever morphologically possible (56a), but the determiner in strong definites can never contract with prepositions (56b).

(56) a. Hans ging **zum** **Haus**.
Hans went to.the$_{\text{WEAK}}$ house
'Hans went to the house.'
b. Hans ging **zu dem** **Haus**.
Hans went to the$_{\text{STRONG}}$ house
'Hans went to the house.'
(F. Schwarz 2009:7)

[27] The standard formulation of Trace Conversion in (55) is designed for DPs. For a category-general version of Trace Conversion, which is compatible with the proposals here, see Moulton 2015.

[28] The literature on definite descriptions is extensive, and I do not do it justice here. For more on the topic, see F. Schwarz 2009 and the references therein.

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Schwarz shows that the different morphosyntactic forms in (56) are restricted to certain kinds of uses, reflecting the distinction between weak and strong definites. These interpretive distinctions will be discussed in section 5.2, where they are retooled as diagnostics for weak and strong definites in English.

According to F. Schwarz's (2009) analysis, what makes a definite a strong definite is the presence of an *index* (see also Elbourne 2005). The interpretation of the index depends on the assignment function, as the interpretation of a pronoun does. Thus, the index can be valued contextually or be bound by a quantificational expression. The presence or absence of an index in the definite description is encoded in the denotation of the determiner. Thus, there are two definite determiners: one that does *not* take an index, thereby producing a weak definite (57a), and one that does take an index, thereby producing a strong definite (57b). (The presuppositional part of the meaning is excluded in (57) for ease of presentation.)

(57) a. $[\![\text{the}_{\text{WEAK}}]\!] = \lambda s\ \lambda \mathrm{P}_{\langle e,\langle s,t\rangle\rangle}\ .\ \iota x[\mathrm{P}(x)(s)]$
b. $[\![\text{the}_{\text{STRONG}}]\!] = \lambda s\ \lambda \mathrm{P}_{\langle e,\langle s,t\rangle\rangle}\ \underbrace{\lambda y}_{\text{index}}\ .\iota x[\mathrm{P}(x)(s) \wedge \underbrace{x = y}_{\text{index}}]$

Against this backdrop, consider where traces fit into the picture. If traces are definite descriptions—as I am arguing for here—then they would be strong definites, because they are anaphoric and have an index. In fact, traces would *have to* be strong definites because having an index is a prerequisite for the bound interpretation that traces require.[29] In the case of traces, the index of the strong definite is bound by the λ-operator inserted below the landing site of movement, which is syntactically represented as a copied index (58).

(58) $\underbrace{[_{\text{DP}} \text{ every cat}]}_{\text{moved exp}}\ [1\ [\text{a child adopted } \underbrace{[_{\text{DP}}\ 1\ [\text{the}_{\text{STRONG}} \text{ cat}]]}_{\text{trace}}]]$

Weak definites, on the other hand, would be inadequate for representing traces because they lack an index and hence cannot be bound.

Note that the standard formulation of Trace Conversion in (55) already produces a strong definite equivalent to (58), though not of exactly the same syntactic form. However, it is trivial to recast Trace Conversion to produce a structure in line with F. Schwarz's (2009) analysis. Moreover, there are other proposals in the literature about the structure of strong definites, in particular about the position of the index (e.g., Simonenko 2014, Hanink 2018), which are equally compatible with the proposals in this article. Trace Conversion could be adapted to produce the strong-definite structures of these other proposals as well.

[29] F. Schwarz (2009:261) briefly mentions this connection between traces and strong definites.

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5.2 Definites in Higher-Type Positions

This section argues that higher-type DP positions—that is, positions that require expressions of type $\langle e, t\rangle$ or $\langle\langle e, t\rangle, t\rangle$—prohibit strong definites, as stated in (59). Therefore, definite descriptions in higher-type positions are necessarily weak definites.

(59) Higher-type positions prohibit strong definite descriptions.

Because the weak/strong-definite distinction does not manifest morphosyntactically in English, determining whether a definite is weak or strong requires probing its interpretation. This probing requires some indirect reasoning, which is worth spelling out explicitly: It is possible to create contexts where only a strong definite would be felicitous. Two properties that distinguish strong definites from weak definites, and thus can be used to create such contexts, are that (a) strong definites must have an antecedent and that (b) strong definites do not have to satisfy the uniqueness requirement that weak definites do (F. Schwarz 2009). I will show that definite descriptions can occur in higher-type positions, but that when these two conditions are satisfied and controlled for, they become infelicitous. Because definites can felicitously occur in higher-type positions, but not in these contexts that allow only strong definites, we can reason that it must be the case that the definites in higher-type positions are necessarily weak definites. The infelicity then arises because the uniqueness requirement of weak definites is not satisfied in the strong-definite context.

