PRO as an anaphoric variable: Rebinding and MaxElide-effects

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1 Introduction

1.1 The Issue

• **Subjects of Control Infinitives.** A significant point of debate in theoretical syntax concerns the nature of the silent, embedded subject position Δ of Control constructions (Chomsky 1965, Rosenbaum 1967).

(1) Lou_1 tried [$\mathbf{\Delta_1}$ to leave]

• **Two Theories of Control.** Modern transformational grammar has seen a debate regarding the choice between two prominent views (see Davies & Dubinsky 2004 and Landau 2013):

– Control as Anaphora : The standard transformational analysis of control postulates a null pronominal argument that is promoted to the embedded subject position (e.g., Chomsky 1981, Landau 2000, 2015).

(2) Lou_1 tried [$\mathbf{PRO_1}$ to leave]

– Control as Movement : An influential alternative proposes that the embedded subject position may contain a trace of A-movement (e.g., Hornstein 2001, Grano 2015, Green 2019).

(3) Lou_1 tried [$\boldsymbol{t_1}$ to leave]

1.2 The Outlook

• **The Claim.** The following discussion will investigate the behavior of Δ under ellipsis and argue that it most naturally supports PRO-based theories of Control:

> **Δ is an anaphoric variable**
> The subject position of infinitival Control clauses is an anaphoric variable PRO.

• **Overlooked Evidence from Ellipsis.** In the context of $\overline{\text{A}}$-movement, there is a preference in Control structures for ellipsis of a larger predicate over a smaller one (i.e., MaxElide-effects; Sag 1976, Appendix A).

> **Δ behaves like an anaphoric variable under ellipsis**
> With respect to MaxElide-effects, PRO behaves like an anaphoric variable.

(4) Gary knows who_1 **Δ** to invite x_1 and also

a. Anne does $\langle_{\text{VP}}$ ~~know who_2 **Δ** to invite y_2~~ $\rangle$

b. *Anne knows who_2 **Δ** to $\langle_{\text{VP}}$ ~~invite y_2~~ $\rangle$

• **Comparison to Pronouns.** Arguing that non-elided variables can also induce MAX-ELIDE effects, the analysis provides an account for similar behavior from overt pronouns (e.g., Merchant 2001, 2008):

(5) GARY knows who$_1$ **he** should invite x_1 and also

a. ANNE does ⟨$_{VP}$ ~~know who$_2$ **she** should invite y_2~~ ⟩

b. *ANNE knows who$_2$ **she** should ⟨$_{VP}$ ~~invite y_2~~ ⟩

• **The Uniformity of PRO.** These facts are ultimately part of a robust pattern in which various infinitival constructions and various types of control all behave similarly (see Appendix B):

– Syntactic Uniformity : MAXELIDE-effects are observed in infinitival complements and adjuncts.

– Semantic Uniformity : MAXELIDE-effects are observed with obligatory and non-obligatory control.

• **Comparison to A-traces.** The limitations of English, and other available languages, have thus far precluded a direct comparison with A-traces, which nevertheless do not induce MAXELIDE-effects.

2 MAXELIDE-effects in Infinitival Clauses

2.1 MAXELIDE and MAXELIDE-effects

• **$\overline{\text{A}}$-Movement and MAXELIDE.** Research on MAXELIDE-effects is typically concerned with preferences for Sluicing (TP-ellipsis) over predicate ellipsis (VP-ellipsis) (Schuyler 2001; Stockwell 2020 and references).

(6) I know that Jeanette was talking about SOMEONE but

a. I don't know **WHO$_1$** ⟨$_{TP}$ ~~she was [$_{VP}$ talking about **x_1**]~~⟩ (Sluicing)

$\overline{\text{A}}$-MOVE

b. *I don't know **WHO$_1$** [$_{TP}$ she was ⟨$_{VP}$ ~~talking about **x_1**~~ ⟩] (VP-Ellipsis)

$\overline{\text{A}}$-MOVE

• **Pronominal Binding and MAXELIDE.** It was also observed by Sag (1976) that pronominal binding in the form of sloppy identity gives rise to MAXELIDE-effects (see also Takahashi & Fox 2005).

(7) TOM said that I embarrassed him$_t$ and

a. **SUSIE** also did ⟨$_{VP}$ ~~say that I [$_{VP}$ embarrassed **her$_s$**]~~⟩ (Matrix Pred-Ellipsis)

BIND

b. ***SUSIE** also [$_{VP}$ said that I did ⟨$_{VP}$ ~~embarrass **her$_s$**~~ ⟩] (Embedded Pred-Ellipsis)

BIND

• **A Definition of MAXELIDE.** A descriptive generalization for MAXELIDE-effects that is relatively unburdened by heavy theoretical terminology can be adapted from Merchant 2008:

(8) *Generalized* MAXELIDE
Let XP be an elided constituent containing a bound variable. Let YP be a possible target for deletion. YP must not properly contain XP.

i.) * ZP$_n$ [$_{YP}$ ... ⟨$_{XP}$ ~~... x_n ...~~ ⟩]

ii.) ✓ ZP$_n$ ⟨$_{YP}$ ~~... [$_{XP}$ ... x_n ...]~~⟩

• **A-Movement.** There is a consensus that A-movement, for reasons to be speculated on, does not feed the conditions for MAXELIDE-effects (Merchant 2008, Messick & Thoms 2016; see also Overfelt 2020).

