Syntactic sensitivity without inaudible structure

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Abstract

Yoshida et al. (to appear) recently argue for the necessity of positing an abstract syntactic structure in the ellipsis site of sluicing on the basis of new data involving the distribution of parasitic gaps. I show in this paper that the data that Yoshida et al. discuss all straightforwardly fall out from a version of 'hybrid' analysis of sluicing proposed by Barker (2013), which takes the licensing condition of sluicing to be sensitive to some (but not all) syntactic information. More specifically, on Barker's analysis, all that is visible to the sluicing licensor is the syntactic category of the inner antecedent (i.e. the constituent corresponding to the sluicing remnant in the antecedent clause). Building on Barker's analysis of sluicing, I formulate an explicit analysis of sluicing/parasitic gap interaction which predicts the relevant empirical patterns. The conclusion that follows from this discussion is that the new evidence from parasitic gap licensing in sluicing adduced by Yoshida et al. is *not* evidence for the existence of unpronounced syntactic structure at the ellipsis site, but rather, for the 'partial syntactic sensitivity' (Chung 2013), which the valence-driven (in the broader sense of the notion) and flexible syntactic composition characteristic to categorial grammar is exactly suited for capturing.

Keywords: sluicing, parasitic gap, syntactic identify, continuations, categorial grammar

1 Introduction

Yoshida et al. (to appear) discuss an interesting set of data involving sluicing and parasitic gap (PG) licensing that they adduce for the hypothesis that sluicing involves a full syntactic structure in the ellipsis site. The central paradigm can be exemplified by the following sentences, where the sluice (or remnant) in the target clause contains a gap corresponding to a PG in the antecedent clause:

(1) a. The editor told me which book I must review $\_\__1$ soon after receiving $\_\__2$, but I don't remember exactly how soon after receiving $\_\__3$.

b. The school superintendent told me which school just a few attempts to expand $\_\__1$ ultimately overburdened $\_\__2$, but I don't remember [exactly how many attempts to expand $\_\__3$].

Yoshida et al.'s argument (reviewed in section 2) involves establishing the PG status of the third gap ($\_\__3$) in the above sentences via independent criteria for PG-hood. They then conclude that positing a syntactic structure in the ellipsis site is necessary since otherwise the

PG status of the third gap cannot be accounted for. This is a rather intriguing argument since, as Yoshida et al. themselves point out, the question of whether sluicing involves deletion of syntactic material is a particularly controversial issue given the well-known island insensitivity that this phenomenon exhibits (an observation which in fact goes back to the very first discussion of sluicing by Ross (1969)).

At the same time, the recent literature on sluicing points to a somewhat different conclusion about the status of syntactic sensitivity. In particular, based on her study of sluicing in English and Chamorro, Chung (2013) argues that sluicing is sensitive to only argument structure and Case-related information. Barker (2013) formulates a formal analysis of sluicing in a version of categorial grammar which captures this 'partial syntactic sensitivity' neatly by assuming that the anaphoric mechanism underlying sluicing makes reference to the syntactic category of the inner antecedent (i.e. the expression in the antecedent clause corresponding to the sluice) and nothing more. Barker's analysis is interesting in that it sheds some initial light on the fundamental question (left unanswered in both the existing syntactic and semantic approaches to sluicing) of why ellipsis in sluicing is sensitive to only *part* of the syntactic information of the 'elided material'. If Barker's analysis gives us 'exactly the limited syntactic identity required' (Barker 2013, 188), it should also be able to account for the sluicing/PG interaction that Yoshida et al. adduce for their syntactic analysis. The purpose of this paper is to examine in detail whether this prediction holds. To preview the conclusion, we will see that, once some reasonable analysis of PGs is in place, Barker's analysis does indeed predict exactly the right empirical patterns. The key to capturing the distributional patterns without positing an abstract syntactic structure is what one might call 'valence-driven' analysis of filler-gap dependency and PG licensing characteristic to CG. As I show below, in CG, expressions that contain PGs and those that don't have different syntactic categories reflecting their respective combinatoric properties. Thus, a sluice that contains a PG can only be licensed if there is a matching inner antecedent containing a PG in the antecedent clause (sprouting examples are somewhat more complex, but they are treated in essentially the same way). After reviewing Yoshida et al.'s key arguments in section 2, I formulate an extension of Barker's analysis in which the facts discussed by Yoshida et al. fall out from independently motivated analyses of sluicing and PG licensing.

2 Sluicing and parasitic gaps: Evidence for syntactic structure?

Yoshida et al. provide the following examples as evidence for an interaction between sluicing and PG licensing:

(2) a. The editor told me which book I must review $\_\__1$ soon after receiving $\_\__2$, but I don't remember exactly how soon after receiving $\_\__3$.

b. The school superintendent told me which school just a few attempts to expand $\_\__1$ ultimately overburdened $\_\__2$, but I don't remember [exactly how many attempts to expand $\_\__3$].

In (1a), the antecedent clause contains a structure involving *wh*-movement that licenses a PG ($\_\__2$) and the sluice in the target clause contains a gap ($\_\__3$) corresponding to this PG. Interestingly, as Yoshida et al. point out, for (1a), it is also possible to construct a parallel sprouting example in which a structure containing a PG is missing in the antecedent clause:

(3) The editor told me which newly published book I must review $\_\_\_1$, but I don't remember how soon after receiving $\_\_\_3$.

The primary evidence that this 'third gap' is a PG comes from the fact that its presence is dependent on the presence of a real gap. Thus, if the second clause itself contains an overt structure that does not license PGs, this third gap fails to be licensed (note that, in this case, the sentence is no longer an instance of sluicing):[1]

(4) a. *The editor told me which book I must review $\_\_\_1$ (soon after receiving $\_\_\_2$), but I don't remember [exactly how soon after receiving $\_\_\_3$] **I must review it**.

b. *The school superintendent told me which school just a few attempts to expand $\_\_\_1$ ultimately overburdened $\_\_\_2$ but I don't remember [exactly how many attempts to expand $\_\_\_3$] **overburdened the school**.

Moreover, if the antecedent clause does not involve *wh*-movement, the gap in the sluice fails to be licensed:

(5) a. *The editor told me that I must review a book (soon after receiving it), but I don't remember [exactly how soon after receiving ___].

b. *The school superintendent told me that just a few attempts to expand a school ultimately overburdened it, but I don't remember [exactly how many attempts to expand ___].

Yoshida et al. provide further evidence that the gap in the sluice is a PG. The evidence all pertain to independently observed licensing conditions on PGs, and the gap in the sluice does indeed show parallel behaviors to genuine PGs in all these cases. These data actually come in two varieties—those pertaining to the real gap or the structure containing the real gap (the 'PG-licensor' in Yoshida et al.'s terms) and those pertaining to the structure containing the PG itself (which Yoshida et al. call the 'PG-host'). Since what is at issue is the presence of syntactic material corresponding to the former in the ellipsis site, the first type of evidence provides a more direct type of support for Yoshida et al.'s hypothesis that

[1]Note also that the following examples are unacceptable too. This rules out the possibility that the examples in (2) and (3) are instances of pseudo-sluicing (Merchant 2001) involving a copular structure that does not have a matching syntactic structure in the antecedent clause.

(i) a. *The editor told me which book I must review $\_\_\_1$ soon after receiving $\_\_\_2$, but I don't remember [exactly how soon after receiving $\_\_\_3$] it is.

b. *The school superintendent told me which school just a few attempts to expand $\_\_\_1$ ultimately overburdened $\_\_\_2$ but I don't remember [exactly how many attempts to expand $\_\_\_3$] it is.

Some speakers might find (ib) not totally unacceptable, due to the (irrelevant) intransitive use of *expand*. The contrast is perhaps clearer with the following:

(ii) a. The contest director told me which pies just a few attempts to devour $\_\_\_1$ confirmed the superiority of $\_\_\_2$, but I don't remember exactly how many attempts to devour $\_\_\_3$.

b. *The contest director told me which pies just a few attempts to devour $\_\_\_1$ confirmed the superiority of $\_\_\_2$, but I don't remember exactly how many attempts to devour $\_\_\_3$ it was.

the gap in the sluice is licensed by a real gap in an invisible structure. For this reason I focus on the former type of evidence below.[2]

Aside from the facts already noted above—which themselves are instances of evidence pertaining to the PG-licensor—Yoshida et al. offer two types of further evidence pertaining to PG licensors. The first evidence comes from the so-called 'anti-c-command' restriction on PGs, exemplified by the following data:

(6) a. The editor told me which newly published book I must review $\_\__{\mathrm{RG}}$ soon after he receives $\_\__{\mathrm{PG}}$.
  b. *The editor told me which newly published book $\_\__{\mathrm{RG}}$ must be reviewed soon after he receives $\_\__{\mathrm{PG}}$.

