Mapping theory without argument structure*

Jamie Y. Findlay
jamie.findlay@ling-phil.ox.ac.uk

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1 Introduction

- Asudeh & Giorgolo (2012) have suggested that the LFG architecture can do away with a(rgument)-structure.
- What then of Lexical Mapping Theory (LMT)?
- Aim: to demonstrate that Kibort's (Kibort 2001, 2007, 2008, 2013a,b) version of LMT is compatible with A&G's architectural modifications.
- Structure of the talk:
  - A&G's proposal.
  - Lexical Mapping Theory.
  - Kibort's LMT.
  - Combining the approaches.
  - Some examples.

2 The proposal

- A&G reanalyse Figure 1 (p. 2) as in Figure 2 (p. 3).

*This work has benefitted enormously from discussion and ideas which I was exposed to at the Glue Group at the University of Oxford and during Anna Kibort's illuminating lectures on argument structure in Hilary Term 2013. My thanks to all involved, and especially to Ash Asudeh for his detailed comments. A manuscript of the paper this talk is derived from is available on my Academia.edu page: https://www.academia.edu/9055653/Mapping_Theory_without_Argument_Structure.

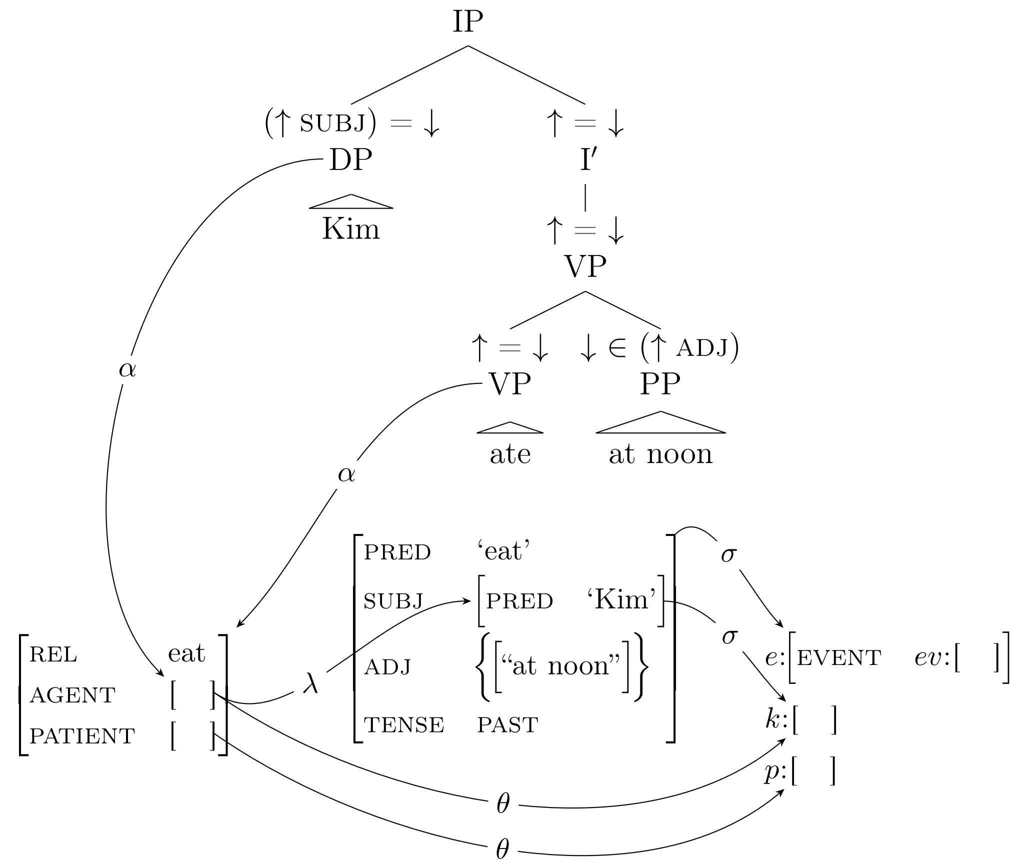

Figure 1: Relevant structures and correspondences for *Kim ate at noon* (after Asudeh & Giorgolo 2012: 70, Figure 1)