Let us proceed by first investigating definite descriptions in property positions and then turning to GQs. (A note on judgments: many of the infelicitous English examples in this section are improved by replacing *the* with *that*; I will return to this point in section 5.3.)

5.2.1 Property Positions (60) shows that definite descriptions are in principle allowed in property positions—and thus have $\langle e, t\rangle$-meanings—but it does not reveal what *kinds* of definite descriptions are allowed.

(60) a. A: What shall we dig up this year? *Existentials*
B: Well, there are **the peonies**.
(McNally 1998:366)
b. Megan painted the house **Anna's favorite color**. *Change-of-color verbs*
c. Irene called the cat **that dumb nickname**. *Naming verbs*
d. Erika became **the best kind of teacher**. *Predicate nominals*

I present three arguments that definites in property positions are necessarily weak definites. The arguments are based on interpretive properties of weak and strong definites noted by F. Schwarz (2009). To illustrate the properties, I use German examples, where the morphosyntactic distinction (see (56)) can be tracked alongside the interpretation.

The first argument is based on discourse anaphoric uses of strong definites: namely, that a strong definite can refer back to a previously mentioned indefinite in contexts where uniqueness is not satisfied. Starting with a German baseline, (61) shows that the definite *dem Zimmer* can refer back to the indefinite *eines der Zimmer*, but only if it is a strong definite, as reflected in the inability of the determiner to contract with the preposition. The partitive form of the indefinite crucially indicates the presence of several rooms in the situation. Thus, in (61) the uniqueness

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requirement of the weak definite is not satisfied, yielding infelicity. The strong definite, on the other hand, is able to convey that the intended referent is the indefinite in the preceding sentence, because it is anaphoric.

(61) Bei der Gutshausbesichtigung hat mich **eines der Zimmer** besonders
during the mansion.tour has me one the.GEN rooms especially
beeindruckt. Angeblich hat Goethe im Jahr 1810 eine Nacht {**#im** /
impressed supposedly has Goethe in.the$_{\text{WEAK}}$ year 1810 a night in.the$_{\text{WEAK}}$
in dem } **Zimmer** verbracht.
in the$_{\text{STRONG}}$ room spent
'One of the rooms especially impressed me during the mansion tour. Supposedly Goethe spent a night in the room in 1810.'
(F. Schwarz 2009:30)

(62) sets up a parallel configuration in English. The definite *the color* is able to refer back to the indefinite *one of the colors.* As with the German example in (61), the partitive form of the indefinite in (62) indicates that there are several colors in the situation. Thus, the definite does not involve a uniqueness interpretation; rather, it is anaphoric.

(62) Blanche picked out **one of the colors** for the living room, but Dorothy thought that **the color** was too dark.

Morphosyntactically, the definite in (62) is ambiguous between weak and strong, since English does not morphosyntactically distinguish the two. However, given the felicity of the definite in this particular context, where a weak definite's uniqueness requirement would not be satisfied, it must be the case that it is a strong definite; this matches up with its anaphoric interpretation. Crucially, in the same context, a definite description in a property position is infelicitous, as illustrated in (63) with a change-of-color verb.

(63) #Blanche picked out **one of the colors** for the living room, and Dorothy painted the room [**the color**]$_{\text{prop-pos}}$.

The infelicity of (63) indicates that the definite description in the property position cannot be a strong definite; otherwise, it would have a felicitous reading, as (62) does. Rather, it can only be a weak definite. The uniqueness requirement of weak definites is not satisfied in this context, thereby yielding infelicity. (64)–(66) show that the same contrast holds for the other property positions as well.[30]

(64) Susan saw **one of the congresswomen** walk into the room. *Existentials*
a. So, (at least) **the congresswoman** was at the cabinet meeting.
b. #So, in the cabinet meeting, there was (at least) [**the congresswoman**]$_{\text{prop-pos}}$.

[30] (64), (70), and (74) are so-called list existentials, which are already somewhat marked independently (McNally 1992, 1997). A definite description is allowed in a list existential, but only on a weak-definite reading: *Who was in the cabinet meeting? Well, there was the congresswoman.* This example is felicitous only on a weak-definite reading, and it implies that the meeting had only one congresswoman.

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(65) My mother liked **one of the names** in the baby book. *Naming verbs*
  a. My grandmother had wanted to give **the name** to my uncle.
  b. #My grandmother had wanted to call my uncle [**the name**]$_{\text{prop-pos}}$.

(66) Anna decided on **one of the types of doctor** to become. *Predicate nominals*
  a. **The type (of doctor)** made a lot of money.
  b. #And she became [**the type (of doctor)**]$_{\text{prop-pos}}$.

