∃-closure and alternatives[o]

Simon Charlow, *Rutgers University*

1   Contrast and closure

The central goal of Griffiths (2019) is to account for familiar contrasts such as (1) and (2), without a constraint like MaxElide penalizing non-maximal deletions (cf. Merchant 2008, Takahashi & Fox 2005). Grayed-out text represents elided material, and the numbered operators are syntactic triggers for the Predicate Abstraction rule (Heim & Kratzer 1998; the formal treatment of PA is reviewed in Section 2).

(1)   I know who [1 [$_\alpha$ JOHN$_F$ will call t$_1$]] and also who [2 [$_\beta$ MARY$_F$ will call t$_2$]].

(2)   *[$_\alpha$ SUE$_F$ knows who [1 John saw t$_1$]] and [$_\beta$ MARY$_F$ knows who [2 he did see t$_2$]] too.

Griffiths' theory works as follows (suppressing irrelevant details for simplicity). Ellipsis is licensed given a node β (reflexively) dominating the ellipsis site and a node α (reflexively) dominating the antecedent, such that β **Contrasts** with α, and vice versa, modulo **∃-closure**:

(3)   Contrast(β, α) iff for all assignments g, $[\![\beta]\!]^g \neq [\![\alpha]\!]^g$, and $[\![\alpha]\!]^g \in [\![\beta]\!]^g_f$.

(4)   ∃-closure: When assessing Contrast(β, α), ∃-bind free variables in β and α.

In addition to $[\![\alpha]\!]^g$ and $[\![\beta]\!]^g$ (α and β's 'normal' meanings relative to the assignment g) the definition of Contrast refers to $[\![\beta]\!]^g_f$, the set of Alternative Semantics meanings generated by varying the focused/F-marked material in β. (See Section 2 for an overview of AS.)

According to Griffiths, ellipsis in (1) is licensed because its α and β nodes Contrast with each other, modulo ∃-closure. Griffiths suggests that Contrast associates both of these phrases

with the AS value in (5), which results from ∃-closing the free-variable traces, and varying the focused subjects. Clearly, the normal meanings of α and β (after ∃-closure) are both in this set, and distinct from each other. α and β therefore mutually Contrast, and ellipsis is licensed. Notice that without ∃-closure the free variables in α and β would remain free and Contrast would not be satisfied.

(5) $\{\exists x : \mathsf{will}(\mathsf{call}(\mathsf{j}, x)), \exists x : \mathsf{will}(\mathsf{call}(\mathsf{m}, x)), \ldots\}$

What goes wrong with (2)? Griffiths notes that α and β here are the only domains that could possibly satisfy Contrast (in view of ∃-closure). However, Griffiths (2019: 590ff) argues that PA and AS are fundamentally incompatible: the occurrence of a PA operator inside a constituent γ renders the AS value of γ *undefined*, and similarly for any node dominating γ. PA thus throws a spanner in the gears of AS calculation, preventing α and β from having well-defined AS values at all, and thereby making Contrast impossible to satisfy.

This note critically examines Griffiths' use of ∃-closure, concluding that the theory problematically requires AS to be incompatible with PA, but compatible with ∃-closure. I show that the formal pressures which characterize the interaction of PA and alternatives apply equally ∃-closure and alternatives. That is, it is impossible to define a true ∃-closure operation within what might be termed 'standard' AS. A well-behaved AS reflex of ∃-closure can only be defined in a compositional setting where a well-behaved AS reflex of PA is definable too. It is, in sum, theoretically problematic to appeal to the inherent incompatibility of PA and AS, while assuming the compatibility of ∃-closure and AS. The final section of the paper additionally identifies several empirical issues with Griffiths' appeals to ∃-closure and PA.