In (6b), the real gap is in the subject position c-commanding the PG whereas in (6a) it is in the object position and does not c-command the PG. The acceptability contrast in these examples is standardly attributed to the restriction on the licensor real gap that it should not c-command the PG. Yoshida et al. provide the following data, which show that the gap in the sluice exhibits a parallel behavior as PGs in this respect:[3]

(7) a. The editor told me which newly published book I must review $\_\__{\mathrm{RG}}$, but I don't remember how soon after he receives $\_\__{\mathrm{PG}}$.
  b. *The editor told me which newly published book $\_\__{\mathrm{RG}}$ must be reviewed, but I don't remember how soon after he receives $\_\__{\mathrm{PG}}$.

The other piece of evidence for the PG-hood of the third gap comes from the syntactic category restriction on PG-licensors. Several authors in the literature (cf., e.g., Chomsky 1982; Cinque 1990; Postal 1993) have taken the following type of data to indicate that only NP gaps can host PGs.[4]

(8) a. The editor told me which book I must write about $\_\__{\mathrm{RG}}$ soon after talking about $\_\__{\mathrm{PG}}$.
  b. *The editor told me about which book I must write $\_\__{\mathrm{RG}}$ soon after talking $\_\__{\mathrm{PG}}$.

And we indeed see the same pattern in the sluicing/sprouting examples:

(9) a. The editor told me which newly published book I must write about $\_\__{\mathrm{RG}}$, but I don't remember exactly how soon after talking about $\_\__{\mathrm{PG}}$.
  b. *The editor told me about which newly published book I must write $\_\__{\mathrm{RG}}$, but I don't remember exactly how soon after talking $\_\__{\mathrm{PG}}$.

[2]For the latter type of evidence, see Yoshida et al.'s paper. The analysis of PG licensing that I formulate in the next section is compatible with this latter type of data, as long as the distribution of PG in ordinary environments can be properly constrained along the relevant lines.

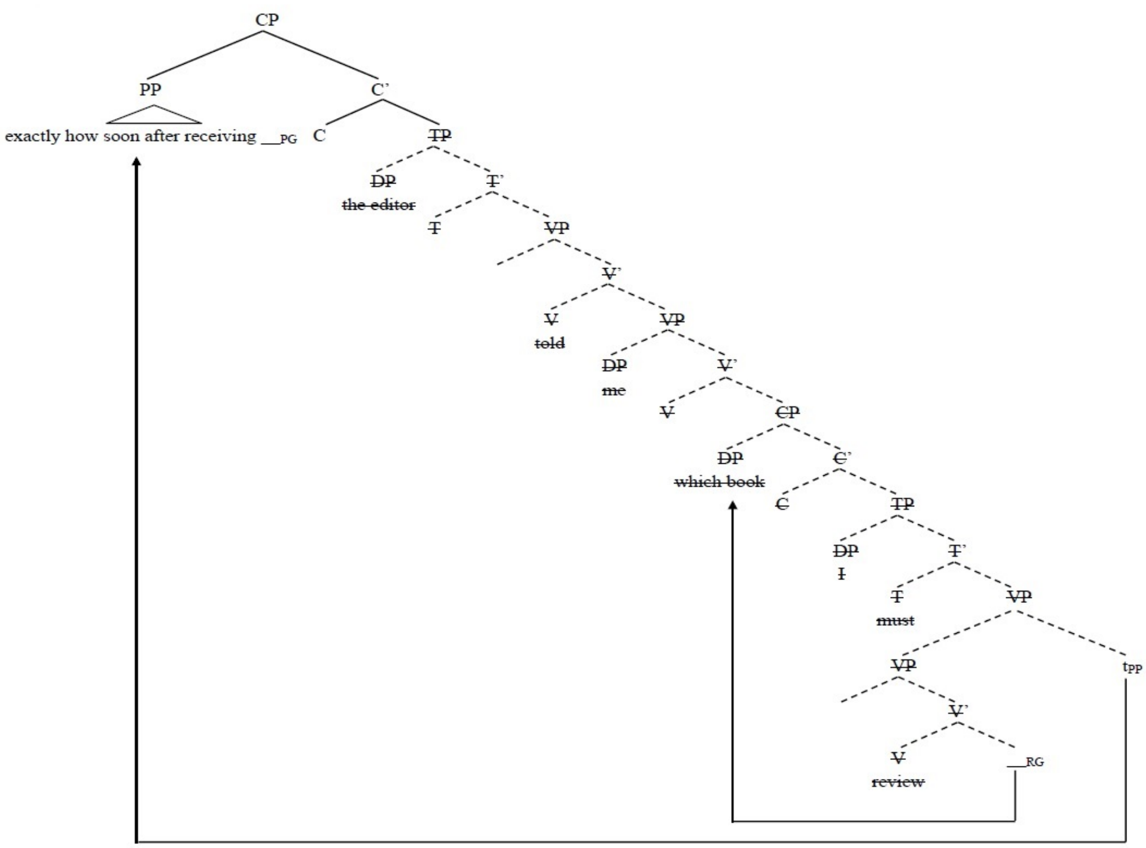
[3]As Yoshida et al. note, this point can be demonstrated with sprouting type examples only. In a non-sprouting type sluicing example, the sentence will be independently ruled out because of the presence of the (licensor-c-commanded) PG in the antecedent clause.

[4]But see Levine et al. (2001) for important counterevidence for this (alleged) generalization. If the contrasts in (8) and (9) aren't syntactic in nature, this syntactic category restriction argument provides only an indirect support for Yoshida et al.'s hypothesis.

Though this last argument involving the syntactic category restriction leaves room for alternative interpretations due to the questionable status of the underlying generalization (see footnote 4), taken together, the data reviewed above (and the conditions on PG-host discussed by Yoshida et al.'s) argue convincingly for the PG status of the gap in the sluice.

Based on these observations, Yoshida et al. conclude that a full syntactic structure is present in the ellipsis site in the target clause along the following lines:

(10)



In particular, Yoshida et al. (to appear, 23) explicitly claim that 'it will not be possible to account for [the distributional patterns just reviewed] within a theory that posits no syntactic structure at all in ellipsis sites (Barker 2012a, b, Culicover and Jackendoff 2005, Ginzburg and Sag 2000)'.[5] I show below that this assertion is too strong at least as far as Barker (2013) is concerned.

3 Predicting the sluicing/PG interaction without inaudible structure

I now formulate an explicit analysis of the sluicing/PG interaction data building on Barker's (2013) analysis of sluicing. The version of Type-Logical Categorial Grammar (TLCG; Morrill 1994; Moortgat 1997) that Barker's grammar of continuation builds on employs a somewhat complex mechanism for extraction and will become cumbersome in extending to the

[5]Barker (2012a) is a manuscript version of Barker (2013) which contains essentially the same analysis as the published version.

sluicing/PG interaction. For this reason, I recast his analysis in Hybrid Type-Logical Categorial Grammar (Hybrid TLCG; Kubota 2010, to appear; Kubota and Levine 2012), a theory that has properties similar to Barker's continuation-based grammar but which is more general in treating both 'overt' and 'covert' movement by the same mechanism.

3.1 Hybrid TLCG

For space reasons, I provide here only a compact sketch of Hybrid TLCG. For a more leisurely presentation, see Kubota (2010, to appear); Kubota and Levine (2014) spells out some formal details that were only implicit in previous work.