The second argument involves covarying interpretations in which a strong definite covaries with an indefinite in a quantificational sentence.[31] For example, in the German baseline in (67) the strong definite *dem Buch* covaries with the indefinite *ein Buch über Topinambur* for each library. That is, for library *a*, they both pick out book *a′*; for library *b*, they both pick out book *b′*; and so on. As reflected in the inability of the determiner to contract with the preposition, a weak definite does not allow the same covarying interpretation.

(67) In jeder Bibliothek, die **ein Buch über Topinambur** hat, sehe ich {#**im** / **in dem**} **Buch** nach, ob man Topinambur grillen kann.
  in every library that a book about topinambur has look I in.the$_{\text{WEAK}}$ in the$_{\text{STRONG}}$ book PRT whether one topinambur grill can
  ‘In every library that has a book about topinambur, I check in the book whether one can grill topinambur.’
  (F. Schwarz 2009:33)

In the situations being quantified over, there may be more than one book about topinambur in each library and, by extension, in each situation. Thus, in (67) the weak definite is infelicitous because its uniqueness requirement is not satisfied. The strong definite, on the other hand, is able to achieve the covarying interpretation in (67) by virtue of its anaphoricity (for the specifics, see F. Schwarz 2009:253–276). Turning to English, in (68) the definite *the color* is able to covary with the indefinite *a color*, even though the situations being quantified over may contain more than one color and thus would not satisfy uniqueness. Again, the definite in (68) is morphosyntactically ambiguous, but its felicity in the particular context reveals that it must be a strong definite.

(68) Every time Blanche picks out **a color** for the bathroom, Dorothy complains that **the color** is too bright.

In the same context, a definite description in a property position is infelicitous, as shown in (69) with a change-of-color verb. This infelicity indicates that the definite in (69) can only be a weak definite and that its uniqueness requirement is not being satisfied.

(69) #Every time Blanche picks out **a color** for the bathroom, Dorothy has to paint the room [**the color**]$_{\text{prop-pos}}$.

[31] There are also covarying interpretations involving weak definites—namely, *donkey* sentences—which are not discussed here for reasons of space.

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(70)–(72) show that the same contrast holds for the other property positions as well.

(70) In every hotel room with **an ugly lamp**, . . . *Existentials*
  a. **the lamp** is on the dresser.
  b. #there is [**the lamp**]$_{\text{prop-pos}}$ on the dresser.

(71) Every time that my mom found **a new puppy name**, . . . *Naming verbs*
  a. my dad vetoed **the name**.
  b. #she nicknamed the family dog [**the name**]$_{\text{prop-pos}}$.

(72) In every store with **a rare type of plant**, . . . *Predicate nominals*
  a. my aunt bought **the rare type**.
  b. #my aunt bought a plant that was [**the rare type**]$_{\text{prop-pos}}$.

While the previous two arguments focused on strong definites not being permitted in property positions, the third argument involves the inverse: showing that weak definites can indeed occur in property positions. There are special contexts that independently require a weak definite, which are called *bridging contexts*. In a bridging context, there is a part-whole relation between a definite description and the individuals and events in the preceding discourse, which is sufficient to satisfy uniqueness. As shown in (73), bridging contexts in German require a weak definite.

(73) **Der Kühlschrank** war so groß, dass der Kürbis problemlos {**im** /
  the fridge was so big that the pumpkin without.a.problem in.the$_{\text{WEAK}}$
  #**in dem** } **Gemüsefach** untergebracht werden konnte.
  in the$_{\text{STRONG}}$ crisper stowed be could
  'The fridge was so big that the pumpkin could easily be stowed in the crisper.'
  (F. Schwarz 2009:52)

Discussion of why bridging contexts require weak definites and how the uniqueness requirement is satisfied in them can be found in F. Schwarz 2009:212–236.[32] (74) and (75) show that bridging contexts allow definite descriptions with existential constructions and change-of-color verbs, respectively. This compatibility explicitly shows that property positions allow weak definites. It is not clear (to me) how to go about constructing part-whole relations for names and predicate nominals—and (75) with change-of-color verbs is already pushing it—so they are not tested.

(74) *Weak definite in existential constructions*
  A: What did you like about **the fridge**?
  B: Well, there was [**the spacious vegetable crisper**]$_{\text{prop-pos}}$.

[32] F. Schwarz (2009) observes that there is another kind of bridging context that instead requires a *strong* definite and involves a producer-product relation. A similar contrast appears to hold in property positions as well (i). However, I leave exploring this contrast for future research.

(i) A: What did the critic not like about **the play**?
  B: #Well, there was **the author** who is a snob.

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(75) *Weak definite with change-of-color verbs*
(At the paint store, color palettes contain an accent color and two matching colors.)
Rose went to the store and picked out **the color palette** for the bathroom. The next morning, she painted the south-facing wall [**the accent color**]$_{\text{prop-pos}}$.