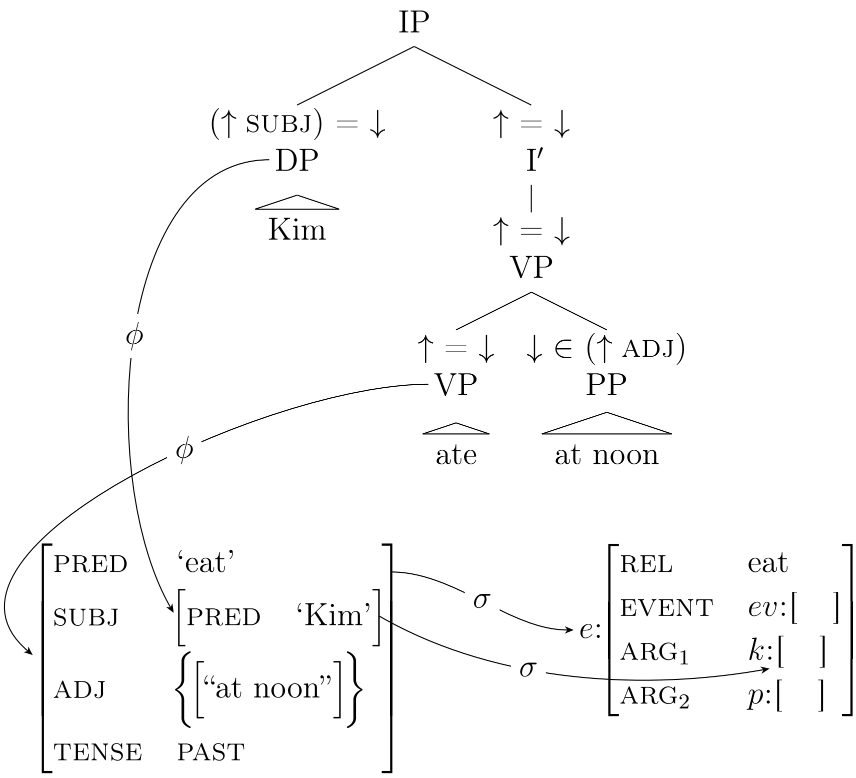

Figure 2: Alternative analysis of *Kim ate at noon* (after Asudeh & Giorgolo 2012: 72, Figure 2)

- The information previously captured at a-structure is now encoded in a connected semantic structure.
- A&G assume an event semantics for their meaning language, where thematic roles are functions from events to individuals (Parsons 1990), and so avoid redundancy by using attributes like ARG_1 rather than AGENT in the semantic structure.
- Mapping is done by stipulation:

(1) $(\uparrow \text{SUBJ})_\sigma = (\uparrow_\sigma \text{ARG}_1)$

3 Lexical Mapping Theory

- Mapping theories attempt to find general principles by which arguments and grammatical functions are related, thus avoiding repeated (and redundant) lexical stipulation.
- The traditional work on this problem in LFG is Lexical Mapping Theory (LMT; Bresnan & Kanerva 1989; Bresnan 1990; Butt et al. 1997).
- No straightforward relationship between arguments and grammatical functions: there are many operations which alter the mapping between the two, e.g. passive:

(2) Jeremy devoured the pizza.

(3) The pizza was devoured (by Jeremy).

- But these alternations are not unrestricted: in the present case, there is no operation which makes the devourer an object, as in (4), and none which makes the devourum an oblique, as in (5), for example:

(4) a. * The pizza devoured Jeremy. [With the intended meaning.]
 b. * It devoured Jeremy ((by/to/...) the pizza).

(5) * Jeremy devoured by/to/... the pizza.

- Any theory of mapping must explain why the alternations in (2–3) are possible, while others are not.

3.1 Grammatical functions decomposed

- The standard approach is decomposition by features, specifically as follows (Bresnan & Kanerva 1989) :

(6)

	$-r$	$+r$
$-o$	SUBJ	OBL_θ
$+o$	OBJ	OBJ_θ

- The two features, *o* and *r*, refer respectively to the *object*-like properties of a GF, and to whether it is semantically *restricted* or not.

- The *devour* question now has a straightforward solution: we associate each argument with a single feature, which limits its choice of GF to two.