(9) JANE should be interviewed t_j tomorrow and probably

a. **KEN** $\langle_{\text{TP}}$ ~~should be interviewed $\boldsymbol{t_k}$ tomorrow~~ $\rangle$ (Stripping)

b. **KEN** should $\langle_{\text{VoiceP}}$ ~~be interviewed $\boldsymbol{t_k}$ tomorrow~~ $\rangle$ (Large Pred-Ellipsis)

c. **KEN** should be $\langle_{\text{VP}}$ ~~interviewed $\boldsymbol{t_k}$ tomorrow~~ $\rangle$ (Small Pred-Ellipsis)

2.2 The Phenomenon: MAXELIDE-effects in Control constructions

• **Embedded Questions and MAXELIDE-effects.** The movement associated with embedded questions creates the conditions under which we observe MAXELIDE-effects in infinitival clauses (see Sag 1976:117–121).

(10) GARY [$_{\text{VP}}$ knows [$_{\text{CP}}$ who$_1$ Δ_g to [$_{\text{VP}}$ invite x_1]]] and also

a. ANNE does $\langle_{\text{VP}}$ ~~know [$_{\text{CP}}$ **who$_2$** Δ_a to [$_{\text{VP}}$ invite **y_2**]]~~ $\rangle$

b. *ANNE [$_{\text{VP}}$ knows [$_{\text{CP}}$ **who$_2$** Δ_a to $\langle_{\text{VP}}$ ~~invite **y_2**~~ $\rangle$]

(11) HELEN [$_{\text{VP}}$ figured out [$_{\text{CP}}$ who$_1$ Δ_h to [$_{\text{VP}}$ interview x_1]]] and also

a. ERIC did $\langle_{\text{VP}}$ ~~figure out [$_{\text{CP}}$ **who$_2$** Δ_e to [$_{\text{VP}}$ interview **y_2**]]~~ $\rangle$

b. *ERIC [$_{\text{VP}}$ figured out [$_{\text{CP}}$ **who$_2$** Δ_e to $\langle_{\text{VP}}$ ~~interview **y_2**~~ $\rangle$]]

(12) JAMES$_1$ [$_{\text{VP}}$ asked [$_{\text{CP}}$ what$_1$ Δ_j to [$_{\text{VP}}$ read x_1]] and also

a. MAXINE$_2$ did $\langle_{\text{VP}}$ ~~ask [$_{\text{CP}}$ **what$_2$** Δ_m to [$_{\text{VP}}$ read **y_2**]~~ $\rangle$

b. *MAXINE [$_{\text{VP}}$ asked [$_{\text{CP}}$ **what$_2$** Δ_m to $\langle_{\text{VP}}$ ~~read **y_2**~~ $\rangle$] (»)

• **Schematizing MAXELIDE-effects in Control.** Variable-binding across Δ induces MAXELIDE-effects, that disrupt ellipsis of a smaller predicate in favor of deleting a larger predicate:

(13) *$\overline{A}$-movement over Δ prevents ellipsis of the embedded predicate*

* ZP$_n$ [$_{\text{VP}}$ ... wh_1 ... $\boxed{\Delta_n}$ ... $\langle_{\text{VP}}$ ~~... x_1 ...~~ $\rangle$] ✓ ZP$_n$ $\langle_{\text{VP}}$ ~~... wh_1 ... $\boxed{\Delta_n}$ ... [$_{\text{VP}}$ ... x_1 ...~~]$\rangle$

2.3 Diagnosing MAXELIDE-effects

• **Factors for MAXELIDE-effects.** The contrasts that we see above, and elsewhere (see Appendix B), show the tell-tale signs of being MAXELIDE-effects:

– Bound-Variable Dependence : The preference for ellipsis of a larger constituent arises only when the ellipsis site contains a bound variable.

– Elided-Variable Dependence : The preference for ellipsis of a larger constituent arises only when the bound-variable is in contained in the ellipsis site.

– Contrast-Locality Condition : The preference for ellipsis of a larger constituent is ameliorated when a focused element intervenes between an elided variable and its binder.

• **Dependence on Bound Variables.** Given the description of Generalized MAXELIDE, the preference to maximize ellipsis should not be found in absence of a bound variable in the lower deletable constituent.

(14) *Generalized* MAXELIDE
Let XP be an elided constituent containing a bound variable. Let YP be a possible target for deletion. YP must not properly contain XP.

(15) GARY [$_{VP}$ knows Δ_g to [$_{VP}$ invite someone]] and also (cf. section 2.2)

a. ANNE does ⟨$_{VP}$ ~~know Δ_a to [$_{VP}$ invite someone]~~⟩

b. ANNE [$_{VP}$ knows Δ_a to ⟨$_{VP}$ ~~invite someone~~ ⟩]

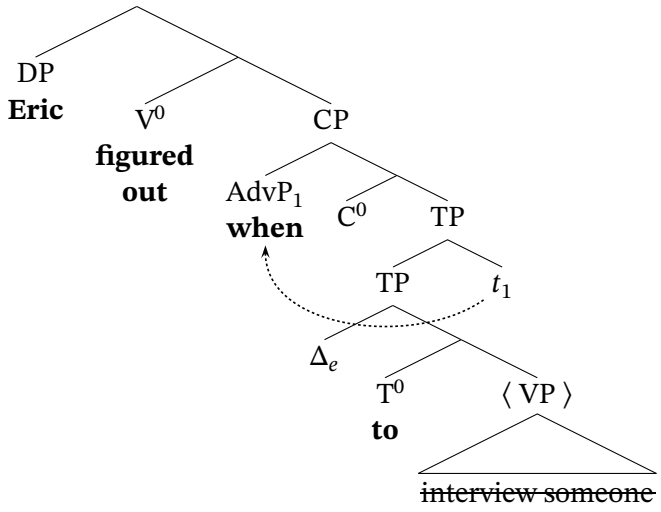
• **Dependence on Elided Variables.** Given the description of Generalized MAXELIDE, the effects should not be found if the bound variable is not contained inside the ellipsis site (e.g., Schuyler 2001, Hartman 2011).