In sum, we have seen that in contexts that require a strong definite, definites in property positions are infelicitous, and in contexts that require a weak definite, they are felicitous. I take this pattern to indicate that property positions prohibit strong definites, and thus that all definites in property positions are weak definites, in support of the claim in (59).[33]

5.2.2 Generalized-Quantifier Positions Testing the claim in (59) for GQ positions is less straightforward than it is for property positions. Because there are no expressions that obviously denote functions taking a GQ as argument, there are not as readily available GQ positions as there are property positions—at least as far as we know. However, there is one instance in which a DP would necessarily have to be type $\langle\langle e, t\rangle, t\rangle$: when it conjoins with another expression that itself must be $\langle\langle e, t\rangle, t\rangle$. Conjoining two expressions requires that both expressions be the same semantic type (Partee and Rooth 1983). There is a certain class of GQs—called "strong," but unrelated to strong definites—that cannot have their type lowered to e or $\langle e, t\rangle$, such as *every NP* and *most NPs* (Partee 1986). To conjoin with a GQ of this class, the other DP needs to be type $\langle\langle e, t\rangle, t\rangle$ to match it, either by being born as such or by having its type lifted.[34] This configuration is schematized in (76).

(76) $[_{\&P}\ \text{GQ}_{\langle\langle e,t\rangle,t\rangle}$ and $\_\_\__{\langle\langle e,t\rangle,t\rangle}]_{\langle\langle e,t\rangle,t\rangle}$

The claim in (59) predicts that only weak definites may conjoin with GQs, because strong definites cannot occur in higher-type positions.

According to this prediction, in a context requiring a strong definite, a definite description conjoined with a GQ should be infelicitous, because the uniqueness requirement of a weak definite is not satisfied in the context. This prediction is tested in (77) using covarying interpretations, which require a strong definite (see (67)). In (77a), *the book* can covary with the indefinite when it stands on its own and is not conjoined with anything. Therefore, *the book* can in principle be a strong definite in this position. However, in (77b), when *the book* is conjoined with *every encyclopedia*, the sentence becomes degraded.

[33] Additionally, if we adopt Elbourne's (2005) proposal that pronouns are definite descriptions, we have a straightforward account of Postal's (1994) observation that property positions prohibit pronouns like *it*: these pronouns are strong definites and thus cannot occur in property positions (see footnote 12).

(i) a. *There is [**it**]$_{\text{prop-pos}}$ in the pantry. *Existential constructions*
b. *Megan painted the house [**it**]$_{\text{prop-pos}}$. *Change-of-color verbs*
c. *Irene called the cat [**it**]$_{\text{prop-pos}}$. *Naming verbs*
d. *Erika became [**it**]$_{\text{prop-pos}}$. *Predicate nominals*

[34] In the same vein as Partee (1986), I use the terms *lift* and *lower* without a commitment to where type shifting happens in the grammar.

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(77) In every library with **a book about topinambur** . . .
  a. I checked in **the book** to see if it can be grilled.
  b. ??I checked in **the book and every encyclopedia** to see if it can be grilled.

The only difference between these two sentences is the semantic type of *the book*: in (77a), it is type *e*, and in (77b), it is type $\langle\langle e, t\rangle, t\rangle$. I contend that the unacceptability of (77b) is due to infelicity: *the book* in (77b) must be a weak definite, since it is conjoined with a GQ (76), and its uniqueness requirement is not being satisfied in the context.

Conversely, in bridging contexts, which require a weak definite (see (73)), the prediction is that a definite should be able to conjoin with a GQ, because weak definites can freely occur in higher-type positions. This prediction is also borne out, as shown in (78).

(78) **The town** was so big that **the church (and every municipal building)** was impossible to find.

Assuming that (76) is a bona fide GQ position, as I have claimed, these two arguments support the claim in (59) that strong definites cannot occur in higher-type positions.

5.3 Discussion

We have now arrived at two generalizations about what is prohibited in higher-type positions; these are repeated in (79).

(79) a. Higher-type positions prohibit traces (and thus require reconstruction). (= (51))
  b. Higher-type positions prohibit strong definite descriptions. (= (59))

What these two generalizations reveal is that traces and strong definites form a *natural class*. This state of affairs is precisely what one expects under traces-as-definites. That is, the reason that traces are prohibited in higher-type positions is that (a) strong definites are prohibited in higher-type positions and (b) traces are strong definites. Therefore, (79a) can be subsumed under (79b). I take this parallel as a compelling argument in favor of the theory of traces-as-definites.