Hybrid TLCG is essentially an extension of the Lambek calculus (which has the two slashes / and \) with one additional, non-directional mode of implication (written |, and called the 'vertical slash'). This non-directional mode of implication is similar to Barker's continuation mode, but has a somewhat wider empirical application. Specifically, as illustrated below, it is used to model not just 'covert' movement but also 'overt' movement (in this respect, the present approach follows Muskens (2003) and Mihaliček and Pollard (2012)). For each of the connectives (/ and \ from the Lambek calculus, and |, the new, non-directional slash), the calculus recognizes the Introduction and Elimination rules.[6]

(11)

Connective	Introduction	Elimination
$/$	$\dfrac{\dfrac{\begin{array}{c}\vdots\;\vdots \quad \underline{[\varphi;\, x;\, A]^n} \quad \vdots\;\vdots \\ \vdots\;\vdots \qquad \vdots\;\vdots \qquad \vdots\;\vdots\end{array}}{b \circ \varphi;\, \mathcal{F};\, B}}{b;\, \lambda x.\mathcal{F};\, B/A}\,/\mathrm{I}^n$	$\dfrac{a;\, \mathcal{F};\, A/B \quad b;\, \mathcal{G};\, B}{a \circ b;\, \mathcal{F}(\mathcal{G});\, A}\,/\mathrm{E}$
$\backslash$	$\dfrac{\dfrac{\begin{array}{c}\vdots\;\vdots \quad \underline{[\varphi;\, x;\, A]^n} \quad \vdots\;\vdots \\ \vdots\;\vdots \qquad \vdots\;\vdots \qquad \vdots\;\vdots\end{array}}{\varphi \circ b;\, \mathcal{F};\, B}}{b;\, \lambda x.\mathcal{F};\, A\backslash B}\,\backslash\mathrm{I}^n$	$\dfrac{b;\, \mathcal{G};\, B \quad a;\, \mathcal{F};\, B\backslash A}{b \circ a;\, \mathcal{F}(\mathcal{G});\, A}\,\backslash\mathrm{E}$
$\vert$	$\dfrac{\dfrac{\begin{array}{c}\vdots\;\vdots \quad \underline{[\varphi;\, x;\, A]^n} \quad \vdots\;\vdots \\ \vdots\;\vdots \qquad \vdots\;\vdots \qquad \vdots\;\vdots\end{array}}{b;\, \mathcal{F};\, B}}{\lambda\varphi.b;\, \lambda x.\mathcal{F};\, B\vert A}\,\vert\mathrm{I}^n$	$\dfrac{a;\, \mathcal{F};\, A\vert B \quad b;\, \mathcal{G};\, B}{a(b);\, \mathcal{F}(\mathcal{G});\, A}\,\vert\mathrm{E}$

In this system, quantification can be modelled via hypothetical reasoning involving the vertical slash | (an idea originally due to Oehrle (1994)), as illustrated in (12) ($\boldsymbol{\forall}_{\mathbf{person}}$ is an abbreviation for the term $\lambda P.\forall x[\mathbf{person}(x) \to P(x)]$).

(12)

$$\dfrac{\begin{array}{c}\lambda\sigma.\sigma(\mathsf{everyone}); \\ \boldsymbol{\forall}_{\mathbf{person}};\, \mathrm{S}\vert(\mathrm{S}\vert\mathrm{NP})\end{array} \quad \dfrac{\dfrac{\mathsf{john};\, \mathbf{j};\, \mathrm{NP} \quad \dfrac{\mathsf{loves};\, \mathbf{love};\, (\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP} \quad [\varphi; x; \mathrm{NP}]^1}{\mathsf{loves} \circ \varphi;\, \mathbf{love}(x);\, \mathrm{NP}\backslash\mathrm{S}}\,/\mathrm{E}}{\mathsf{john} \circ \mathsf{loves} \circ \varphi;\, \mathbf{love}(x)(\mathbf{j});\, \mathrm{S}}\,\backslash\mathrm{E}}{\lambda\varphi.\mathsf{john} \circ \mathsf{loves} \circ \varphi;\, \lambda x.\mathbf{love}(x)(\mathbf{j});\, \mathrm{S}\vert\mathrm{NP}}\,\vert\mathrm{I}^1}{\mathsf{john} \circ \mathsf{loves} \circ \mathsf{everyone};\, \boldsymbol{\forall}_{\mathbf{person}}(\lambda x.\mathbf{love}(x)(\mathbf{j}));\, \mathrm{S}}\,\vert\mathrm{E}$$

[6]For phonological variables I use Greek letters $\varphi_1, \varphi_2, \ldots$ (type $\mathbf{st}$); $\sigma_1, \sigma_2, \ldots$ (type $\mathbf{st}\to\mathbf{st}$, $\mathbf{st}\to\mathbf{st}\to\mathbf{st}$, etc.); $\tau_1, \tau_2, \ldots$ (type $(\mathbf{st}\to\mathbf{st})\to\mathbf{st}$, etc.).

By withdrawing the hypothesis posited in the direct object position after the whole sentence is built, an expression of type S|NP is derived (the second to last step in the derivation), with the right semantics to be given as an argument to the quantifier. Note that, unlike / and \, | explicitly keeps track of the 'gap' position that the quantifier 'lowers into' via lambda binding in the phonological component. Then the quantifier takes this S|NP as an argument. The last step of the derivation involves |-Elimination, whose effect is function application in both semantics and phonology. This way, the string phonology of the quantifier is correctly realized in the direct object position via function application of the higher-order phonology of type $(\mathsf{st} \to \mathsf{st}) \to \mathsf{st}$ for the quantifier to its argument (a gapped sentence of type $\mathsf{st} \to \mathsf{st}$).

As shown by Muskens (2003) (see also Mihaliček and Pollard (2012)), this non-directional mode of implication enables a straightforward analysis of extraction (i.e. 'overt' movement) as well. The key idea of Muskens's approach to extraction involves analyzing an (incomplete) sentence with a gap like *Kim gave __ to Chris* in (13) as a sentence missing some expression somewhere inside, again with hypothetical reasoning for |, as in the derivation in (14).

(13) (I don't know) what$_i$ Kim gave __$_i$ to Chris.

(14)

$$
\dfrac{
\begin{array}{l}\lambda\sigma.\mathsf{what} \circ \sigma(\varepsilon);\\ \lambda\mathcal{F}.\mathbf{what}(\mathcal{F});\\ \mathrm{Q}|(\mathrm{S}|\mathrm{NP})\end{array}
\quad
\dfrac{
\dfrac{
\begin{array}{l}\mathsf{kim};\\ \mathbf{k};\mathrm{NP}\end{array}
\quad
\dfrac{
\dfrac{
\begin{array}{l}\mathsf{gave};\\ \mathbf{gave};\mathrm{VP/PP/NP}\end{array}
\quad
\begin{bmatrix}\varphi;\\ x;\mathrm{NP}\end{bmatrix}^1
}{\mathsf{gave} \circ \varphi;\ \mathbf{gave}(x);\ \mathrm{VP/PP}}{\scriptstyle /\mathrm{E}}
\quad
\begin{array}{l}\mathsf{to} \circ \mathsf{chris};\\ \mathbf{c};\mathrm{PP}\end{array}
}{\mathsf{gave} \circ \varphi \circ \mathsf{to} \circ \mathsf{chris};\ \mathbf{gave}(x)(\mathbf{c});\ \mathrm{VP}}{\scriptstyle /\mathrm{E}}
}{\mathsf{kim} \circ \mathsf{gave} \circ \varphi \circ \mathsf{to} \circ \mathsf{chris};\ \mathbf{gave}(x)(\mathbf{c})(\mathbf{k});\ \mathrm{S}}{\scriptstyle \backslash\mathrm{E}}
}{\lambda\varphi.\mathsf{kim} \circ \mathsf{gave} \circ \varphi \circ \mathsf{to} \circ \mathsf{chris};\ \lambda x.\mathbf{gave}(x)(\mathbf{c})(\mathbf{k});\ \mathrm{S}|\mathrm{NP}}{\scriptstyle |\mathrm{I}^1}
}{\mathsf{what} \circ \mathsf{kim} \circ \mathsf{gave} \circ \mathsf{to} \circ \mathsf{chris};\ \mathbf{what}(\lambda x.\mathbf{gave}(x)(\mathbf{c})(\mathbf{k}));\ \mathrm{Q}}{\scriptstyle |\mathrm{E}}
$$

The fronted *wh*-expression then simply takes the property denoted by this S|NP as an argument semantically. Phonologically, instead of filling in an overt string in the gap position (as in the case of 'covert' movement of quantifiers above), it fills in an empty string for the gap, and concatenates the string *what* to the left of the string thus obtained. Thus, in the present system, the difference between 'overt' and 'covert' movement reduces to the 'phonological action' of the relevant operator.

3.2 Barker's (2013) analysis of sluicing

The key idea behind Barker's analysis of sluicing is that the 'anticonstituent' (or continuation) in the antecedent clause is the anaphoric antecedent of the missing material in the ellipsis site in the target clause. Informally, the anticonstituent is whatever remains in the sentence by removing the inner antecedent (typically an indefinite) corresponding to the sluice. For example, in (15), the anticonstituent is the discontinuous constituent *John saw __ yesterday.*

(15) John saw someone yesterday, but I don't know who.

In our setup, such a discontinuous constituent can be derived by hypothetical reasoning for |, just as in the above examples.