2 Alternatives and abstraction

AS involves lifting a basic set of compositional operations into operations on sets of meanings, such that if the normal denotation of α is type τ, α's AS value is type $\{\tau\}$, the type of a set of τ's (Hamblin 1973, Rooth 1985). If $[\alpha \; \beta]$ has a meaning characterizable via (6), where O is a binary operation like Functional Application or Predicate Modification combining the meanings of α and β (at the assignment g), the AS value of $[\alpha \; \beta]$ is given by (7), where O combines members of α's and β's AS values (again, at g).[1]

(6) $[\![\alpha \; \beta]\!]^g = O([\![\alpha]\!]^g, [\![\beta]\!]^g)$

(7) $[\![\alpha \; \beta]\!]^g_f = \{O(a, b) \mid a \in [\![\alpha]\!]^g_f, b \in [\![\beta]\!]^g_f\}$

Suppose $[\![\text{Mary}]\!]^g_f = \{m\}$, $[\![\text{saw}]\!]^g_f = \{\lambda_x \lambda_y \, \text{saw}(y, x)\}$, and $[\![\text{AL}_F]\!]^g_f = \{a, b\}$ (i.e., focused expressions generate alternatives, and everything else is associated with a singleton set containing only its usual meaning). Then $[\![\text{Mary saw AL}_F]\!]^g_f = \{\text{saw}(m, a), \text{saw}(m, b)\}$.

By construction, the recipe in (7) applies whenever the normal meaning of $[\alpha \; \beta]$ is given by a rule like (6). However, it is possible to conceive of semantic rules which do not fit this schema. Consider the standard PA rule defined in (8): the meaning of $[n \; \alpha]$ at g is a function associating any x in its domain with $[\![\alpha]\!]^{g[n \mapsto x]}$, the meaning of α at an assignment g' differing from g at most in that g' maps n to x. PA isn't an instance of (6): the index n isn't assigned a meaning, and the meaning of α is calculated at an assignment distinct from g.

(8) $[\![n \; \alpha]\!]^g := \lambda_x \, [\![\alpha]\!]^{g[n \mapsto x]}$

If the meaning of α has type τ, then the output of PA will have type $e \to \tau$ (assuming for

simplicity that we only abstract over variables of type e). Thus, an AS semantic value for $[n\ \alpha]$ should be of type $\{e \to \tau\}$, a set of $e \to \tau$ functions. Since we can't rely on (7), we'll need to invent a bespoke rule to import PA into AS. An initial, failed, attempt is (9).

(9) $\quad [\![n\ \alpha]\!]^g_f := \left\{ \lambda_x [\![\alpha]\!]^{g[n\mapsto x]}_f \right\}$

This misses the mark in two (related) ways. The output of this rule is a singleton set of functions, and it has the wrong type: $\{e \to \{\tau\}\}$. Instead, we would like to have derived a potentially non-singleton set of functions, type $\{e \to \tau\}$.

The standard solution, due to Hagstrom (1998) and Kratzer & Shimoyama (2002), flattens the inner layer of alternatives with a *choice function*, as in (10).[2] A choice function (for a type τ) is a function of type $\{\tau\} \to \tau$ that selects a type-τ element from any non-empty set of τ's, as formalized in (11) (see Reinhart 1997, Winter 1997, Kratzer 1998).[3]

(10) $\quad [\![n\ \alpha]\!]^g_f := \left\{ \lambda_x \mathcal{F} [\![\alpha]\!]^{g[n\mapsto x]}_f \mid \mathcal{F} \in \mathsf{CF} \right\}$

(11) $\quad \mathsf{CF} := \left\{ \mathcal{F} \mid \forall S \supsetneq \varnothing : \mathcal{F} S \in S \right\}$

With the inner layer of alternatives duly flattened by a choice function, the output of abstraction contains multiple values and has the correct type, $\{e \to \tau\}$. But the resulting alternative sets are much too big, as emphasized by Shan (2004) and Charlow (2019b). Intuitively, $[\![n\ \alpha]\!]^g_f$ should be a set of alternatives with the same cardinality as $[\![\alpha]\!]^g_f$. In other words, PA shouldn't *itself* generate alternatives! But this isn't so in general. Suppose for illustration that $[\![t_1\ \text{saw AL}_F]\!]^g_f = \left\{ \text{saw}(g_1, \text{a}), \text{saw}(g_1, \text{b}) \right\}$ (where 'g_1' stands for the value g assigns to 1). We'd hope that $[\![1\ t_1\ \text{saw AL}_F]\!]^g_f = \left\{ \lambda_x \text{saw}(x, \text{a}), \lambda_x \text{saw}(x, \text{b}) \right\}$, but this isn't how things pan out: the

4

resulting set includes these two functions, and many more besides — for example, an h such that $h\,\mathsf{c} = \mathsf{saw}(\mathsf{c}, \underline{\mathsf{a}})$ and $h\,\mathsf{d} = \mathsf{saw}(\mathsf{d}, \underline{\mathsf{b}})$, i.e., where the choice of a or b inappropriately varies with the value supplied to h.[4]