As a result, the TIC then is part of a more general constraint on definite descriptions, namely, one that (presumably) allows strong definites to only range over individual semantic types. The question that follows is why strong definites are subject to such a constraint, and weak definites are not. Put differently, why are weak definites type-flexible, but strong definites not? This question is beyond the scope of this article, but one important point worth mentioning here is that it is unlikely that the constraint is semantic, that is, coming directly from the meaning of strong definites. The only difference in meaning between weak and strong definites is that the latter are anaphoric (F. Schwarz 2009). Anaphoricity itself is perfectly fine in higher-type positions. In the strong-definite examples in section 5.2, the infelicitous cases with *the NP* in higher-type positions become acceptable, with the intended anaphoric interpretation, if *the* is replaced with *that*, as illustrated in (80) and (81).

(80) Every time Blanche picks out **a color** for the bathroom, Dorothy has to paint the room [**that color**]$_{\langle e,t\rangle}$. (cf. (69))

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(81) In every library with **a book about topinambur**, I checked in [**that book and every encyclopedia**]$_{\langle\langle e,t\rangle,t\rangle}$ to see if it can be grilled. (cf. (77b))

In (80) and (81), *that NP* is able to achieve the anaphoric interpretation that a strong definite is not. It is not entirely clear where *that NP* fits within the weak/strong-definite distinction, but (80) and (81) nevertheless show that anaphoricity alone cannot be what is behind the type restriction on strong definites (and traces).

Rather, it must be something else about strong definites. There is a growing body of work showing that weak and strong definites differ syntactically—in particular, that strong definites contain additional structure that weak definites do not (e.g, Simonenko 2014, Cheng, Heycock, and Zamparelli 2017, Patel-Grosz and Grosz 2017, Hanink 2018). I find this a promising direction for explaining this type restriction on strong definites (i.e., as an underlyingly syntactic phenomenon), but I leave pursuing this to future research.

In sum, this section has argued that strong definites are prohibited in higher-type positions, just as traces are. This parallelism receives a straightforward explanation if traces are themselves strong definites, as the theory of traces-as-definites asserts. Note that in the remainder of this article, I will continue to refer to "the TIC" for the sake of consistency, even though the constraint generalizes from traces to (all) strong definites.

6 Functional Questions

Constituent questions may have *functional readings* (Engdahl 1980, 1986, Groenendijk and Stokhof 1984). For illustration, consider (82). The *wh*-phrase in (82) does not range over pictures; rather, it ranges over picture-valued functions. For example, a possible answer to (82) is a function that when given a woman, returns her first picture—which roughly corresponds to the response *Her first picture.*

(82) [Which picture of herself$_2$]$_1$ does no woman$_2$ like __$_1$?

Building on Engdahl 1980, 1986, Heim (2019) argues that (82) denotes the set of propositions in (83) (here, simplified and ignoring intensionality).

(83) $\{p : \underbrace{\exists f}_{wh\text{-var}}[\underbrace{\forall y[\textsc{woman}(y) \rightarrow \textsc{pic-of}(f(y))(y)]}_{\text{characterizes } f} \wedge p = \neg\exists x[\textsc{woman}(x) \wedge x \text{ likes } \underbrace{f(x)}_{\text{trace}}]]\}$

The interrogative component of the *wh*-phrase in (82) corresponds to the existentially bound variable f in (83); let us refer to this as the *wh-variable.* In (83), f is a function of type $\langle e, e\rangle$ such that for every woman, it returns a picture of that woman. The different answers to (82) are functions that satisfy this criterion: for example, *her first picture*, *her prom picture.* In the *wh*-phrase's thematic position, there is function-argument structure: the functional *wh*-variable f takes as argument x, which is itself bound by *no woman.*

At first glance, it might appear that functional questions are problematic for the TIC because the *wh*-phrase ranges over functions, which are of higher semantic types, and the TIC bans higher-type traces. However, it is important here to distinguish between the *wh*-variable (i.e., the

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interrogative component) and the trace of the *wh*-phrase, because they are not one and the same. In simple cases, like (84a), it is conceivable to conflate the two, because they are the same semantic type. Consider, though, a *how many*–question like (84b): the *wh*-variable ranges over degrees (type *d*), but the *wh*-phrase as a whole is type *e*. If the *wh*-phrase in (84b) were to map onto a trace, that trace would be type *e*, not type *d*. In the same spirit, in a *how*-question like (84c), the *wh*-variable is type *d*, but the *wh*-phrase itself must reconstruct (see section 4.2); it does not map onto a trace of type *d*.