(16) HELEN [$_{VP}$ figured out [$_{CP}$ when$_1$ Δ_h to [$_{VP}$ interview someone] t_1]] and also

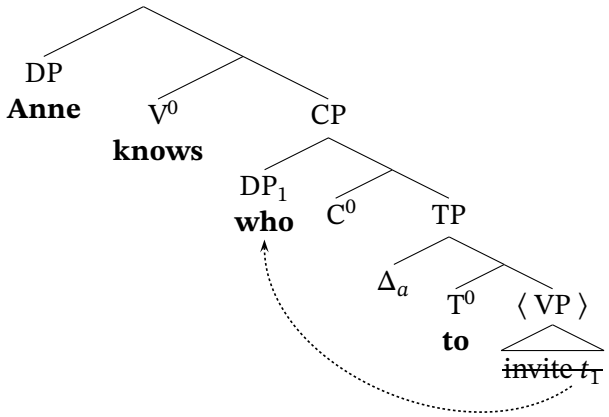
a. ERIC did ⟨$_{VP}$ ~~figure out [$_{CP}$ **when$_2$** Δ_e to [$_{VP}$ interview someone] **t_2**~~⟩

b. ?ERIC [$_{VP}$ figured out [$_{CP}$ **when$_2$** Δ_e to ⟨$_{VP}$ ~~interview someone~~ ⟩ **t_2**] (cf. section 2.2)

(17) ?



(18) *



• **Contrast-Locality (Schuyler 2001).** At a descriptive level, MAXELIDE-effects are ameliorated by the inclusion of focus marked elements (Schuyler 2001; see also Griffiths 2019, Stockwell 2020).

(19) *Contrast-locality condition for VPE* (adapted from Schuyler 2001)
For [variable binding from outside] the site of VPE to be licensed, there must be a contrastively focused expression in the c-command domain of the [binder] phrase.

(20) JAMES [$_{VP}$ asked [$_{CP}$ what$_1$ Δ_j to [$_{VP}$ read x_1]]] and

a. MAXINE [$_{VP}$ asked [$_{CP}$ **what$_2$** Δ_m NOT to ⟨$_{VP}$ ~~read **y_2**~~ ⟩]]

b. *MAXINE DIDN'T [$_{VP}$ ask [$_{CP}$ **what$_2$** Δ_m to ⟨$_{VP}$ ~~read **y_2**~~ ⟩]]

3 Ellipsis-licensing and Variable Re-binding

3.1 The Core Intuition (Sag 1976)

• **No Contra-Indexed Free Variables.** Variables that are free within an ellipsis site and contra-indexed with a parallel variable in the antecedent disrupt ellipsis-licensing.

(21) a. *[$_{CP}$ GARY will [$_{VP}$ invite **her$_1$**]] and then [$_{PD}$ ANNE will ⟨$_{VP}$ ~~invite **her$_2$**~~⟩]

"Gary will invite Sue and then Anne will invite Martha."

b. ⟦ [$_{VP}$ invite her$_1$] ⟧^{g} ≠ ⟦ ⟨$_{VP}$ invite her$_2$ ⟩ ⟧^{g}

• **Re-Binding and Contra-Indexing.** A variable that is *re-bound* outside the ellipsis site is necessarily contra-indexed with the parallel variable in the antecedent (Sag 1976, Heim 1997).

(22) a. *GARY [$_{VP}$ knows [$_{CP}$ **who$_1$** Δ to [$_{VP}$ invite ***x$_1$***]]] and also

ANNE [$_{VP}$ knows [$_{CP}$**who$_2$** Δ to ⟨$_{VP}$ ~~invite ***y$_2$***~~⟩]]

b. ⟦ [$_{VP}$ invite x_1] ⟧^{g} ≠ ⟦ ⟨$_{VP}$ invite y_2 ⟩ ⟧^{g}

• **Internal-Binding.** When all variables are bound internal to an ellipsis site, the result will be sufficiently similar to an antecedent for purposes of licensing ellipsis.

(23) a. Gary [$_{VP}$ knows [$_{CP}$ **who$_1$** Δ to [$_{VP}$ invite ***x$_1$***]]] and also

Anne does ⟨$_{VP}$ ~~know [$_{CP}$ **who$_2$** Δ to [$_{VP}$ invite ***y$_2$***]]~~⟩

b. ⟦ [$_{VP}$ knows who$_1$ to invite x_1] ⟧^{g} = ⟦ ⟨$_{VP}$ know who$_2$ to invite y_2 ⟩ ⟧^{g}

3.2 A Licensing Condition for Ellipsis

• **Grammatical Re-binding.** While the intuition above has been influential, it has become clear that there are instances of grammatical re-binding (Evans 1980, Jacobson 1992, Schuyler 2001).

(24) a. **SUE$_1$**, we will [$_{VP}$ invite ***x$_1$***] and **MARTHA$_2$**, we will ⟨$_{VP}$ ~~invite ***y$_2$***~~⟩ also

b. ⟦ [$_{VP}$ invite x_1] ⟧^{g} ≠ ⟦ ⟨$_{VP}$ invite y_2 ⟩ ⟧^{g}

• **Focus-Based Contrast Condition.** Grammatical re-binding can be accommodated by identifying an antecedent for a constituent containing the ellipsis site (Rooth 1992b, Takahashi & Fox 2005, et seq.).