This over-generation of alternatives is empirically problematic. For example, if $[\![\text{who}]\!]^g_f = \{x \mid \mathsf{human}\, x\}$, then $[\![\text{nobody [1 who likes } \mathsf{t}_1]]\!]^g_f = \{\neg \exists x : \mathsf{likes}(s\,x, x) \mid \mathsf{Range}\, s = \mathsf{human}\}$, with s ranging over human-valued Skolem functions, type $e \rightarrow e$. However, if the possible answers to a question are drawn from its AS value (cf. Hamblin 1973), this wrongly predicts that a possible answer to *who likes nobody* will be *nobody$_i$'s mom likes them$_i$* (Shan 2004).

It *is* possible to define well-behaved PA operations in AS, if we begin with a slightly different set of assumptions (Rooth 1985, Poesio 1996, Romero & Novel 2013). First, assume that the interpretation function associates trees with functions from assignments to values, as in (12). This means treating assignment-dependence as part of an expression's meaning, which in turn has the important consequence that an expression's AS value will be a *set of assignment-dependent meanings*, as in (13).

(12) $\quad [\![\alpha\,\beta]\!] = \lambda_g\, O([\![\alpha]\!]g, [\![\beta]\!]g)$

(13) $\quad [\![\alpha\,\beta]\!]_f = \{\lambda_g\, O(a\,g, b\,g) \mid a \in [\![\alpha]\!]_f, b \in [\![\beta]\!]_f\}$

PA is now defined as in (14). As in the prior definition (8), PA is effected by yoking the evaluation of α to a modified assignment. Crucially, though, layering assignment-dependence under alternative sets allows a 'true' AS reflex of PA to be defined, as in (15).

(14) $\quad [\![n\,\alpha]\!] := \lambda_g\, \lambda_x\, [\![\alpha]\!]g[n{\mapsto}x]$

(15) $\quad [\![n\,\alpha]\!]_f := \{\lambda_g\, \lambda_x\, a\,g[n{\mapsto}x] \mid a \in [\![\alpha]\!]_f\}$

Correctly, the cardinality of our AS values is the same pre- and post-PA. Suppose for illustration that $\llbracket t_1 \text{ saw } \text{AL}_F \rrbracket_f = \{\lambda_g \text{ saw}(g_1, a), \lambda_g \text{ saw}(g_1, b)\}$. Then rule (15) yields the expected set of two functions, $\llbracket 1\ t_1 \text{ saw } \text{AL}_F \rrbracket_f = \{\lambda_g \lambda_x \text{ saw}(x, a), \lambda_g \lambda_x \text{ saw}(x, b)\}$.[5]

3   Abstraction as intervener

We've seen two kinds of basic architectures with alternatives, the 'standard' setup based on $\llbracket \cdot \rrbracket^g$ and $\llbracket \cdot \rrbracket^g_f$, and another based on $\llbracket \cdot \rrbracket$ and $\llbracket \cdot \rrbracket_f$. The former problematically over-generates alternatives for PA structures $[n\ \alpha]$ when $\llbracket \alpha \rrbracket^g_f$ contains multiple alternatives (e.g., when α contains one or more focused expressions).

Kotek (2017) and Erlewine & Kotek (2017), suggest that the apparently problematic state of affairs observed with $\llbracket \cdot \rrbracket^g$ and $\llbracket \cdot \rrbracket^g_f$ is in fact salutary. Kotek (2017: 157) puts things as follows (emphases added):

> Intervention is the result of movement into a part of structure where *non-trivial alternatives* are being computed — because *Predicate Abstraction, necessary to compose the movement step, is not well-defined in such cases.*

We might formalize this suggestion by replacing (10) with (16). This rule includes an ι operator and so requires $\llbracket \alpha \rrbracket^{g[n \mapsto x]}_f$ to be a singleton (i.e., a trivial set of alternatives).