(84) a. **What**$_1$ did Alex eat ___$_1$? *wh*-var: *e*, *wh*-phrase: *e*
b. [**How many cookies**]$_1$ did Alex eat ___$_1$? *wh*-var: *d*, *wh*-phrase: *e*
c. [**How tall**]$_1$ is Alex ___$_1$? *wh*-var: *d*, *wh*-phrase: $\langle e, t\rangle$ or $\langle s, t\rangle$

What cases like (84b) and (84c) reveal is that there is no systematic relation between the *wh*-variable's type and the overall *wh*-phrase. Crucially, the type of the trace will always depend on the *wh*-phrase as a whole—that is, what actually moves—not the *wh*-variable.[35]

Functional questions involve *wh*-variables of higher semantic types (e.g., type $\langle e, e\rangle$ or $\langle e, \langle e, e\rangle\rangle$). The TIC, though, is not a constraint on variables; it is a constraint on traces. Therefore, it is unproblematic for the TIC that functional questions involve higher-type *wh*-variables. In addition, it turns out that independently, the *wh*-phrase in functional questions must reconstruct because it contains a bound variable (Romero 1998, Heim 2019). Consequently, functional questions do not even have trace representations that could violate the TIC in the first place.

There remains the issue of how the function-argument structure is introduced into the meaning in (83). According to Heim (2019), it involves covert pronouns in the *wh*-phrase and is unrelated to the *wh*-movement itself. For discussion, see Heim 2019; here, I note that Heim's analysis is fully compatible with the proposals in this article (see footnote 4).

7 Conclusion and Outlook

This article has argued that traces may only range over individual semantic types, a principle I have called the *Trace Interpretation Constraint* (TIC). Under the TIC, movement is tightly restricted in that it has only two possible semantic representations: an individual-type trace and reconstruction. I showed that the TIC provides a unified account of a variety of seemingly unrelated restrictions on movement and its interpretation. I then used the TIC to further probe the underlying nature of traces. I observed that definite descriptions cannot occur in positions requiring expressions of higher types, a restriction that parallels the TIC. I took this parallel as an argument in support of the theory that traces are bound definite descriptions (e.g., Sauerland 1998, 2004, Fox 2002).

The remainder of this article is devoted to two tasks: First, section 7.1 compares the TIC with previous proposals concerning possible traces. Second, section 7.2 outlines several questions that arise from the worldview of possible traces according to the TIC.

[35] It is sometimes assumed that the *wh*-phrase must move in order to bind the *wh*-variable. However, as the *wh*-variable's type is not generally related to the *wh*-phrase, this cannot be the case. There are various solutions to this problem, all of which are compatible with the claims in this article; see footnote 4.

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7.1 Comparison with Previous Proposals

7.1.1 Beck 1996 and Fox 1999 The TIC prohibits higher-type traces by imposing a constraint directly on traces. Fox (1999) proposes a more indirect way of blocking higher-type traces. He suggests that "the semantic type of a trace is determined to be the lowest type compatible with the syntactic environment" (Fox 1999:180), an idea that he attributes to Beck (1996). Let us call this proposal *Lowest Compatible Type* (LCT). LCT is designed to block GQ traces, and the logic is as follows: (a) argument positions are compatible with expressions of both type e and type $\langle\langle e, t\rangle, t\rangle$; (b) e is a lower type than $\langle\langle e, t\rangle, t\rangle$; and (c) thus, traces in argument positions may only be type e. The upshot of LCT is that it tries to derive the prohibition on higher-type traces from factors external to traces, namely, their syntactic environment. However, LCT faces two problems.

The first problem is conceptual: the lowest compatible type for a trace position cannot be determined in a strictly local manner. Computing the lowest compatible type requires knowing which semantic-composition rule will be used to interpret the position's parent, which in turn requires knowing the types of its children, which includes the trace—resulting in a circularity problem. Overcoming this problem requires comparing possible semantic derivations—that is, transderivationality, whose status is controversial.

The second problem is empirical. LCT does not in fact derive a *total* ban on higher-type traces. Consider property traces. In a position that requires a property-denoting DP, the lowest compatible type is $\langle e, t\rangle$. According to LCT, a trace of type $\langle e, t\rangle$ should therefore be possible in property positions. However, as argued in section 3, property traces are unavailable in the grammar. The TIC does not face this problem, because it does not depend on the syntactic environment of the trace, and thus it is more restrictive. A similar argument can be made for movement of VPs and APs (see section 4.2).

7.1.2 Chierchia 1984 Chierchia (1984) argues that *functors* (i.e., maps between categories) do not enter into anaphoric processes, a constraint that he calls *No Functor Anaphora.* Crucially, in his property-theoretic semantics properties are *not* functors, even in their predicative forms. They are taken as basic, roughly on par with individuals. With respect to pro-forms and ellipsis, No Functor Anaphora seems to be on the right track. In addition to pronouns, there are pro-forms and elliptical processes for APs, VPs, and NPs (85), all of which presumably denote properties (modulo predicate-internal subjects).