(16) $\lambda\varphi.\mathsf{john} \circ \mathsf{saw} \circ \varphi \circ \mathsf{yesterday};\ \lambda x.\mathbf{yest}(\mathbf{saw}(x))(\mathbf{j});\ \mathrm{S}|\mathrm{NP}$

Then, a phonetically empty binding operator identifies the meaning of the missing S|NP expression in the ellipsis site with the meaning of an antecedent S|NP in the antecedent clause. This involves first hypothesizing two type S|NP expressions, one in the antecedent clause and the other in the target clause, which are then 'merged' with one another by the binding operator. The relevant binding operator has the following form (I write $\lambda\tau\lambda\sigma$ as $\lambda\tau\sigma$; similarly for semantic terms):

(17) $\lambda\tau\sigma.\tau(\varepsilon_{\mathsf{ss}})(\sigma);\ \lambda\mathcal{R}\mathcal{P}.\mathcal{R}(\mathcal{P})(\mathcal{P});\ (\mathrm{S|(S|NP))|(S|(S|NP)|(S|NP))}$

As expected, the syntactic category and the semantics are that of an 'argument reducer' (cf., e.g., Bach and Partee 1980; Szabolcsi 1989; Morrill 1994; Dowty 2007), where the operator takes an S missing two expressions of the same type (S|NP) and returns an S looking for just one S|NP. Semantically, the meaning of the two missing expressions are simply identified. For the phonology, note first that S|NP is prosodically of type $\mathsf{st}\to\mathsf{st}$. This means that the argument of this operator S|(S|NP)|(S|NP) has the type $(\mathsf{st}\to\mathsf{st})\to(\mathsf{st}\to\mathsf{st})\to\mathsf{st}$. What the sluicing binding operator does on the prosodic side is that it simply retains the 'gap' position of type $\mathsf{st}\to\mathsf{st}$ in the antecedent clause but fills in the corresponding 'gap' by feeding an appropriate empty expression of type $\mathsf{st}\to\mathsf{st}$, that is, $\varepsilon_{\mathsf{ss}} = \lambda\varphi.\varphi$.

The complete derivation is given in (18) (where $\mathrm{C} = \mathrm{S|NP}$ and $\mathsf{bidk} = \mathsf{but}\circ\mathsf{i}\circ\mathsf{don't}\circ\mathsf{know}$):

(18)

$$\dfrac{\begin{array}{c}\vdots\quad\vdots\\ \lambda\varphi.\mathsf{john}\circ\mathsf{saw}\circ\\ \varphi\circ\mathsf{yesterday};\\ \lambda x.\mathbf{yest}(\mathbf{saw}(x))(\mathbf{j});\\ \mathrm{S|NP}\end{array}\quad \dfrac{\begin{array}{c}\lambda\tau\sigma.\tau(\varepsilon_{\mathsf{ss}})(\sigma);\\ \lambda\mathcal{R}\mathcal{P}.\mathcal{R}(\mathcal{P})(\mathcal{P});\\ \mathrm{(S|C)|(S|C|C)}\end{array}\quad \dfrac{\dfrac{\dfrac{\begin{array}{l}\lambda\sigma.\sigma(\mathsf{someone});\\ \exists_{\mathbf{pers}};\\ \mathrm{S|(S|NP)}\end{array}\quad \left[\begin{array}{l}\sigma_2;\\ Q;\\ \mathrm{S|NP}\end{array}\right]^2}{\sigma_2(\mathsf{someone});\ \exists_{\mathbf{pers}}(Q);\ \mathrm{S}}\quad \dfrac{\vdots\ \vdots\quad \dfrac{\left[\begin{array}{l}\sigma_1;\\ P;\mathrm{S|NP}\end{array}\right]^1}{\vdots\ \vdots}\quad \vdots\ \vdots}{\begin{array}{l}\mathsf{bidk}\circ\mathsf{who}\circ\sigma_1(\varepsilon);\\ \lambda p.p\wedge\\ \quad\neg\mathbf{know}(\mathbf{i})(\mathbf{who}(P));\\ \mathrm{S\backslash S}\end{array}}}{\begin{array}{c}\sigma_2(\mathsf{someone})\circ\mathsf{bidk}\circ\mathsf{who}\circ\sigma_1(\varepsilon);\\ \exists_{\mathbf{pers}}(Q)\wedge\neg\mathbf{know}(\mathbf{i})(\mathbf{who}(P));\mathrm{S}\end{array}}\ |\mathrm{I}^2,\mathrm{I}^1}{\begin{array}{c}\lambda\sigma_1\sigma_2.\sigma_2(\mathsf{someone})\circ\mathsf{bidk}\circ\mathsf{who}\circ\sigma_1(\varepsilon);\\ \lambda PQ.\exists_{\mathbf{pers}}(Q)\wedge\neg\mathbf{know}(\mathbf{i})(\mathbf{who}(P));\mathrm{S|C|C}\end{array}}}{\lambda\sigma.\sigma(\mathsf{someone})\circ\mathsf{bidk}\circ\mathsf{who};\ \lambda P.\exists_{\mathbf{pers}}(P)\wedge\neg\mathbf{know}(\mathbf{i})(\mathbf{who}(P));\ \mathrm{S|C}}}{\begin{array}{l}\mathsf{john}\circ\mathsf{saw}\circ\mathsf{someone}\circ\mathsf{yesterday}\circ\mathsf{bidk}\circ\mathsf{who};\\ \exists_{\mathbf{pers}}(\lambda x.\mathbf{yest}(\mathbf{saw}(x))(\mathbf{j}))\wedge\neg\mathbf{know}(\mathbf{i})(\lambda x.\mathbf{yest}(\mathbf{saw}(x))(\mathbf{j}));\mathrm{S}\end{array}}$$

Interestingly, Barker's analysis straightforwardly extends to the case of sprouting like the following, where there is apparently no inner antecedent corresponding to the sluice:

(19) John left, but I don't know when.

As Barker shows, by assuming an empty adverbial expression in the antecedent clause, we can construct an appropriate anticonstituent of type S|Adv (where Adv = (NP\S)\(NP\S)) to serve as the antecedent for the sluice gap in the ellipsis site. Just as in Barker's system, an empty adverbial can be derived as a theorem in Hybrid TLCG:

(20)

$$\dfrac{\dfrac{\dfrac{\dfrac{[\varphi_1;x;\mathrm{NP}]^1\quad[\varphi_2;P;\mathrm{NP\backslash S}]^2}{\varphi_1\circ\varphi_2;\ P(x);\ \mathrm{S}}}{\varphi_2;\ \lambda x.P(x);\ \mathrm{NP\backslash S}}\backslash\mathrm{I}^1}{\varphi_2\circ\varepsilon;\ \lambda x.P(x);\ \mathrm{NP\backslash S}}}{\varepsilon;\ \lambda Px.P(x);\ \mathrm{(NP\backslash S)\backslash(NP\backslash S)}}\backslash\mathrm{I}^2$$

This can then be used to ‘close off’ the adverbial gap in the antecedent clause. The rest of the derivation essentially remains the same as above, as shown below (here, Adv = (NP\S)\(NP\S), C = S|Adv and $\mathbf{id}_{et,et} = \lambda Px.P(x)$).

(21)