(25) Ellipsis of some XP is permitted only if:

i.) there is a Parallelism Domain (PD) that contains XP,

ii.) there is an Antecedent Constituent (AC), and

iii.) the denotation of AC is a member or a subset of the focus semantic denotation of PD:

⟦ AC ⟧^{o} ∈ ⟦ PD ⟧^{f} (individual case)

⟦ AC ⟧^{o} ⊆ ⟦ PD ⟧^{f} (set case)

• **Focus Semantic Denotation.** The focus denotation of a constituent is a set of elements (e.g., $\langle st \rangle$ or $\langle vt \rangle$ functions) that are computed by replacing FOCUSED constituents with their alternatives (Rooth 1992b).

(26) a. SUE we will invite x_1 and [$_{\text{PD}}$ MARTHA we will $\langle_{\text{VP}}$ ~~invite y_2~~ $\rangle$] also

b. $Alt(\text{Martha}) = \{$ Martha, Nancy, Sue, Robert $\}$

c. $[\![\text{PD}]\!]^{\text{f}} = \left\{ \begin{array}{c} \text{that we will invite Martha, that we will invite Nancy,} \\ \text{that we will invite Sue, that we will invite Robert} \end{array} \right\}$

d. $[\![\text{PD}]\!]^{\text{f}} = \{ p : p = \text{ that we will invite } y \mid y \in Alt(\text{Martha}) \}$

• **Redundancy Calculation for Ellipsis.** The ability to identify an antecedent for the extended Parallelism Domain that contains the ellipsis site permits grammatical instances of re-binding.

(27) [$_{\text{CP}}$ SUE we will invite x_1] and [$_{\text{PD}}$ MARTHA we will $\langle_{\text{VP}}$ ~~invite y_2~~ $\rangle$] also

i.) $[\![\text{PD}]\!]^{\text{f}} = \{ p : p = \text{ that we will invite } y \mid y \in Alt(\text{Martha}) \}$

ii.) $[\![\text{CP}]\!]^{\text{o}} =$ that we will invite Sue

iii.) $[\![\text{CP}]\!]^{\text{o}} \in [\![\text{PD}]\!]^{\text{f}}$; ellipsis within PD is licensed

4 The Role of PRO in MAXELIDE-effects

4.1 Uncovering the Puzzle

• **Unexpected MAXELIDE.** Given the tools above, it is not necessarily expected that ellipsis cannot be licensed by identifying a Parallelism Domain that contains the *wh*-element binding the elided variable.

(28) *GARY knows [$_{\text{CP}}$ **who$_1$** Δ to [$_{\text{VP}}$ invite $\boldsymbol{x_1}$]] and also ANNE knows [$_{\text{PD}}$ **who$_2$** Δ to $\langle_{\text{VP}}$ ~~invite $\boldsymbol{y_2}$~~ $\rangle$]

• **The Denotation of Questions.** Questions denote sets of possible answers that are computed by replacing *wh*-expressions with their alternatives (Hamblin 1973, Karttunen 1977, Rooth 1992a, Beck 2006).

(29) a. $Alt(\text{who}) = \{$ Martha, Nancy, Sue, Robert $\}$

b. $[\![\text{CP}]\!]^{\text{o}} = [\![\text{PD}]\!]^{\text{f}} = \left\{ \begin{array}{c} \text{for } \Delta \text{ to invite Martha, for } \Delta \text{ to invite Nancy,} \\ \text{for } \Delta \text{ to invite Sue, for } \Delta \text{ to invite Robert} \end{array} \right\}$

c. $[\![\text{CP}]\!]^{\text{o}} = [\![\text{PD}]\!]^{\text{f}} = \{ p : p = \text{ for } \Delta \text{ to invite } x \mid x \in Alt(\text{who}) \}$

• **Something is Missing.** There is something about the embedded clauses which remains to be identified and which is precluding the licensing of ellipsis.

(30) ✗GARY knows [$_{\text{CP}}$ **who$_1$** Δ to [$_{\text{VP}}$ invite $\boldsymbol{x_1}$]] and also ANNE knows [$_{\text{PD}}$ **who$_2$** Δ to $\langle_{\text{VP}}$ ~~invite $\boldsymbol{y_2}$~~ $\rangle$]

i.) $[\![\text{PD}]\!]^{\text{f}} = \{ p : p = \text{ for } \Delta \text{ to invite } y \mid y \in Alt(\text{who}) \}$

ii.) $[\![\text{CP}]\!]^{\text{o}} = \{ p : p = \text{ for } \Delta \text{ to invite } x \mid x \in Alt(\text{who}) \}$

iii.) $[\![\text{CP}]\!]^{\text{o}} \subseteq [\![\text{PD}]\!]^{\text{f}}$; yet ellipsis is not licensed??

4.2 Contra-Indexing PRO

• **The Claim.** The subject position Δ contains the anaphoric variable PRO that disrupts licensing ellipsis of a smaller constituent, inducing its own MAXELIDE-effects.

Δ is an anaphoric variable
The subject position of infinitival Control clauses is an anaphoric variable PRO.

• **The Analysis.** The analysis asserts that $\overline{\text{A}}$-movement across non-elided PRO may require additional extension of the PD to accommodate PRO and thereby inducing MAXELIDE-effects.