(16) $\llbracket n\ \alpha \rrbracket^g_f := \{\lambda_x \iota a : a \in \llbracket \alpha \rrbracket^{g[n \mapsto x]}_f\}$

Returning to our previous example of $\llbracket t_1 \text{ saw } \text{AL}_F \rrbracket^g_f = \{\text{saw}(g_1, a), \text{saw}(g_1, b)\}$, we find that $\llbracket 1\ t_1 \text{ saw } \text{AL}_F \rrbracket^g_f$ can never be defined (more precisely, the set that results contains only a

function with an empty domain). On the other hand, without focus in the scope of PA, things work out fine: $[\![1 \ t_1 \ \text{saw Al}]\!]^g_f = \{\lambda_x \ \text{saw}(x, \text{a})\}$.

As we have already seen in Section 1, Griffiths (2019: 590ff) assumes something significantly stronger than (16) — namely, that PA scuppers alternative calculation, *regardless of* whether the scope of PA denotes a singleton set of alternatives or not. We might formalize this suggestion as follows:

(17) $[\![n \ \alpha]\!]^g_f$ is undefined

Only (17) predicts that α and β in (2) will lack AS values, as Griffiths' theory requires. In both α and β, the scope of PA has no focused expressions and is accordingly associated with a singleton AS value. While (16) returns a result in such cases, (17) does not.

Regardless of whether one adopts (16) or (17), Kotek (2017), Erlewine & Kotek (2017), and Griffiths (2019) all agree that the problem of PA in AS isn't an issue to be solved (e.g., by moving to a semantic architecture based on $[\![\cdot]\!]$ and $[\![\cdot]\!]_f$). Instead, the problematic predictions of an 'ersatz' PA rule like (10) should be avoided by rendering PA's AS value undefined tout court along the lines of (17), or severely restricted along the lines of (16).

4   A fundamental problem

I wish to highlight a fundamental issue with Griffiths' account of (1) and (2). In brief, in an AS architecture built on $[\![\cdot]\!]^g$ and $[\![\cdot]\!]^g_f$, a satisfactory operation of $\exists$-closure is, like a satisfactory PA operation, impossible to define — and for precisely the same reasons. The upshot is that the alternative set in (5) *cannot be compositionally derived* from the AS value of (1)'s α and β

nodes. The reason is that the formal pressures on the interaction of PA and AS are much more general than PA: they recur when attempting to characterize *any* binding operations in AS, including ∃-closure. While it is possible to define a well-behaved AS correlate of ∃-closure in a grammar based on $[\![\cdot]\!]$ and $[\![\cdot]\!]_f$, this appears to significantly undermine Griffiths' account of the contrast between (1) and (2): in such a compositional setting, a well-behaved AS correlate of PA can be straightforwardly characterized as well (as in (15)).

Let us begin by considering the AS value of α in (1), and seeing why we cannot define an operation mapping it into the set of existentially closed alternatives (5). Relative to any g, the AS value of *JOHN$_F$ will call t$_1$* is a set of propositions obtained by varying the value associated with the focused expression *JOHN$_F$*, as in (18).[6]

(18) $[\![\text{JOHN}_F \text{ will call } t_1]\!]_f^g = \{\text{will}(\text{call}(j, g_1)), \text{will}(\text{call}(m, g_1)), \ldots\}$

How can we map this set of alternatives into a set of existentially closed ones? The dialectic here turns out to be precisely the same as we observed with PA. Parallel to (9), we make an initial, failed attempt in (19). This definition is a non sequitur. As with PA, we want a potentially non-singleton set of existentially closed alternatives. Instead, the set that results from (19) is a singleton, the sole member of which is not even well-typed: $[\![\alpha]\!]_f^{g[n \mapsto x]}$ is at best a *set* of propositions, not the sort of object that can be evaluated for truth or falsity.

(19) $[\![\exists n \; \alpha]\!]_f^g := \left\{ \exists x : [\![\alpha]\!]_f^{g[n \mapsto x]} = \text{True} \right\}$

Another attempt, this one parallel to (10), is given in (20). Though this rule solves the typing issue, as with (10), we once again massively over-generate alternatives: there are potentially many more values in this set than there are in $[\![\alpha]\!]_f^g$. For example, if $[\![\text{JOHN}_F]\!]_f^g =$

8

$\{x \mid \mathsf{human}\, x\}$, we observe the equivalence in (21), where s ranges over human-valued Skolem functions, type $\mathsf{e} \to \mathsf{e}$. Along with the existentially closed propositions in (5), this set unintuitively includes propositions like *someone$_i$'s mom will call them$_i$*, which manifestly have nothing to do with whether ellipsis of *call t$_2$* is licensed in (1).