$$
\dfrac{
\begin{array}{c}\vdots\quad\vdots\\ \lambda\varphi.\mathsf{john}\circ\mathsf{left}\circ\varphi;\\ \lambda\mathscr{P}.\mathscr{P}(\mathbf{leave})(\mathbf{j});\\ \mathrm{S|Adv}\end{array}
\quad
\dfrac{
\begin{array}{c}\lambda\tau\sigma.\tau(\mathsf{id})(\sigma);\\ \lambda\mathcal{R}\mathcal{P}.\mathcal{R}(\mathcal{P})(\mathcal{P});\\ \mathrm{(S|C)|(S|C|C)}\end{array}
\quad
\dfrac{
\dfrac{
\dfrac{
\begin{array}{c}\varepsilon;\\ \mathbf{id}_{et,et};\\ \mathrm{Adv}\end{array}
\quad
\begin{bmatrix}\sigma_2;\\ \mathscr{F};\\ \mathrm{S|Adv}\end{bmatrix}^2
}{\sigma_2(\varepsilon);\ \mathscr{F}(\mathbf{id}_{et,et});\ \mathrm{S}}
\quad
\dfrac{
\begin{array}{c}\vdots\vdots\quad \dfrac{\begin{bmatrix}\sigma_1;\\ \mathscr{H};\mathrm{S|Adv}\end{bmatrix}^1}{\vdots\vdots}\quad\vdots\vdots\\ \vdots\vdots\end{array}
}{\begin{array}{l}\mathsf{bidk}\circ\mathsf{when}\circ\sigma_1(\varepsilon);\\ \lambda p.p\wedge\neg\mathbf{know}(\mathbf{i})(\mathbf{when}(\mathscr{H}));\\ \mathrm{S\backslash S}\end{array}}
}{\begin{array}{c}\sigma_2(\varepsilon)\circ\mathsf{bidk}\circ\mathsf{when}\circ\sigma_1(\varepsilon);\\ \mathscr{F}(\mathbf{id}_{et,et})\wedge\neg\mathbf{know}(\mathbf{i})(\mathbf{when}(\mathscr{H}));\mathrm{S}\end{array}}
}{\begin{array}{c}\lambda\sigma_1\sigma_2.\sigma_2(\varepsilon)\circ\mathsf{bidk}\circ\mathsf{when}\circ\sigma_1(\varepsilon);\\ \lambda\mathscr{H}\mathscr{F}.\mathscr{F}(\mathbf{id}_{et,et})\wedge\neg\mathbf{know}(\mathbf{i})(\mathbf{when}(\mathscr{H}));\mathrm{S|C|C}\end{array}}|\mathrm{I}^2,\mathrm{I}^1
}{\lambda\sigma.\sigma(\varepsilon)\circ\mathsf{bidk}\circ\mathsf{when};\ \lambda\mathscr{F}.\mathscr{F}(\mathbf{id}_{et,et})\wedge\neg\mathbf{know}(\mathbf{i})(\mathbf{when}(\mathscr{F}));\ \mathrm{S|C}}
}{\mathsf{john}\circ\mathsf{left}\circ\mathsf{bidk}\circ\mathsf{when};\ \mathbf{leave}(\mathbf{j})\wedge\neg\mathbf{know}(\mathbf{i})(\mathbf{when}(\lambda\mathscr{P}.\mathscr{P}(\mathbf{leave})(\mathbf{j})));\ \mathrm{S}}
$$

3.3 Parasitic gaps and sluicing

In TLCG, both filler-gap dependency and sluicing are treated in terms of hypothetical reasoning, and, as I show below, the interaction of the two phenomena from Yoshida et al. automatically falls out as a ‘theorem’. But in order to extend the analysis above to sluicing/PG interaction, we first need an analysis of PGs in CG. Here, I propose to treat PGs by positing an empty operator that merges gaps contained in different linguistic expressions.[7]

The syntactic distribution of PGs in English is restricted mostly to the subject position and adverbial clauses. Thus, we can identify lexical heads that license PGs so that the PG-licensing operator specifically targets these lexical heads to derive alternative signs that license PGs. In the case of PGs in adverbial clauses, the PG licensing operator takes an adverbial modifier head like that in (22) as an argument to return an alternative sign in (23) (PGs in the subject position can be licensed by a similar operator applying to the lexical entries for verbs).[8]

(22) $\lambda\varphi_1\varphi_2.\varphi_2\circ\mathsf{soon}\circ\mathsf{after}\circ\varphi_1;\ \mathbf{pos}(\mathbf{soon\text{-}aft});\ \mathrm{VP|VP|VP_{ing}}$

(23) $\lambda\sigma_1\sigma_2\varphi.\sigma_2(\varphi)\circ\mathsf{soon}\circ\mathsf{after}\circ\sigma_1(\varepsilon);$
$\lambda R_1R_2x.\mathbf{pos}(\mathbf{soon\text{-}aft})(R_1(x))(R_2(x));\mathrm{(VP|NP)|(VP|NP)|(VP_{ing}|NP)}$

[7] Previous proposals in CG (Steedman 1987; Morrill 2002) treat PGs by enriching the combinatoric component of grammar. Such accounts introduce violations to resource sensitivity in the grammar, which is a somewhat radical departure from the standard setup of (at least) the type-logical variants of CG. But the particular choice of the analysis of PGs isn’t so important for us, since what is crucial for accounting for the sluicing/PG paradigm is that expressions containing (parasitic) gaps have different syntactic categories than those that don’t, which is a feature that is shared in all analyses of PGs in CG that I know of.

[8] **soon-aft** is of type $d\to et\to et\to et$ (with d the type of degrees and et an abbreviation for $e\to t$), where $\mathbf{soon\text{-}aft}(d)(P)(Q)(x)$ is true of a degree d just in case d represents the degree of soon-ness of $P(x)$ obtaining after $Q(x)$. (For a more complete analysis, a temporal or event variable needs to be posited, but I gloss over this detail since it is irrelevant.) Without the presence of a degree modifier, an empty **pos** operator (of type $(d\to et\to et\to et)\to(et\to et\to et)$) saturates the degree argument, requiring the degree in question to exceed the contextual standard (cf. Kennedy and McNally (2005); Kennedy (2007)): $\mathbf{pos}=\lambda\mathscr{F}PQx.\exists d.d\geq\mathbf{stnd}\wedge\mathscr{F}(d)(P(x))(Q(x))$.

The alternative sign in (23) identifies the two NP gaps in the adverbial clause and the modified VP and passes the 'merged' gap to the resultant VP. The lexical entry for the empty operator which produces (23) from (22) can be formulated as follows:

(24) $\lambda\sigma_0\sigma_1\sigma_2\varphi.\sigma_0(\sigma_1(\varepsilon))(\sigma_2(\varphi))$;
$\lambda\mathscr{R}PQx.\mathscr{R}(P(x))(Q(x))$; $((\mathrm{VP}|\mathrm{NP})|(\mathrm{VP}|\mathrm{NP})|(\mathrm{VP}_{\mathrm{ing}}|\mathrm{NP}))|(\mathrm{VP}|\mathrm{VP}|\mathrm{VP}_{\mathrm{ing}})$

We can then analyze sentences containing PGs such as (25) as in (26).

(25) (I don't know) which book I should review $\_\__{\mathrm{RG}}$ soon after receiving $\_\__{\mathrm{PG}}$.

(26)

$\lambda\sigma_1\sigma_2\varphi.\sigma_2(\varphi)\circ$ soon $\circ$ after $\circ\ \sigma_1(\varepsilon)$; $\lambda PQx.\mathbf{pos}(\mathbf{soon\text{-}aft})(P(x))(Q(x))$; $(\mathrm{VP}|\mathrm{NP})|(\mathrm{VP}|\mathrm{NP})|(\mathrm{VP}_{\mathrm{ing}}|\mathrm{NP})$ $\lambda\varphi.$ rcving $\circ\ \varphi$; **receive**; $\mathrm{VP}_{\mathrm{ing}}|\mathrm{NP}$

$\lambda\sigma_2\varphi.\sigma_2(\varphi)\circ$ soon $\circ$ after $\circ$ rcving; $\lambda Qx.\mathbf{pos}(\mathbf{soon\text{-}aft})(\mathbf{receive}(x))(Q(x))$; $(\mathrm{VP}|\mathrm{NP})|(\mathrm{VP}|\mathrm{NP})$

$\lambda\varphi.$ rvw $\circ\ \varphi$; **review**; $\mathrm{VP}|\mathrm{NP}$

$\lambda\varphi.$rvw $\circ\ \varphi\circ$ soon $\circ$ after $\circ$ rcving; $\lambda x.\mathbf{pos}(\mathbf{soon\text{-}aft})(\mathbf{receive}(x))(\mathbf{rvw}(x))$; $\mathrm{VP}|\mathrm{NP}$ $\begin{bmatrix}\varphi;\\ x;\\ \mathrm{NP}\end{bmatrix}^1$

rvw $\circ\ \varphi\circ$ soon $\circ$ after $\circ$ rcving; $\mathbf{pos}(\mathbf{soon\text{-}aft})(\mathbf{receive}(x))(\mathbf{review}(x))$; VP

i $\circ$ shd; $\lambda P.\Box P(\mathbf{i})$; S/VP

i $\circ$ shd $\circ$ rvw $\circ\ \varphi\circ$ soon $\circ$ after $\circ$ rcving; $\Box\mathbf{pos}(\mathbf{soon\text{-}aft})(\mathbf{receive}(x))(\mathbf{review}(x))(\mathbf{i})$; S

$|\mathrm{I}^1$

$\lambda\varphi.$i $\circ$ shd $\circ$ rvw $\circ\ \varphi\circ$ soon $\circ$ after $\circ$ rcving; $\lambda x.\Box\mathbf{pos}(\mathbf{soon\text{-}aft})(\mathbf{receive}(x))(\mathbf{review}(x))(\mathbf{i})$; $\mathrm{S}|\mathrm{NP}$

$\lambda\sigma.$which $\circ$ book $\circ\ \sigma(\varepsilon)$; $\mathbf{which}(\mathbf{book})$; $\mathrm{Q}|(\mathrm{S}|\mathrm{NP})$

which $\circ$ book $\circ$ i $\circ$ shd $\circ$ rvw $\circ$ soon $\circ$ after $\circ$ rcving; $\mathbf{which}(\mathbf{book})(\lambda x.\Box\mathbf{pos}(\mathbf{soon\text{-}aft})(\mathbf{receive}(x))(\mathbf{review}(x))(\mathbf{i}))$; Q

However, as it is, this analysis overgenerates in one serious way. The problem is that nothing in the analysis so far constrains the NP corresponding to the 'real gap' to really surface as a gap. Thus, by replacing the *wh*-expression that combines with an S|NP at the end of the derivation in (26) with an ordinary NP *this book*, we overgenerate the following:

(27) *I should review this book soon after receiving __.