Non-elided variables induce MAXELIDE-effects
Non-elided variables, including PRO, can require extending a PD and, thus, induce MAXELIDE-effects.

(31) *The Calculus of* MAXELIDE*-effects in Control constructions*

I.) *$\overline{A}$-movement leaves behind a variable that disrupts ellipsis of the smaller VP*

* $[_{\text{VP}}\ \text{ZP}_n\ \ldots\ wh_1\ \ldots\ \text{PRO}_n\ \ldots\ \langle_{\text{VP}}\ \sout{\ldots\ x_1\ \ldots}\ \rangle\ ]$
(wh_1 … PRO_n: $\overline{\text{A}}$-MOVE)

II.) *The PD is extended to the binder to accommodate the retrieval of a suitable AC*

* $[_{\text{VP}}\ \text{ZP}_n\ \ldots\ \underline{wh_1\ \ldots\ \text{PRO}_n\ \ldots\ \langle_{\text{VP}}\ \sout{\ldots\ x_1\ \ldots}\ \rangle}\ ]$

III.) *The inclusion of the variable PRO disrupts ellipsis of the smaller VP*

* $[_{\text{VP}}\ \text{ZP}_n\ \ldots\ \underline{wh_1\ \ldots\ \text{PRO}_n\ \ldots\ \langle_{\text{VP}}\ \sout{\ldots\ x_1\ \ldots}\ \rangle}\ ]$
(ZP_n … wh_1: BIND)

IV.) *The PD is further extended to the binder to accommodate the retrieval of a suitable AC*

✓ $\underline{\langle_{\text{VP}}\ \sout{\text{ZP}_n\ \ldots\ wh_1\ \ldots\ \text{PRO}_n\ \ldots\ [_{\text{VP}}\ \ldots\ x_1\ \ldots\ ]}\ \rangle}$

• **Free Contra-Indexed PRO.** The inability to license ellipsis within the intermediate PD is expected if we treat Δ as a variable that is contra-indexed within the PD with a parallel variable in the AC, viz. PRO.

(32) *GARY knows $\underline{[_{\text{CP}}\ \text{who}_1\ \textbf{PRO}_g\ \text{to}\ [_{\text{VP}}\ \text{invite}\ x_1\ ]]}$ and also
ANNE knows $\underline{[_{\text{PD}}\ \text{who}_2\ \textbf{PRO}_a\ \text{to}\ \langle_{\text{VP}}\ \sout{\text{invite}\ y_2}\ \rangle\ ]}$

i.) $[\![\ \text{PD}\ ]\!]^{\text{f}} = \{\ p : p = \text{ for PRO}_a \text{ to invite } y \mid y \in \mathit{Alt}(\text{who})\ \}$

ii.) $[\![\ \text{CP}\ ]\!]^{\text{o}} = \{\ p : p = \text{ for PRO}_g \text{ to invite } x \mid x \in \mathit{Alt}(\text{who})\ \}$

iii.) $[\![\ \text{CP}\ ]\!]^{\text{o}} \not\subseteq [\![\ \text{PD}\ ]\!]^{\text{f}}$; ellipsis is not licensed.

• **Accommodating PRO Extends the PD.** Ellipsis is only licensed by identifying an extended PD that contains the binder for PRO, which results in ellipsis of the matrix VP; PRO feeds MAXELIDE-effects.

(33) GARY [$_{VP}$ GARY knows [$_{CP}$ who$_1$ **PRO$_g$** to [$_{VP}$ invite $\boldsymbol{x_1}$]]] and also
ANNE does ⟨$_{PD}$ ~~ANNE know [$_{CP}$ who$_2$ **PRO$_a$** to [$_{VP}$ invite y_2]]~~ ⟩

i.) ⟦ PD ⟧^{f} = { p : p = x knows who PRO$_x$ to invite | $x \in Alt$(Anne) }
ii.) ⟦ VP ⟧^{o} = Gary knows who PRO$_g$ to invite
iii.) ⟦ VP ⟧^{o} ∈ ⟦ PD ⟧^{f}; ellipsis is licensed.

5 Variables Feed MAXELIDE-effects

5.1 Setting up An Experiment

• **The Prediction.** To the extent that Δ is an anaphoric variable PRO, other anaphoric variables like pronouns should be observed to similarly feed MAXELIDE-effects.

Δ behaves like other anaphoric variables under ellipsis
With respect to MAXELIDE-effects, PRO behaves like an anaphoric variable.

• **Near-Minimal Pairs.** The experiments below will test several predictions of the analysis with near-minimal pairs for comparison that involve replacing PRO with a pronoun.

(34) *PRO induced* MAXELIDE-*effects*
* ZP$_n$ [$_{VP}$ ... wh_1 ... PRO$_n$ ... ⟨$_{VP}$ ~~... x_1 ...~~ ⟩]

(35) *Pronoun induced* MAXELIDE-*effects*
* ZP$_n$ [$_{VP}$ ... wh_1 ... *pro*$_n$ ... ⟨$_{VP}$ ~~... x_1 ...~~ ⟩]

5.2 Comparing PRO with *pro*

• **MAXELIDE-effects Induced by Pronouns.** Non-elided pronouns that are included in a PD that is extended as a result of re-binding disrupt ellipsis licensing in the same way as above.