(85) a. **Waterproof**$_1$ phones are nice, but **such**$_1$ phones are expensive. *AP pro-form*
b. Whenever the baby **sleeps**$_1$, the mother does **so**$_1$ too. *VP pro-form*
c. Whenever the baby **sleeps**$_1$, the mother does Δ_1 too. *VP-ellipsis*
d. Sophia stole Dorothy's **hat**$_1$, but not Rose's Δ_1. *NP-ellipsis*

At the same time, there do not seem to be pro-forms and elliptical processes for determiners, prepositions, complementizers, connectives, and so on, which is precisely what No Functor Anaphora predicts. However, if we understand No Functor Anaphora as applying to traces, then it would face an immediate problem because it would permit property traces, since in Chierchia's semantics, properties are not functors. Thus, it fails to predict that DPs in property positions obligatorily

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reconstruct. For this reason, No Functor Anaphora is empirically too permissive with respect to traces—though it may be correct for anaphors.

7.1.3 M. Landman 2006 M. Landman (2006) proposes the *No Higher-Type Variables* (NHTV) constraint in (86). Note that for Landman, the domain of type *e* is multisorted and includes degrees, situations, times, kinds, and so on.

(86) *No Higher-Type Variables*
Variables in the LFs of natural languages are of type *e*.
(M. Landman 2006:1)

Building on Chierchia 1984, the arguments for NHTV come from subjecting to closer scrutiny the putative cases of property anaphora, like those in (85). Landman argues that it is possible to recast these anaphora either as variables over kinds or as deletion of fully articulated syntactic structure. With respect to movement, Landman is noncommittal about whether NHTV applies to traces (see M. Landman 2006:chap. 3). Moreover, given the arguments that traces are definite descriptions and not just variables (see section 5), it is unclear whether NHTV *could* apply to traces. This point is especially relevant under Landman's own definition of variable: "those LF objects that receive their denotation *solely* from an assignment function" (M. Landman 2006:2; emphasis added). These points notwithstanding, if NHTV were to apply to traces, then it would subsume the TIC.

However, there is an independent argument against NHTV: functional questions. As discussed in section 6, functional questions involve *wh*-variables of higher semantic types, such as types $\langle e, e\rangle$ and $\langle e, \langle e, e\rangle\rangle$. These functional variables are not the types of objects that can be (variables over) kinds, nor can they be replaced with deletion of syntactic structure. Thus, it is unclear how NHTV would extend to functional questions. On the other hand, functional questions are entirely unproblematic for the TIC because the TIC is a constraint on traces, not on variables.

7.2 Open Questions

The toolkit for interpreting movement under the TIC is simple: individual-type traces and reconstruction. The foremost next task, then, is to revisit phenomena that have been analyzed using the one tool that the TIC does not allow, higher-type traces, in order to see whether these phenomena are amenable to analysis in terms of the TIC's simpler toolkit. Some phenomena worth highlighting in this regard are sloppy VP-ellipsis (Hardt 1999, B. Schwarz 2000; cf. Tomioka 2008), verb clusters (Keine and Bhatt 2016), *as*-parentheticals (Potts 2002a,b; cf. LaCara 2016), and exceptional-scope indefinites (on some approaches; e.g., Demirok 2019, Charlow 2020). In addition to these phenomena, there are several other open questions that arise from the TIC, which I discuss below.

7.2.1 Condition A Connectivity Under ordinary circumstances, an anaphor can be bound from an intermediate landing site, as shown in (87).

(87) a. ***Maria**$_2$ said [that John liked [the picture of **herself**$_2$]].
b. [Which picture of **herself**$_2$]$_1$ did **Maria**$_2$ say [__$_1$ that John liked __$_1$]?

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If DPs in property positions must reconstruct, as argued in section 3, then an anaphor in a DP moved from a property position should not be able to be bound from an intermediate landing site because the DP must reconstruct into its base position at LF. Testing this prediction faces two complications. First, it requires using *picture*-NPs, but out of the four property positions investigated here, only existential constructions allow these kinds of phrases. For instance, the NPs *color of herself* and *name of herself* do not really make sense, so this prediction cannot be tested with change-of-color and naming verbs. Second, *picture*-NPs are subject to perspectival effects; under some proposals, they are exempt from binding theory (e.g., Pollard and Sag 1992, Reinhart and Reuland 1993). Nevertheless, the kinds of cases that would need to be tested are like those in (88). The prediction is that (88b) should be ungrammatical because *himself* cannot be bound by *John* in the base position of the *wh*-phrase. (Note that it is necessary to use *how many* in (88) to avoid violating the definiteness restriction on existential pivots.)

(88) a. [How many pictures of **herself**$_2$]$_1$ did John say [__$_1$ that **Maria**$_2$ wanted there to be __$_1$ in the gallery]?
b. ?[How many pictures of **himself**$_3$]$_1$ did **John**$_3$ say [__$_1$ that Maria wanted there to be __$_1$ in the gallery]?