(20) $[\![\exists n\, \alpha]\!]^g_\mathsf{f} := \big\{ \exists x : \mathcal{F}\, [\![\alpha]\!]^{g[n \mapsto x]}_\mathsf{f} = \mathsf{True} \mid \mathcal{F} \in \mathsf{CF} \big\}$

(21) $[\![\exists 1\, \mathsf{JOHN_F}\, \text{will call } \mathsf{t_1}]\!]^g_\mathsf{f} = \big\{ \exists x : \mathsf{will}(\mathsf{call}(s\, x, x)) \mid \mathsf{Range}\, s = \mathsf{human} \big\}$

It isn't obvious that this over-generation of existentially closed alternatives itself represents an empirical issue for Griffiths' account of (1) and (2) (but see Section 5 for empirical arguments against Griffiths' assumptions about PA and $\exists$-closure). The issue, rather, is whether Griffiths' rejection of PA in AS is justified given his acceptance of $\exists$-closure: why should PA necessarily yield undefinedness in AS, even as $\exists$-closure does not? If an operation like (20) is available in principle, on what basis is an operation like (10) ruled out?

If such a stipulation is taken on in the end, it seems vastly preferable to re-orient our semantics around $[\![\cdot]\!]$ and $[\![\cdot]\!]_\mathsf{f}$. As I noted back in Section 2, this architecture allows a well-behaved alternative-friendly PA operation to be defined, in (15). Unsurprisingly, then, a well-behaved, alternative-friendly $\exists$-closure operation is available to $[\![\cdot]\!]_\mathsf{f}$ too:

(22) $[\![\exists n\, \alpha]\!]_\mathsf{f} := \big\{ \lambda_g \exists x : a\, g[n \mapsto x] = \mathsf{True} \mid a \in [\![\alpha]\!]_\mathsf{f} \big\}$

(23) $[\![\exists 1\, \mathsf{JOHN_F}\, \text{will call } \mathsf{t_1}]\!]_\mathsf{f} = \big\{ \lambda_g \exists x : \mathsf{will}(\mathsf{call}(\mathsf{j}, x)), \lambda_g \exists x : \mathsf{will}(\mathsf{call}(\mathsf{m}, x)), \dots \big\}$

As desired, the output of (22) doesn't generate alternatives beyond what's reflected in the input. The resulting AS value (23) is thus parallel to the desired set of existentially closed

9

propositions (5). If we wish to maintain Griffiths' account of (2)'s ungrammaticality, however, we must then baldly stipulate that $[\![n\ \alpha]\!]_f$ is undefined, taking on (24) in parallel with (17), even though a well-behaved AS correlate of PA is definable in principle, as in (15).

(24) $[\![n\ \alpha]\!]_f$ is undefined

As with $[\![\cdot]\!]_f^g$, there does not appear to be any principled technical basis for distinguishing between PA and $\exists$-closure in this way. Be that as it may, the framework oriented around $[\![\cdot]\!]$ and $[\![\cdot]\!]_f$ at least delivers the expected set of existentially closed alternatives for $[\![\exists n\ \alpha]\!]_f$.

It is worth noting that the issue identified here — arbitrarily treating the AS correlate of PA as undefined and the AS correlate of other binding operations as defined — is more general, and more pressing, than our focus on $\exists$-closure might suggest. As alluded to in foot-note 6, intensionalization in standard compositional settings for AS is (like PA and $\exists$-closure) problematic. Calculating the intension of α, as in (25) below, requires us to abstract over (i.e., bind) the world parameter of the interpretation function (e.g., Montague 1974, Keshet 2008, von Fintel & Heim 2011). However, a satifactory AS correlate of this operation is out of reach for familiar reasons: analogously to PA, there is no way to move from $\left\{\lambda_{w'}[\![\alpha]\!]_f^{g,w'}\right\}$, an inap-propriately high-typed singleton set, to an appropriately typed, potentially non-singleton AS value, without over-generating alternatives (Rooth 1985: 45ff).