(36) BETH [$_{VP}$ asked [$_{CP}$ who$_1$ **she$_b$** should [$_{VP}$ interview x_1]]] and then
a. CHARLIE did ⟨$_{VP}$ ~~ask [$_{CP}$ who$_2$ **he$_c$** should [$_{VP}$ interview y_2]]~~ ⟩
b. *CHARLIE [$_{VP}$ asked [$_{CP}$ who$_2$ **he$_c$** should ⟨$_{VP}$ ~~interview y_2~~ ⟩]]] (cf. contrastive ***HE$_c$***)

(37) i.) ⟦ PD ⟧^{f} = { p : p = that he$_c$ should interview y | $y \in Alt$(who) }
ii.) ⟦ CP ⟧^{o} = { p : p = that she$_b$ should interview x | $x \in Alt$(who) }
iii.) ⟦ CP ⟧^{o} ⊈ ⟦ PD ⟧^{f}; ellipsis is not licensed.

• **Re-binding Prevents Sluicing.** Because the embedded clause is unable to recover a suitable AC, the proposed analysis correctly predicts that sluicing should also be impossible for PRO and pronouns.

– PRO : Sluicing is not possible in infinitival embedded questions with a PRO subject.

(38) *GARY knows [$_{CP}$ who$_1$ **PRO$_g$** to [$_{VP}$ invite x_1]] and also
ANNE [$_{VP}$ knows [$_{PD}$ who$_2$ ⟨$_{TP}$ ~~**PRO$_a$** to invite y_2~~ ⟩]]
i.) ⟦ PD ⟧^{f} = { p : p = for PRO$_a$ to invite y | $y \in Alt$(who) }
ii.) ⟦ CP ⟧^{o} = { p : p = for PRO$_g$ to invite x | $x \in Alt$(who) }
iii.) ⟦ CP ⟧$^o \not\subseteq$ ⟦ PD ⟧^{f}; ellipsis is not licensed.

– Pronouns : Sluicing is not possible in finite embedded questions with a pronominal subject (Ross 1969, Merchant 2001, 2008).

(39) *BETH asked [$_{CP}$ who$_1$ **she$_b$** should [$_{VP}$ interview x_1]] and also
Charlie asked [$_{CP}$ who$_2$ ⟨$_{TP}$ ~~**he$_c$** should ⟨$_{VP}$ interview y_2 ⟩~~]
i.) ⟦ PD ⟧^{f} = { p : p = that he$_c$ should interview y | $y \in Alt$(who) }
ii.) ⟦ CP ⟧^{o} = { p : p = that she$_b$ should interview x | $x \in Alt$(who) }
iii.) ⟦ CP ⟧$^o \not\subseteq$ ⟦ PD ⟧^{f}; ellipsis is not licensed.

• **The Uniformity of PRO and pronouns.** These facts are ultimately part of a robust pattern in which various infinitival constructions and various types of control all behave similarly (see Appendix B):

– Syntactic Uniformity : MAXELIDE-effects are observed in infinitival complements and adjuncts.

– Semantic Uniformity : MAXELIDE-effects are observed with obligatory and non-obligatory control.

6 Investigating A-traces

6.1 Setting up An Second Experiment

• **The Prediction.** To the extent that Δ is an anaphoric variable PRO, and A-traces do not feed MAXELIDE-effects, A-traces should display distinct behaviors.

A-traces do not behave like PRO or pronouns under ellipsis
With respect to MAXELIDE-effects, A-traces are distinct from variables

• **Expected Near-Minimal Pairs.** The experiments below should investigate near-minimal pairs for comparison that involve replacing PRO with an A-trace.

(40) *PRO induced* MAXELIDE*-effects*
* ZP$_n$ [$_{VP}$ … μ_1 … PRO$_n$ … ⟨$_{VP}$ ~~… x_1 …~~ ⟩]

(41) *No* MAXELIDE*-effects with A-traces*
✓ ZP$_n$ [$_{VP}$ … μ_1 … t_A … ⟨$_{VP}$ ~~… x_1 …~~ ⟩]

• **The Limits of English.** I have yet to figure out how to run this version of the experiment in English because A-movement is not possible out of clauses with $\overline{\text{A}}$-movement (see Appendix C for another failed attempt).

(42) a. *Dave appears [what$_1$ t_d to understand x_1]

A $\overline{\text{A}}$

b. *Dave appears [the abstract$_1$ t_d to understand x_1]

A $\overline{\text{A}}$

• **Desiderata for the Experiment.** In order to run this experiment, we need to identify a language that:

(i) permits (hyper)raising over $\overline{\text{A}}$-moved elements and

(ii) permits ellipsis to target predicates or modal complements.

6.2 Considerations Against An A-movement Alternative

• **A-traces Feed MaxElide-effects?** One might propose that Δ is an A-trace and its this embedded A-position that disrupts ellipsis in a way that might be similar to the current proposal (though see Appendix B).

(43) *Gary knows [$_{\text{CP}}$ who$_1$ Gary to [$_{\text{VP}}$ invite x_1]] and also

A-move

Anne knows [$_{\text{PD}}$ who$_2$ Anne to ⟨$_{\text{VP}}$ ~~invite y_z~~ ⟩]

A-move

⟦ CP ⟧^{o} ⊈ ⟦ PD ⟧^{f}; ellipsis is not licensed??

• **A-positions Do Not Feed MaxElide-effects.** Embedded A-positions do not feed MaxElided-effects for precisely the reason that they contribute to the Focus-Contrast Condition on ellipsis.