To fix this problem, I borrow the [ant ±] feature from Steedman (2000). The idea is that NPs marked as [ant +] (for 'antecedent governed') cannot be instantiated by overt NPs which are specified as $\mathrm{NP}_{[\mathrm{ant}-]}$. *Wh*-NPs, on the other hand, are specified the syntactic category $\mathrm{Q}|(\mathrm{S}|\mathrm{NP}_{[\mathrm{ant}+]})$ so that they can 'cancel off' an $\mathrm{NP}_{[\mathrm{ant}+]}$ gap. The syntactic category of PG licensor is then revised so that it identifies the 'real gap' that gets inherited as [ant +]:

(28) $\lambda\sigma_0\sigma_1\sigma_2\varphi.\sigma(\sigma_1(\varepsilon))(\sigma_2(\varphi))$;
$\lambda\mathcal{R}PQx.\mathcal{R}(P(x))(Q(x))$; $((\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}_{\mathrm{ing}}|\mathrm{NP}))|(\mathrm{VP}|\mathrm{VP}|\mathrm{VP}_{\mathrm{ing}})$

This blocks the derivation for (27). The gapped S containing a PG can be derived only as $\mathrm{S}|\mathrm{NP}_{[\mathrm{ant}+]}$, which cannot combine with the ordinary NP *the book* which is $\mathrm{NP}_{[\mathrm{ant}-]}$.

An important point to note about this analysis of PG licensing is that a VP modifier containing a PG has a different syntactic category (i.e. $(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})$) than a simple VP modifier (which is of type VP|VP). Thus, sentences missing such PG-containing VP modifiers (which serve as antecedents for the sluice gap in Barker's analysis) also have different categories than sentences missing ordinary VP modifiers. As I show below, this difference in syntactic category reflecting the combinatoric properties of expressions containing PGs plays a key role in accounting for the sluicing/PG paradigm in the present setup.

In fact, the following key contrast from Yoshida et al. falls out automatically from an interaction of Barker's analysis of sluicing and the analysis of PG sketched above, without introducing any additional assumptions.

(29) a. The editor told me which book I must review $\_\__1$ soon after receiving $\_\__2$, but I don't remember [exactly how soon after receiving $\_\__3$].

b. The editor told me which book I must review $\_\__1$, but I don't remember [how soon after receiving $\_\__3$].

(30) a. *The editor told me which book I must review $\_\__1$ (soon after receiving $\_\__2$), but I don't remember [exactly how soon after receiving $\_\__3$] I must review it.

b. *The editor told me that I must review a book soon after receiving it, but I don't remember [exactly how soon after receiving __].

I start with the derivation for (29a). In this example, the sluice is a VP modifier containing a PG *how soon after receiving __*. In the present analysis, such VP modifiers have category $(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})$, that is, they are modifiers of gapped VPs. Thus, the continuation for this gapped VP modifier that antecedes the sluice gap is of type $\mathrm{S}|((\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]}))$, and can be derived as follows:

(31)

$$\dfrac{\begin{array}{l}\lambda\varphi.\mathsf{rvw}\circ\varphi;\\ \mathbf{review};\\ \mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]}\end{array} \quad \left[\begin{array}{l}\tau;\\ \mathscr{F};\\ (\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})\end{array}\right]^2}{\begin{array}{l}\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi);\\ \mathscr{F}(\mathbf{review}); \mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]}\end{array}}$$

$$\dfrac{\begin{array}{l}\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi);\\ \mathscr{F}(\mathbf{review}); \mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]}\end{array} \quad \left[\begin{array}{l}\varphi_1;\\ x;\\ \mathrm{NP}_{[\mathrm{ant}+]}\end{array}\right]^1}{\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varphi_1);\ \mathscr{F}(\mathbf{review})(x);\ \mathrm{VP}}$$

$$\dfrac{\dfrac{\begin{array}{l}\mathsf{i}\circ\mathsf{shd};\\ \lambda P.\\ \Box P(\mathbf{i});\\ \mathrm{S/VP}\end{array} \quad \tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varphi_1);\ \mathscr{F}(\mathbf{review})(x);\ \mathrm{VP}}{\mathsf{i}\circ\mathsf{shd}\circ\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varphi_1);\ \Box\mathscr{F}(\mathbf{review})(x)(\mathbf{i});\ \mathrm{S}}}{\lambda\varphi_1.\mathsf{i}\circ\mathsf{shd}\circ\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varphi_1);\ \lambda x.\Box\mathscr{F}(\mathbf{review})(x)(\mathbf{i});\ \mathrm{S}|\mathrm{NP}_{[\mathrm{ant}+]}}\ |\mathrm{I}^1$$

$$\dfrac{\begin{array}{l}\lambda\sigma.\mathsf{which}\circ\\ \quad\mathsf{book}\circ\sigma(\varepsilon);\\ \mathbf{wh}(\mathbf{bk});\\ \mathrm{Q}|(\mathrm{S}|\mathrm{NP}_{[\mathrm{ant}+]})\end{array} \quad \lambda\varphi_1.\mathsf{i}\circ\mathsf{shd}\circ\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varphi_1);\ \lambda x.\Box\mathscr{F}(\mathbf{review})(x)(\mathbf{i});\ \mathrm{S}|\mathrm{NP}_{[\mathrm{ant}+]}}{\mathsf{which}\circ\mathsf{book}\circ\mathsf{i}\circ\mathsf{shd}\circ\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varepsilon);\ \mathbf{wh}(\mathbf{bk})(\lambda x.\Box\mathscr{F}(\mathbf{review})(x)(\mathbf{i}));\ \mathrm{Q}}$$

$$\dfrac{\dfrac{\begin{array}{l}\mathsf{the}\circ\mathsf{editor}\circ\\ \quad\mathsf{told}\circ\mathsf{me};\\ \lambda F.\mathbf{tell}(\mathbf{the\text{-}ed})\\ \quad(\mathbf{i})(F);\\ \mathrm{S/Q}\end{array} \quad \mathsf{which}\circ\mathsf{book}\circ\mathsf{i}\circ\mathsf{shd}\circ\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varepsilon);\ \mathbf{wh}(\mathbf{bk})(\lambda x.\Box\mathscr{F}(\mathbf{review})(x)(\mathbf{i}));\ \mathrm{Q}}{\begin{array}{l}\mathsf{the}\circ\mathsf{editor}\circ\mathsf{told}\circ\mathsf{me}\circ\mathsf{which}\circ\mathsf{book}\circ\mathsf{i}\circ\mathsf{shd}\circ\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varepsilon);\\ \mathbf{tell}(\mathbf{the\text{-}ed})(\mathbf{i})(\mathbf{wh}(\mathbf{bk})(\lambda x.\Box\mathscr{F}(\mathbf{review})(x)(\mathbf{i}))); \mathrm{S}\end{array}}}{\begin{array}{l}\lambda\tau.\mathsf{the}\circ\mathsf{editor}\circ\mathsf{told}\circ\mathsf{me}\circ\mathsf{which}\circ\mathsf{book}\circ\mathsf{i}\circ\mathsf{shd}\circ\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varepsilon);\\ \lambda\mathscr{F}.\mathbf{tell}(\mathbf{the\text{-}ed})(\mathbf{i})(\mathbf{wh}(\mathbf{bk})(\lambda x.\Box\mathscr{F}(\mathbf{review})(x)(\mathbf{i})));\\ \mathrm{S}|((\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]}))\end{array}}\ |\mathrm{I}^2$$

The structure of the derivation is then exactly the same as in the simpler examples above. We first hypothesize expressions of type $\mathrm{S}|((\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]}))$ (which is prosodically of type $((\mathbf{st}\to\mathbf{st})\to\mathbf{st}\to\mathbf{st})\to\mathbf{st}$) in both the antecedent and target clauses. Then the sluicing binding operator binds the hypothesis in the target clause to the one in the antecedent clause.