- A separate mechanism is required to determine which argument gets priority in selecting a particular GF—this is usually explained by reference to a thematic hierarchy of some kind, although there is a lack of agreement over the exact form this should take (Newmeyer 2002: 65ff.; Rappaport Hovav & Levin 2007; Kibort 2013a). In the analysis presented here, we will use a different mechanism.

3.2 The status of the features $[\pm o]$ and $[\pm r]$

- They cross-classify the GFs.

- Do they also constitute them in some way, or are they purely mnemonic?

- Various theoretical issues with assuming the former, as of yet unresolved.

- But by appealing to these features we are making an empirical claim: if mapping phenomena are sensitive to the $[\pm o]/[\pm r]$ distinction, then we have determined that some pairings/alternations should be ruled out.
  - E.g. There is no way to describe the pair SUBJ and OBJ_θ using a single feature.

- To describe this state of affairs, it is enough to see the $[\pm o]/[\pm r]$ distinction as merely mnemonic, describing four sets of pairs which can be linked to arguments by whatever mechanism we choose to use:[1]

(7) MINUSO $\equiv \{\text{SUBJ}|\text{OBL}_\theta\}$

[1] This formulation benefitted from discussion with Ron Kaplan, p.c.

(8) PLUSO $\equiv$ {OBJ|OBJ$_\theta$}

(9) MINUSR $\equiv$ {SUBJ|OBJ}

(10) PLUSR $\equiv$ {OBL$_\theta$|OBJ$_\theta$}

- Essentially, this approach sidesteps any theoretical questions raised by the decompositional approach and simply co-opts its empirical claims.

3.3 Optionality of grammatical functions

- One other assumption I am making is that all GFs are optional: the syntactic constraints of Coherence and Completeness (see Kaplan & Bresnan 1982 and Dalrymple 2001: 35–39 for formal definitions and discussion) are subsumed by considerations of *resource sensitivity* in a Glue-based semantics (see discussion in Dalrymple 1999; Kuhn 2001; Asudeh 2012).

- When writing f-structures, therefore, I will give PRED values as simple semantic forms in single quotation marks (e.g. 'select'), omitting the traditional GF-selection/subcategorisation information usually given inside and outside angled brackets (e.g. 'select ⟨SUBJ, OBJ⟩').

4 Kibort's LMT

- Kibort (2001, 2007, 2008, 2013a,b) suggests that verbs have open to them a universal subcategorisation frame, from which they select a certain number of arguments.

- Each argument position is associated with an intrinsic assignment of syntactic features (or, ultimately, a pair of GFs, as we are thinking about it), as in (11):

(11) $$\begin{array}{ccccccc} < & \mathrm{arg}_1 & \mathrm{arg}_2 & \mathrm{arg}_3 & \mathrm{arg}_4 & \ldots & \mathrm{arg}_n & > \\ & [-o] & [-r] & [+o] & [-o] & & [-o] & \end{array}$$

- These argument positions are ordered, and a predicate can select any combination of them—that is, not necessarily a contiguous subsection: a predicate could select an arg_1 and an arg_4, for example—but there can only be one of each.

- In addition to the argument positions being ordered, Kibort derives a partial ordering on grammatical functions from the table in (6), which ranks GFs from least to most marked, where being marked is equated with having more + features:

(12) SUBJ > OBJ, OBL_θ > OBJ_θ

- Mapping is then simply linking the highest arg position to the highest available GF (with appropriate restrictions such as Function-Argument Biuniqueness (Bresnan 1980) to prevent multiple arguments mapping to the same GF).

- A verb like *select* will have the following argument structure:

(13) $\begin{array}{llll} \textit{select} & < & \text{arg}_1 & \text{arg}_2 & > \\ & & [-o] & [-r] & \end{array}$

- In the unmarked case, the highest argument position, arg_1, maps to the highest available $[-o]$ GF, in this case the SUBJ. The next argument, arg_2, then maps to the highest available $[-r]$ GF, in this case the OBJ.