(44) It's known [$_{\text{CP}}$ who$_1$ **Gary** should [$_{\text{VP}}$ Gary invite x_1]] and also

It's known [$_{\text{PD}}$ who$_2$ **Anne** should ⟨$_{\text{VP}}$ ~~Anne invite y_z~~ ⟩]

i.) ⟦ PD ⟧^{f} = { p : p = that z should invite y | $y \in Alt$(who), $z \in Alt$(Anne) }

ii.) ⟦ CP ⟧^{o} = { p : p = that Gary should invite x | $x \in Alt$(who) }

iii.) ⟦ CP ⟧^{o} ⊆ ⟦ PD ⟧^{f}; ellipsis is licensed.

• **Contrastive A-Traces.** A promising way forward could attribute the lack of MaxElide-effects in the context of A-movement to the contrastiveness of A-traces (see Griffiths 2019 on D-Linked *wh*-expressions)

(45) Alison [$_{\text{VP}}$ Alison seems to be [$_{\text{VP}}$ t_a studying]] and also

Peter does ⟨$_{\text{VP}}$ ~~Peter seem to be [$_{\text{VP}}$ t_p studying]~~ ⟩

⟦ CP ⟧^{o} ⊆ ⟦ PD ⟧^{f}; ellipsis is licensed.

(46) Alison [$_{\text{VP}}$ t_a seems to be [$_{\text{VP}}$ Alison studying]] and also

Peter [$_{\text{VP}}$ t_p seems to be ⟨$_{\text{VP}}$ ~~Peter studying~~ ⟩]

⟦ CP ⟧^{o} ⊆ ⟦ PD ⟧^{f}; ellipsis is licensed.

7 Conclusion

• **The Observation.** The silent subject Δ of Control infinitives shows the behavior of anaphoric variables, but not A-traces, in the context of ellipsis.

> **Δ behaves like an anaphoric variable under ellipsis**
> With respect to MAXELIDE-effects, PRO behaves like an anaphoric variable.

• **The Claim.** It is possible to understand why Δ disrupts the licensing of ellipsis and induces its own MAXELIDE-effects if it is an anaphoric variable, as opposed to an A-trace.

> **Δ is an anaphoric variable**
> The subject position of infinitival Control clauses is an anaphoric variable PRO.

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Appendix A : Sag's 1976 Original Contrast

• **The Original MaxElide-effects.** The original data regarding MaxElide-effects in Control structures come from Sag 1976:117–121 and are based on data credited to Lakoff (1968).

(47) THE STEAK is $[_{AP}$ ready $[_{CP}$ Op_1 **Δ** to $[_{VP}$ eat x_1 $]]]$ and also

a. THE TOFU is $\langle_{AP}$ ~~ready $[_{CP}$ Op_2 **Δ** to $[_{VP}$ eat y_2 $]]$~~ $\rangle$

b. *THE TOFU is $[_{AP}$ ready $[_{CP}$ Op_2 **Δ** to $\langle_{VP}$ ~~eat y_2~~ $\rangle$ $]$

• **Ellipsis Requires Contrast.** Understanding this contrast requires knowing ellipsis is subject to an additional requirement that the AC must contrast with the PD (Rooth 1992b, Griffiths 2019, Stockwell 2020).

(48) If JOHN is $[_{VP}$ t_j wrong $]$, then

a. HE$_k$ is $\langle_{VP}$ ~~t_k wrong~~ $\rangle$ $\quad$ $[\![$ [VP] $]\!] \neq [\![\langle$VP$\rangle]\!]$

b. *he$_j$ is $\langle_{VP}$ ~~t_j wrong~~ $\rangle$ $\quad$ $[\![$ [VP] $]\!] = [\![\langle$VP$\rangle]\!]$ (Stockwell 2020)

• **Supplementing the Contrast Condition.** We can add this to our ellipsis-licensing condition:

(49) Ellipsis of some XP is permitted only if:
$[\![$ AC $]\!]^o \neq [\![$ PD $]\!]^o$ and
$[\![$ AC $]\!]^o \in [\![$ PD $]\!]^f$ or $[\![$ AC $]\!]^o \subseteq [\![$ PD $]\!]^f$

• **The Original MaxElide-effects.** By treating the embedded subject position as arbitrary PRO_{arb}, the MaxElide-effects reflects a lack of contrast between the embedded clauses (Griffiths 2019, Stockwell 2020).

(50) The steak$_1$ is [$_{\text{AP}}$ t_1 ready [$_{\text{CP}}$ Op_1 PRO_{arb} to [$_{\text{VP}}$ eat x_1]]] and also

a. the tofu$_2$ is ⟨$_{\text{AP}}$ ~~t_2 ready [$_{\text{CP}}$ $\boldsymbol{Op_2}$ $\boldsymbol{\text{PRO}_{arb}}$ to [$_{\text{VP}}$ eat $\boldsymbol{y_2}$]]~~⟩

⟦ AP ⟧ ≠ ⟦ PD ⟧ and ⟦ AP ⟧ ∈ Foc(PD)

b. *the tofu$_2$ is [$_{\text{AP}}$ t_2 ready [$_{\text{CP}}$ $\boldsymbol{Op_2}$ $\boldsymbol{\text{PRO}_{arb}}$ to ⟨$_{\text{VP}}$ ~~eat $\boldsymbol{y_2}$~~ ⟩]]

⟦ CP ⟧ = ⟦ PD ⟧ and ⟦ CP ⟧ ⊆ Foc(PD)

Appendix B : The Extent of MaxElide-effects in Control Constructions

• **Embedded Questions and MaxElide-effects.** The movement associated with embedded questions creates the conditions under which we observe MaxElide-effects in infinitival clauses.

• ***Ready*-class Predicates and MaxElide-effects.** Complements to control adjectives that embed null-operator structures and have non-obligatory control interpretations display MaxElide-effects.