The main difference is in the phonology. Unlike in the simpler examples involving NP and Adv inner antecedents (which are of type **st**), here the inner antecedent has the syntactic category $(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})$, with a corresponding higher-order prosodic type. Thus, the phonology of the sluicing binding operator needs to be generalized accordingly.

However, the generalization is quite straightforward. As in the simpler entry above in (17), the gap in the antecedent clause is simply inherited to the larger linguistic expression that is returned; the gap in the target clause is closed off by feeding an empty expression of type $((\mathsf{st}\to\mathsf{st})\to\mathsf{st}\to\mathsf{st})\to\mathsf{st}$: $\varepsilon_{(\mathsf{ss},\mathsf{ss}),\mathsf{s}} = \lambda\tau.\tau(\lambda\varphi.\varphi)(\varepsilon)$. The entry is given in (32).

(32) $\lambda\theta\rho.\theta(\varepsilon_{(\mathsf{ss},\mathsf{ss}),\mathsf{s}})(\rho)$; $\lambda\mathcal{R}\mathcal{P}.\mathcal{R}(\mathcal{P})(\mathcal{P})$; $(\mathrm{S}|\mathrm{C})|(\mathrm{S}|\mathrm{C}|\mathrm{C})$

The derivation for the whole sentence then goes as in (33) (here, $\varepsilon_{\mathsf{ss},\mathsf{ss}} = \lambda\sigma\varphi.\sigma(\varphi)$ and $\mathrm{C} = \mathrm{S}|((\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})))$.[9]

(33)

$$\dfrac{\begin{array}{l}\lambda\sigma_2\varphi.\sigma_2(\varphi)\circ\mathsf{soon}\circ\\ \quad\mathsf{after}\circ\mathsf{rcving};\\ \mathbf{pos}'(\mathbf{soon\text{-}aft}')(\mathbf{rcv});\\ (\mathrm{VP}|\mathrm{NP})|(\mathrm{VP}|\mathrm{NP})\end{array}\quad \begin{bmatrix}\rho_2;\\ \mathscr{K}_2;\\ \mathrm{C}\end{bmatrix}^2}{\begin{array}{l}\rho_2(\lambda\sigma_2\varphi.\sigma_2(\varphi)\circ\mathsf{soon}\circ\\ \quad\mathsf{after}\circ\mathsf{rcving});\\ \mathscr{K}_2(\mathbf{pos}'(\mathbf{soon\text{-}aft}')(\mathbf{rcv}));\mathrm{S}\end{array}}
\qquad
\dfrac{\dfrac{\vdots\quad\vdots\quad\dfrac{\begin{bmatrix}\rho_1;\\ \mathscr{K}_1;\mathrm{C}\end{bmatrix}^1}{\vdots\quad\vdots}\quad\vdots\quad\vdots}{\vdots\quad\vdots\quad\vdots\quad\vdots}}{\begin{array}{l}\mathsf{bidr}\circ\mathsf{how}\circ\mathsf{soon}\circ\\ \quad\mathsf{after}\circ\mathsf{rcving}\circ\rho_1(\varepsilon_{\mathsf{ss},\mathsf{ss}});\\ \lambda p.p\wedge\neg\mathbf{rem}(\mathbf{i})(\mathbf{how}(\lambda d.\mathscr{K}_1\\ \quad(\mathbf{soon\text{-}aft}'(d)(\mathbf{rcv}))));\\ \mathrm{S}\backslash\mathrm{S}\end{array}}$$

$$\dfrac{\dfrac{\cdots\qquad\cdots}{\begin{array}{l}\rho_2(\lambda\sigma_2\varphi.\sigma_2(\varphi)\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving})\circ\\ \quad\mathsf{bidr}\circ\mathsf{how}\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving}\circ\rho_1(\varepsilon_{\mathsf{ss},\mathsf{ss}});\\ \mathscr{K}_2(\mathbf{pos}'(\mathbf{soon\text{-}aft}')(\mathbf{rcv}))\wedge\\ \quad\neg\mathbf{rem}(\mathbf{i})(\mathbf{how}(\lambda d.\mathscr{K}_1(\mathbf{soon\text{-}aft}'(d)(\mathbf{rcv}))));\mathrm{S}\end{array}}}{\begin{array}{l}\lambda\rho_1\rho_2.\rho_2(\lambda\sigma_2\varphi.\sigma_2(\varphi)\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving})\circ\\ \quad\mathsf{bidr}\circ\mathsf{how}\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving}\circ\rho_1(\varepsilon_{\mathsf{ss},\mathsf{ss}});\\ \lambda\mathscr{K}_1\mathscr{K}_2.\mathscr{K}_2(\mathbf{pos}'(\mathbf{soon\text{-}aft}')(\mathbf{rcv}))\wedge\\ \quad\neg\mathbf{rem}(\mathbf{i})(\mathbf{how}(\lambda d.\mathscr{K}_1(\mathbf{soon\text{-}aft}'(d)(\mathbf{rcv}))));\mathrm{S}|\mathrm{C}|\mathrm{C}\end{array}}\,{|\mathrm{I}^2,\mathrm{I}^1}$$

$$\dfrac{\begin{array}{l}\lambda\tau.\mathsf{the}\circ\mathsf{editor}\circ\\ \quad\mathsf{told}\circ\mathsf{me}\circ\mathsf{which}\circ\\ \quad\mathsf{book}\circ\mathsf{i}\circ\mathsf{shd}\circ\\ \quad\tau(\lambda\varphi.\mathsf{rvw}\circ\varphi)(\varphi_1);\\ \lambda\mathscr{F}.\mathbf{tell}(\mathbf{the\text{-}ed})(\mathbf{i})\\ \quad(\mathbf{wh}(\mathbf{bk})\\ \quad(\lambda x.\Box\mathscr{F}(\mathbf{rvw})\\ \quad(x)(\mathbf{i})));\mathrm{C}\end{array}\quad \dfrac{\begin{array}{l}\lambda\theta\rho.\theta(\varepsilon_{(\mathsf{ss},\mathsf{ss}),\mathsf{s}})(\rho);\\ \lambda\mathcal{R}\mathcal{P}.\mathcal{R}(\mathcal{P})(\mathcal{P});\\ (\mathrm{S}|\mathrm{C})|(\mathrm{S}|\mathrm{C}|\mathrm{C})\end{array}\quad \begin{array}{l}\lambda\rho_1\rho_2.\rho_2(\lambda\sigma_2\varphi.\sigma_2(\varphi)\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving})\circ\\ \quad\mathsf{bidr}\circ\mathsf{how}\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving}\circ\rho_1(\varepsilon_{\mathsf{ss},\mathsf{ss}});\\ \lambda\mathscr{K}_1\mathscr{K}_2.\mathscr{K}_2(\mathbf{pos}'(\mathbf{soon\text{-}aft}')(\mathbf{rcv}))\wedge\\ \quad\neg\mathbf{rem}(\mathbf{i})(\mathbf{how}(\lambda d.\mathscr{K}_1(\mathbf{soon\text{-}aft}'(d)(\mathbf{rcv}))));\mathrm{S}|\mathrm{C}|\mathrm{C}\end{array}}{\begin{array}{l}\lambda\rho.\rho(\lambda\sigma_2\varphi.\sigma_2(\varphi)\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving})\circ\mathsf{bidr}\circ\mathsf{how}\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving};\\ \lambda\mathscr{K}_1\mathscr{K}_2.\mathscr{K}_2(\mathbf{pos}'(\mathbf{soon\text{-}aft}')(\mathbf{rcv}))\wedge\\ \quad\neg\mathbf{rem}(\mathbf{i})(\mathbf{how}(\lambda d.\mathscr{K}_1(\mathbf{soon\text{-}aft}'(d)(\mathbf{rcv}))));\mathrm{S}|\mathrm{C}\end{array}}}{\begin{array}{l}\mathsf{the}\circ\mathsf{editor}\circ\mathsf{told}\circ\mathsf{me}\circ\mathsf{which}\circ\mathsf{book}\circ\mathsf{i}\circ\mathsf{shd}\circ\mathsf{rvw}\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving}\circ\mathsf{bidr}\circ\mathsf{how}\circ\mathsf{soon}\circ\mathsf{after}\circ\mathsf{rcving};\\ \mathbf{tell}(\mathbf{the\text{-}ed})(\mathbf{i})(\mathbf{wh}(\mathbf{bk})(\lambda x.\Box\mathbf{pos}'(\mathbf{soon\text{-}aft}')(\mathbf{rcv})(\mathbf{rvw})(x)(\mathbf{i})))\wedge\\ \quad\neg\mathbf{rem}(\mathbf{i})(\mathbf{how}(\lambda d.\mathbf{tell}(\mathbf{the\text{-}ed})(\mathbf{i})(\mathbf{wh}(\mathbf{bk})(\lambda x.\Box\mathbf{soon\text{-}aft}'(d)(\mathbf{rcv})(\mathbf{rvw})(x)(\mathbf{i})))));\mathrm{S}\end{array}}$$