(25) $[\![^{\wedge}\alpha]\!]^{g,w} := \lambda_{w'}[\![\alpha]\!]^{g,w'}$

As with PA and $\exists$-closure, an AS correlate of intensionalization is easily defined in other compositional settings, e.g., ones replacing world-relative alternative sets with sets of world-relative meanings, cf. (12)–(14). Thus, just as we may wonder on what basis Griffiths' theory

distinguishes PA and ∃-closure, we may wonder whether any theory that treats PA in AS as problematic (including Kotek 2017, Erlewine & Kotek 2017) has a principled basis for distinguishing PA and intensionalization (if such a distinction is desired, as seems likely).

5   Zooming out

While Griffiths' appeal to ∃-closure is problematic, the technical issues it raises aren't insoluble. As the previous section set out, using $\llbracket \cdot \rrbracket$ and $\llbracket \cdot \rrbracket_f$ we can tell an internally consistent, if stipulative, Griffiths-style story about the ungrammaticality of (2). That it seems necessary to stipulate undefinedness for the AS value associated with PA, but not ∃-closure, detracts from the overall appeal of this account, perhaps significantly, but it does not render it incoherent.

Here, however, it is appropriate to take a broader view. Though it is coherent to stipulate that PA nodes lack AS values, is it feasible to do so when we consider other phenomena where AS plays an explanatory role? Consider example (26), which involves variable binding in the scope of the focus-sensitive adverb *only*. The example is well formed, with the expected interpretation: for no N other than *aardvark* did I say that every N ate its dinner.

(26)   I only said that every AARDVARK$_F$ [1 t_1 ate its$_1$ dinner].

On the standard analysis (Rooth 1985), *only* quantifies over the AS values associated with its prejacent/scope α, requiring any $a \in \llbracket \alpha \rrbracket_f$ not already entailed by $\llbracket \alpha \rrbracket$ to be false. According to Griffiths, however, the PA node in (26) lacks an AS value, and so does every node dominating it — including, necessarily, α. $\llbracket \alpha \rrbracket_f$ will therefore not be defined in this case. A revisionary account of (26) will thus need to be given. Such a theory must somehow

distinguish the AS values relevant for Contrast, and the AS values relevant for *only*. [7]

Relatedly, the suggestion that PA inside any γ causes γ to lack an AS value appears straight-forwardly inconsistent with theories that require all non-F-marked nodes to be GIVEN (Schwarzschild 1999; see Büring 2016 for a recent overview of theories oriented around GIVENness): checking whether γ is GIVEN requires reference to γ's AS value, but according to (17), γ lacks such a value whenever PA is triggered anywhere inside it.

Finally, though $\exists$-closing unbound variables to assess Contrast can be made formally coherent, we should again ask whether this use of $\exists$-closure is empirically feasible, in view of a larger range of data. As with PA, difficulties seem to arise fairly quickly. Consider (27), with ellipsis of *see her$_2$* and a putative antecedent *saw her$_1$*. Clearly, this example is only grammatical given an assignment g if $g_1 = g_2$: (27) can't mean that John saw Mary, and Bill saw Sue (see Sag 1976: 123f for a closely related point; thanks to an anonymous referee for bringing this to my attention). However, Griffiths' account straightforwardly predicts the grammaticality of this example, even when $g_1 \neq g_2$: since free variables are $\exists$-bound when assessing Contrast, their actual values in context are ignored. This is crucially not a prediction of Takahashi & Fox's (2005) account of the contrast between (1) and (2), which does not $\exists$-close free variables.[8]

(27)   JOHN$_F$ saw her$_1$. And BILL$_F$ did see her$_2$ too.

Taking stock, the core features of Griffiths' account of the contrast between (1) and (2) can be preserved, but the price is a major stipulation which seems to lack independent moti-vation: certain binding operations ($\exists$-closure, and likely intensionalization) have well-defined AS reflexes, while others (PA) do not. Though such a stipulation can be taken on, the resulting

views of PA and the role of ∃-closure in ellipsis licensing are empirically problematic, and appear to stand in need of revision.

Notes

[1]A summary of the notational conventions used in this note: '$a \rightarrow b$' names the type of functions from type a to type b; '$\lambda_x \Delta$' names the function f such that for all type-appropriate d, $f\, d = \Delta^{d/x}$ (that is, Δ with d substituted for x); and '$f\, x$' is written in lieu of '$f(x)$'.

[2]Hagstrom and Kratzer & Shimoyama's definition is not *precisely* equivalent to (10), but is if $\varnothing \subsetneq \llbracket \alpha \rrbracket_f^{g[n \rightarrow x]}$, for every relevant type-appropriate x. Poesio (1996) considers and rejects a closely related proposal.