(51) MaxElide *effects in* ready*-class constructions*

This room$_1$ is [$_{\text{AP}}$ available [$_{\text{CP}}$ Op_1 Δ to [$_{\text{VP}}$ meet in x_1]] and

a. that room $_2$ is ⟨$_{\text{AP}}$ ~~available [$_{\text{CP}}$ $\boldsymbol{Op_2}$ Δ to [$_{\text{VP}}$ meet in $\boldsymbol{y_2}$]~~⟩ also

b. *that room$_2$ is [$_{\text{AP}}$ available [$_{\text{CP}}$ $\boldsymbol{Op_2}$ Δ to ⟨$_{\text{VP}}$ ~~meet in $\boldsymbol{y_2}$~~ ⟩ also]

• **Complements to Adjectives and MaxElide-effects.** Complements to adjectival predicates that embed null-operator structures and have non-obligatory control interpretations display MaxElide-effects.

(52) MaxElide *effects in* tough*-constructions*

Pencils$_1$ are [$_{\text{AP}}$ hard [$_{\text{CP}}$ Op_1 Δ to [$_{\text{VP}}$ write with x_1]] but

a. pens$_2$ aren't ⟨$_{\text{AP}}$ ~~hard [$_{\text{CP}}$ $\boldsymbol{Op_2}$ Δ to [$_{\text{VP}}$ write with $\boldsymbol{y_2}$]~~⟩

b. *pens$_2$ aren't [$_{\text{AP}}$ hard [$_{\text{CP}}$ $\boldsymbol{Op_2}$ Δ to ⟨$_{\text{VP}}$ ~~write with $\boldsymbol{y_2}$~~ ⟩]

(53) MaxElide *effects in gapped* too*-constructions*

The book$_1$ is [$_{\text{AP}}$ too long [$_{\text{CP}}$ Op_1 Δ to [$_{\text{VP}}$ read x_1]] and also

a. the article$_2$ is ⟨$_{\text{AP}}$ ~~too long [$_{\text{CP}}$ $\boldsymbol{Op_2}$ Δ to [$_{\text{VP}}$ read $\boldsymbol{y_2}$]~~⟩

b. *the article$_2$ is [$_{\text{AP}}$ too long [$_{\text{CP}}$ $\boldsymbol{Op_2}$ Δ to ⟨$_{\text{VP}}$ ~~read $\boldsymbol{y_2}$~~ ⟩]

• **Adjuncts and MAXELIDE-effects.** Infinitival adjuncts that embed null-operator structures and have either obligatory or non-obligatory control (Green 2019) display MAXELIDE-effects.

(54) MAXELIDE *effects in infinitival relative clauses*

MARK [$_{VP}$ has a stool$_1$ [$_{CP}$ Op_1 to [$_{VP}$ sit on x_1]] and also

a. MEG does ⟨$_{VP}$ ~~have a stool$_2$ [$_{CP}$ $\boldsymbol{Op_2}$ Δ to [$_{VP}$ sit on $\boldsymbol{y_2}$]~~⟩

b. *MEG [$_{VP}$ has a stool$_2$ [$_{CP}$ $\boldsymbol{Op_2}$ Δ to ⟨$_{VP}$ ~~sit on $\boldsymbol{y_2}$~~ ⟩]

(55) MAXELIDE *effects in object-gap purpose clauses*

As for cameras, LISA [$_{VP}$ had HERS$_1$ [$_{CP}$ Op_1 Δ to [$_{VP}$ take pictures with x_1]] and also

a. PHIL did ⟨$_{VP}$ ~~have it$_2$ [$_{CP}$ $\boldsymbol{Op_2}$ Δ to [$_{VP}$ take pictures with $\boldsymbol{y_2}$]~~⟩

b. *PHIL [$_{VP}$ had HIS$_2$ [$_{CP}$ $\boldsymbol{Op_2}$ Δ to ⟨$_{VP}$ ~~take pictures with $\boldsymbol{y_2}$~~ ⟩]

Appendix C : An Alternative Experiment with Binding

• **The Prediction.** To the extent that Δ is an anaphoric variable PRO, and A-traces do not feed MAXELIDE-effects, A-traces should display distinct behaviors.

A-traces do not behave like PRO or pronouns under ellipsis
With respect to MAXELIDE-effects, A-traces are distinct from variables

• **A Binding Alternative.** There is an alternative version of this experiment that could compare PRO and A-traces crossed by variable-binding relationships, which we have seen and claimed induce MAXELIDE-effects.

(56) *PRO induced* MAXELIDE*-effects*

* ZP$_n$ [$_{VP}$ … β_1 … PRO$_n$ … ⟨$_{VP}$ ~~… x_1 …~~ ⟩]

BIND

(57) *No* MAXELIDE*-effects with A-traces*

✓ [$_{VP}$ … β_1 … t_A … ⟨$_{VP}$ ~~… x_1 …~~ ⟩]

BIND

• **Looking for MAXELIDE-effects with Binding.** This version of the experiment is confounded by the need to differentially bind the elided variables and the resulting impulse to contrastively focus the binders.

(58) DAN [$_{VP}$ seemed to Kate [t_d to [$_{VP}$ understand her$_k$]]] and also

a. MARK did ⟨$_{VP}$ ~~seem to Kate [t_m to understand her$_k$]~~⟩]

b. ☐ **MARK** [$_{VP}$ seemed to **Lucy** [$\boldsymbol{t_m}$ to ⟨$_{VP}$ ~~understand **her$_l$**~~ ⟩]]

A-MOVE

BIND