Although (88b) is slightly degraded, the judgment is very subtle. Given this subtlety and the complications noted above, I leave exploring this prediction to future research.

7.2.2 Condition C Connectivity Reconstruction is standardly taken to induce Condition C connectivity, because the moved expression is placed back in its launching site at LF, where Condition C is evaluated (Heycock 1995, Romero 1997, 1998, Fox 1999). This assumption is also a crucial component of Romero's and Fox's argument against GQ traces (see section 2.1). The issue is that there does not appear to be Condition C connectivity for DPs moved from property positions, even though property positions force reconstruction (see section 3). For example, there is not a strong contrast between the property position in (89a) and the nonproperty position in (89b) (using the same configuration as (9)).

(89) a. [Which of the colors that **Alex**$_2$ had bought]$_1$ did **she**$_2$ paint the room __$_1$?
b. [Which of the colors that **Alex**$_2$ had bought]$_1$ did **she**$_2$ get rid of __$_1$?

If reconstruction induces Condition C connectivity, then (89a) should be ungrammatical, because the *wh*-phrase must reconstruct, and (89b) should be grammatical, on a derivation where the movement maps onto a trace. However, there does not seem to be a difference in acceptability between the two.

It is clear that there is more to the picture concerning Condition C connectivity and reconstruction effects. While I leave reconciling these issues to future research, there are two points worth highlighting here. First, the novel arguments against higher-type traces in this article do not involve Condition C; only the previous argument in the literature from Romero and Fox does. Therefore, dropping the assumption that reconstruction induces Condition C connectivity does not discredit the TIC. Second, two recent experimental studies have argued that moved DPs do not exhibit Condition C connectivity (Adger et al. 2017, Bruening and Al Khalaf 2019; cf. Stockwell,

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Meltzer-Asscher, and Sportiche 2021). These studies, while crucial to disentangling the overall issue of Condition C connectivity, have focused on the argument-adjunct distinction of Lebeaux effects (Lebeaux 1990, 2009), and not on the relation with quantifier scope. It would be worthwhile to adapt their experimental paradigms to further scrutinize the relationship between Condition C and scope.

7.2.3 ACD, Extraposition, and Property Positions DPs in property positions are able to host an ellipsis site in an ACD configuration and to be extraposed from, as shown in (90).[36]

(90) a. Megan painted the house **the (same) color** *(yesterday)* that Anna did Δ.
b. Irene called the cat **the (same) nickname** *(yesterday)* that Helen did Δ.
c. Erika became **the (same) kind of teacher** *(yesterday)* that Gloria did Δ.

The availability of ACD and extraposition with property positions is at odds with (a) the arguments from section 3 that QR cannot target DPs in property positions and (b) the analyses of ACD and extraposition wherein the host DP must undergo QR (see sections 2.2.1 and 2.2.2). ACD and extraposition with property positions are thus open problems. See Poole 2017:244–249 for observations suggesting that what is moving in (90) is potentially a larger constituent that *contains* the property position (e.g., a small clause) and is not the DP in the property position itself.[37]

7.2.4 Head Movement Head movement has limited semantic effects. For the vast majority of cases—in particular, moving verbal elements—head movement has *no* semantic effect. Given that verbal heads denote functions (e.g., $\langle e, \langle s, t\rangle\rangle$ for intransitive verbs), it follows from the TIC that these heads would be forced to reconstruct. First, a trace of the same semantic type as the head, which would allow for the head to remain in its landing site at LF, would violate the TIC and thus is prohibited. Second, an individual-type trace, which the TIC does permit, cannot semantically compose in the base position of a verbal head, because then its arguments would have nothing with which to compose. Thus, most cases of head movement would be forced to reconstruct under the TIC. Lechner (2006, 2007) argues that there are in fact cases where head movement has a semantic effect. Crucially, the cases that Lechner raises involve configurations where the head movement could map onto a trace of type *s*, which the TIC allows. (The same holds for the arguments involving ellipsis parallelism raised in Hartman 2011.) This is not to say that head movement necessarily takes place in the narrow syntax. However, if head movement is a syntactic process, then the TIC could serve to derive its restricted semantic behavior; I leave working out the details for future research.

[36] Notably, ACD with existential constructions is ungrammatical (Pesetsky 2000:11–14).

(i) *There will be [everyone that there should Δ] at the party.
(Pesetsky 2000:13)

[37] A reviewer raises another possible approach to ACD and extraposition with property positions: higher-type traces are allowed by the grammar (contra the TIC), but only as a *last resort*, namely, when an individual-type trace would not semantically compose and syntactic reconstruction is blocked. ACD and extraposition would be such cases and thus would permit property traces as a last resort.

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