[3]To be formally in order, CF should be parametrized by the type of $\llbracket \alpha \rrbracket_f^{g[n \mapsto x]}$: the CFs that (e.g.) pick an entity from a set of entities are different from the CFs that pick a property from a set of properties. The definitions in the text ignore this complication.

[4]As Shan (2004: 295) notes, the reason a good $\llbracket n\ \alpha \rrbracket_f^g$ rule doesn't exist is that functions to sets are coarser-grained than sets of functions. While an $e \rightarrow \{\tau\}$ function can be naturally generated in this compositional setting, (namely, $\lambda_x \llbracket \alpha \rrbracket_f^{g[n \mapsto x]}$), it doesn't contain the information required to reconstruct an appropriate $\{e \rightarrow \tau\}$ set of functions.

[5]There are at least two other possibilties for addressing the interaction of AS and PA (the approach based on $\llbracket \cdot \rrbracket$ and $\llbracket \cdot \rrbracket_f$ is adopted in this paper for concreteness). (i) In structural theories of alternatives (e.g., Katzir 2007, Fox & Katzir 2011), alternatives are syntactic objects. Because al-

ternative propagation happens 'in the object language', alternatives introduced under a PA operator n will percolate up and over n, exactly as desired. (ii) It turns out to be possible to define AS-friendly PA within a system taking assignment-dependent alternative sets as basic (though crucially not in an architecture based on $[\![\cdot]\!]^g$ and $[\![\cdot]\!]^g_f$). This system is a good fit for AS accounts of exceptionally scoping indefinites. See Charlow 2019a,b for details.

[6]Though I'm talking about 'propositions', I have suppressed explicit reference to intensionality for expository and technical ease. In fact, it was already noticed by Rooth (1985: 45ff) that the combination of AS with intensionality raises technical problems analogous to the combination of AS with variable binding operations. I elaborate on this point at the end of this section.

[7]Related cases such as *I only said that every student$_i$ should read the paper [they$_i$ were assigned in SYNTAX$_F$]* seem like prima facie counterexamples to the weaker approach to PA intervention in (16) (Kotek 2017, Erlewine & Kotek 2017). Here, the bound pronoun *they$_i$* occurs in a relative clause (the bracketed constituent), which also hosts the focused expression *SYNTAX$_F$*. This requires a PA operator to bind the pronoun, scoping over a region teeming with focus alternatives. By the lights of (16) this should result in undefinedness. Thanks to Dylan Bumford for discussion.

[8]Note in this respect that the universal quantification over assignments in definition (3) is ultimately idle, since any free variables in β and α are ultimately $\exists$-bound.

References

Büring, Daniel. 2016. *Intonation and meaning*. Oxford: Oxford University Press. `https://doi`
`.org/10.1093/acprof:oso/9780199226269.001.0001`.

Charlow, Simon. 2019a. Static and dynamic exceptional scope. Unpublished ms., Rutgers University. `https://ling.auf.net/lingbuzz/004650`.

Charlow, Simon. 2019b. The scope of alternatives: indefiniteness and islands. To appear in *Linguistics and Philosophy*. `https://doi.org/10.1007/s10988-019-09278-3`.

Erlewine, Michael Yoshitaka & Hadas Kotek. 2017. Movement and alternatives don't mix: Evidence from Japanese. In *Proceedings of the 21st Amsterdam Colloquium*, ed. by Alexandre Cremers, Thom van Gessel & Floris Roelofsen, 245–254. Amsterdam: ILLC. `https://semanticsarchive.net/Archive/jZiM2FhZ`.

von Fintel, Kai & Irene Heim. 2011. Intensional semantics, Spring 2011 edition.

Fox, Danny & Roni Katzir. 2011. On the characterization of alternatives. *Natural Language Semantics* 19(1). 87–107. `https://doi.org/10.1007/s11050-010-9065-3`.

Griffiths, James. 2019. Beyond MaxElide: An investigation of Ā-movement from elided phrases. *Linguistic Inquiry* 50(3). 571–607. `https://doi.org/10.1162/ling_a_00317`.

Hagstrom, Paul. 1998. *Decomposing questions*. Doctoral dissertation, MIT, Cambridge, MA.