The relationship between the sprouting/PG example (29b) and the sluicing/PG example (29a) is exactly parallel to the relationship between the simpler sluicing-sprouting pair reviewed in the previous section. That is, instead of an overt PG-containing modifier, the sprouting example (29b) contains a phonetically empty PG-containing modifier in the antecedent clause, which again can be derived as a theorem as follows:

(34)
$$\dfrac{\dfrac{[\sigma; R; \mathrm{VP}|\mathrm{NP}]^1 \quad [\varphi; x; \mathrm{NP}]^2}{\sigma(\varphi);\ R(x);\ \mathrm{VP}}}{\lambda\sigma\varphi.\sigma(\varphi);\ \lambda Rx.R(x);\ (\mathrm{VP}|\mathrm{NP})|(\mathrm{VP}|\mathrm{NP})}\,{|\mathrm{I}^2,\mathrm{I}^1}$$

Then, by replacing an overt gapped VP modifier in the antecedent clause with this empty gapped VP modifier in the derivation in (33), we have an analysis of the sprouting/PG example (29b). The translation for the whole sentence obtained is as follows:

[9] **soon-aft**' (of type $d\to eet\to eet\to eet$) and $\mathbf{pos}'$ (of type $(d\to eet\to eet\to eet)\to(eet\to eet\to eet)$) are 'Geached' versions of **soon-aft** and **pos** respectively definable by the latter two as follows:

(i) $\lambda dR_1R_2x.\mathbf{soon\text{-}aft}(d)(R_1(x))(R_2(x))$

(ii) $\lambda\mathscr{F}R_1R_2xy.\exists d.d\geq\mathbf{stnd}\wedge\mathscr{F}(d)(R_1(x))(R_2(x))(y)$

(35) $\mathbf{tell}(\mathbf{the\text{-}ed})(\mathbf{i})(\mathbf{wh}(\mathbf{bk})(\lambda x.\Box\mathbf{review}(x)(\mathbf{i}))) \wedge$
$\neg\mathbf{rem}(\mathbf{i})(\mathbf{how}(\lambda d.\mathbf{tell}(\mathbf{the\text{-}ed})(\mathbf{i})(\mathbf{wh}(\mathbf{bk})(\lambda x.\Box\mathbf{soon\text{-}aft}'(d)(\mathbf{receive})(\mathbf{review})(x)(\mathbf{i})))))$

The ungrammatical examples in (30) are automatically blocked in the present analysis. The non-sluicing example that does not contain a real gap in the second clause (30a) is blocked since in this example there is a category mismatch between the fronted VP modifier (containing a PG, and hence is of type $(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})$) and the VP modifier gap in the sentence (which doesn't contain a PG, and hence is simply of type VP|VP).

Similarly, (30b) is unacceptable since the sluice contains a PG despite the presence of a real gap in the antecedent clause. Here too, the ungrammaticality falls out from the mismatch between the sluice and the anticonstituent. In this example, since the fronted *wh*-adverbial clause is a PG-containing VP modifier, an expression of type $\mathrm{S}|((\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]}))$ needs to be hypothesized in the sluice gap site. However, unlike the well-formed sprouting example (29b), the antecedent clause has only a saturated VP and hence cannot host a type $(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})$ modifier. Thus, this example fails to be derived.

The anti-c-command condition and the syntactic category restriction data ((7) and (9)) are also both straightforward. For the former, note that the PG-containing VP modifier has type $(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})|(\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]})$. To be modified by this adverbial clause, the VP has to be analyzed as a gap-containing VP, i.e., $\mathrm{VP}|\mathrm{NP}_{[\mathrm{ant}+]}$. However, the subject argument can never be the licensor gap since by turning it to a gap, we obtain S|NP instead of VP|NP, which is no longer modifiable by the PG-containing modifier:

(36)
$$\cfrac{\cfrac{[\varphi; x; \mathrm{NP}]^1 \quad \mathsf{was} \circ \mathsf{reviewed};\ \lambda x.\exists y.\mathbf{review}(x)(y);\ \mathrm{NP}\backslash\mathrm{S}}{\varphi \circ \mathsf{was} \circ \mathsf{reviewed};\ \exists y.\mathbf{review}(x)(y);\ \mathrm{S}}}{\lambda\varphi.\varphi \circ \mathsf{was} \circ \mathsf{reviewed};\ \lambda x.\exists y.\mathbf{review}(x)(y);\ \mathrm{S}|\mathrm{NP}}\,|\mathrm{I}^1$$

Since PG-containing sluices are restricted to environments in which the antecedent clause has the ability to license such PG-containing adverbial clauses, the ungrammaticality of the (7b) follows from the ungrammaticality of the simpler anti-c-command violation (6b).

Similarly, imposing a syntactic category restriction on the PG-licensing gap is also straightforward, if one chooses to implement it as a syntactic constraint. To do so, the only thing that needs to be said is that the type of gap that the PG-licensor duplicates is restricted to NPs, as in the entry for the PG-licensor operator introduced above. This way, both in the ordinary context and in the sluicing context, PGs whose syntactic categories are PPs are ruled out. Dropping this syntactic condition (to admit the kind of examples discussed by Levine et al. (2001)) is also straightforward. In this case, one merely needs to generalize the category of the gap in the lexical specification of PG-licensing operator suitably.

To summarize, in Barker's analysis of sluicing, the anaphoric mechanism that identifies the 'elided' material and the antecedent makes reference to the syntactic category of the sluice. From this, it immediately follows that sluicing is sensitive to PG licensing, since in CG, linguistic expressions containing PGs have different syntactic categories (reflecting their combinatoric properties) than those that don't. The sluicing/PG paradigm discussed by Yoshida et al. then directly falls under the case of 'limited syntactic sensitivity' that Barker's analysis entails. Thus, the general conclusion remains unchanged: reference to the syntactic category of the missing material is needed, but a full reconstruction of syntactic structure is unnecessary.

4 Conclusion

Traditionally, discussions of ellipsis phenomena have tended to be dominated by a debate between syntactic and semantic approaches. But the partial syntactic sensitivity of the sort discussed by Chung (2013) is difficult to make sense of in either a purely syntactic or a purely semantic approach. It is true that purely semantic approaches have nothing to say about syntactic sensitivity, but at the same time, purely syntactic approaches are also far from satisfactory in that, as they stand, they do not offer any principled explanation for why only *part* of the syntactic information encoded in the reconstructed material is made reference to. Thus, as Merchant (2013a) suggests in the conclusion of his survey of analytic approaches to ellipsis, time seems ripe to step back from the narrow dichotomy of traditional syntactic and semantic approaches and explore a wider range of analytical options.

In fact, recently researchers have started exploring possibilities of what Merchant (2013a) calls 'hybrid' approaches, which take into consideration both syntactic and semantic constraints regulating ellipsis licensing (cf., e.g., Kehler 2002; Craenenbroeck 2010; Chung 2013; Merchant 2013b). But one needs to beware that not all hybrid approaches are equally promising. Suppose we had a theory which involved full syntactic reconstruction, and which, in addition, imposed some semantic condition. As far as partial syntactic sensitivity is concerned, such an approach is equally unsatisfactory as traditional syntactic approaches: if the whole syntactic structure is fully present, why is it that sluicing behaves *as if* only part of it is present?

The variant of hybrid approach advocated by Barker (2013) is then interesting in that it has the flexibility of syntactic reference lacking in purely semantic approaches while at the same time dispensing with full syntactic reconstruction which seems an overkill. Of course, whether such an approach has any other advantage over other analytical options in the wider domain of ellipsis phenomena is an open question.[10] But once we allow ourselves the luxury of hybrid approaches, the question of how to constrain the theory become particularly imminent. In view of this, the success of the Barker-type analysis seems to suggest that the flexible but systematic syntax-semantics interfere of (certain variants of) contemporary categorial grammar offers a particularly attractive general framework in which to explore analytical options in the complex empirical domain of ellipsis.

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[10] But see Kubota and Levine (2014), which independently arrives at very similar conclusions as Barker's (2013) in the domain of pseudogapping, another ellipsis phenomenon whose proper characterization has turned out to be quite challenging for traditional approaches.

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