Hamblin, C. L. 1973. Questions in Montague English. *Foundations of Language* 10(1). 41–53.

Heim, Irene & Angelika Kratzer. 1998. *Semantics in generative grammar*. Oxford: Blackwell.

Katzir, Roni. 2007. Structurally-defined alternatives. *Linguistics and Philosophy* 30(6). 669–690. `https://doi.org/10.1007/s10988-008-9029-y`.

Keshet, Ezra. 2008. *Good intensions: Paving two roads to a theory of the de re/de dicto distinction*. Doctoral dissertation, MIT, Cambridge, MA. `https://hdl.handle.net/1721.1/45622`.

Kotek, Hadas. 2017. Intervention effects arise from scope-taking across alternatives. In *NELS 47: Proceedings of the 47th Annual Meeting of the North East Linguistic Society*, ed. by Andrew Lamont & Katerina Tetzloff, 153–166. vol. 2. Amherst, MA: GLSA.

Kratzer, Angelika. 1998. Scope or pseudoscope? Are there wide-scope indefinites? In *Events and grammar*, ed. by Susan Rothstein, 163–196. Studies in Linguistics and Philosophy 55. Dordrecht: Springer Netherlands. `https://doi.org/10.1007/978-94-011-3969-4_8`.

Kratzer, Angelika & Junko Shimoyama. 2002. Indeterminate pronouns: The view from Japanese. In *Proceedings of the Third Tokyo Conference on Psycholinguistics*, ed. by Yukio Otsu, 1–25. Tokyo: Hituzi Syobo.

Merchant, Jason. 2008. Variable island repair under ellipsis. In *Topics in ellipsis*, ed. by Kyle Johnson, 132–153. Cambridge University Press. `https://doi.org/10.1017/cbo978051148 7033.006`.

Montague, Richard. 1974. The proper treatment of quantification in ordinary English. In *Formal Philosophy*, ed. by Richmond Thomason, 247–270. New Haven: Yale University Press.

Poesio, Massimo. 1996. Semantic ambiguity and perceived ambiguity. In *Semantic Ambiguity and Underspecification*, ed. by Kees van Deemter & Stanley Peters, 159–201. CSLI Lecture Notes 55. Stanford: CSLI Publications.

Reinhart, Tanya. 1997. Quantifier scope: How labor is divided between QR and choice func-
tions. *Linguistics and Philosophy* 20(4). 335–397. `https://doi.org/10.1023/A:1005349801`
`431`.

Romero, Maribel & Marc Novel. 2013. Variable binding and sets of alternatives. In *Alternatives
in Semantics*, ed. by Anamaria Fălăuș, 174–208. London: Palgrave Macmillan UK. `https:`
`//doi.org/10.1057/9781137317247_7`.

Rooth, Mats. 1985. *Association with focus*. Doctoral dissertation, University of Massachusetts,
Amherst.

Sag, Ivan A. 1976. *Deletion and logical form*. Doctoral dissertation, MIT, Cambridge, MA. `https`
`://hdl.handle.net/1721.1/16401`.

Schwarzschild, Roger. 1999. Gɪᴠᴇɴness, AᴠᴏɪᴅF and other constraints on the placement of
accent. *Natural Language Semantics* 7(2). 141–177. `https://doi.org/10.1023/A:10083709`
`02407`.

Shan, Chung-chieh. 2004. Binding alongside Hamblin alternatives calls for variable-free
semantics. In *Proceedings of Semantics and Linguistic Theory 14*, ed. by Kazuha Watanabe &
Robert B. Young, 289–304. Ithaca, NY: Cornell University. `https://doi.org/10.3765/sa`
`lt.v14i0.2901`.

Takahashi, Shoichi & Danny Fox. 2005. MaxElide and the re-binding problem. In *Proceedings
of Semantics and Linguistic Theory 15*, ed. by Effi Georgala & Jonathan Howell, 223–240.
Ithaca, NY: Cornell University. `https://doi.org/10.3765/salt.v15i0.3095`.

Winter, Yoad. 1997. Choice functions and the scopal semantics of indefinites. *Linguistics and Philosophy* 20(4). 399–467. `https://doi.org/10.1023/A:1005354323136`.

Simon Charlow

Department of Linguistics

Rutgers, The State University of New Jersey

18 Seminary Place

New Brunswick, NJ 08901

`simon.charlow@rutgers.edu`