- The passive voice mapping can also be easily explained, given a simple account of the passive operation as one which further restricts arg_1 to $[+r]$ (Kibort 2001):

(14) $\begin{array}{lllll} \textit{select}_{\text{PASS}} & < & \text{arg}_1 & \text{arg}_2 & > \\ & & [-o] & [-r] & \\ & & [+r] & & \end{array}$

- Now the GF corresponding to the arg_1 is fully specified.

- Kibort's LMT offers a simple and general solution to many of the traditional mapping problems, but it is based in a theory where argument structure has a fundamental role. Can we keep the advantages of such an account while maintaining A&G's claim that we can do without a separate argument structure?

5 Mapping without argument structure

5.1 Preliminaries

- I want to suggest that Kibort's arg positions can be equated with the ARG attribuets in A&G's connected semantic structure.

- One immediate advantage: the uniqueness condition on arg positions 'comes for free', since the functional nature of semantic structures (assuming they share this property with f-structures) means that there cannot be more than one attribute with the same name.

- The subscript numbers on the ARG features are now no longer simply indices for distinctiveness; i.e. alongside structures like (15) there are also those like (16), with discontinuities in the numberings which are meaningful.

(15) $\begin{bmatrix} \text{REL} & \text{select} \\ \text{EVENT} & [\ ] \\ \text{ARG}_1 & [\ ] \\ \text{ARG}_2 & [\ ] \end{bmatrix}$

(16) $\begin{bmatrix} \text{REL} & \text{put} \\ \text{EVENT} & [\ ] \\ \text{ARG}_1 & [\ ] \\ \text{ARG}_2 & [\ ] \\ \text{ARG}_4 & [\ ] \end{bmatrix}$

- Is this a problem?

- A&G evacuate information about thematic roles out of the grammatical architecture by relegating it to the meaning language, and have empty place-holder names for semantic arguments.

- But without further information, this situation makes a principled theory of mapping impossible: without knowledge of which argument corresponds to which thematic role, *or* which argument corresponds to which grammatical function, we cannot know that 'John loves Mark' means *love(john, mark)*, not *love(mark, john)*, for example.

- One of these has to give: either we return thematic role information to the grammar, or we invest the argument names with some meaning.

- Reasons to prefer not to admit thematic role information to the grammar:
  - As many have pointed out (e.g. Dowty 1991; Levin & Rappaport Hovav 2005; Davis 2011), a satisfactory list of roles has never been given.
  - And even when a set of roles is agreed upon, finding a coherent ranking or hierarchy among them that will apply equally well to all the phenomena for which such hierarchies are adduced has not proved possible (Newmeyer 2002: 65ff.; Rappaport Hovav & Levin 2007; Kibort 2013a).

- Also, thematic roles are sometimes thought of as sets of entailments, and it would then certainly seem to make more sense to categorise them as semantic predicates which can take part in such entailments, and which can stand as abbreviations for whatever complex of 'proto-role' properties actually instantiate them (Dowty 1991; Ackerman & Moore 2001).

5.2 Formalising Kibort's LMT

- Kibort imposes no upper limit on the number of argument positions a verb can select, motivated by the fact that there are very many argument-adding operations such as the applicative, benefactive, causative, etc.
- However, we can draw a distinction, following Needham & Toivonen (2011), between *core* and *derived* arguments.
- Core arguments are those which are intrinsic to a verb's meaning, such as the two arguments of *devour*: a devouring event is inherently a binary relation, between the devourer and the devourum. This is in contrast to derived arguments, which can be optionally added to certain classes of verb. These include Instrumentals, Beneficiaries, and Experiencers, as in (17–19):

  (17) Saint George slew the dragon **with a lance**.

  (18) Kim drew a picture **for his sister**.

  (19) It seems **to me** as if you don't know the answer.

- One interesting point to note: in English, derived arguments are often introduced by prepositions, and therefore surface as OBLiques. Notably, this corresponds to the fact that all arg positions above arg_4 in Kibort's valency frame are marked $[-o]$.
- With this in mind, we can associate all argument slots higher than arg_4 with derived arguments.
- I therefore propose to restrict the application of LMT to the core arguments of a predicate, and to limit these to the first four, explicitly numbered, slots in Kibort's valency frame.
- By contrast, derived arguments will not participate in mapping theory proper, but rather will be introduced lexically/syntactically.

(20) $< \quad \begin{array}{cccc} \text{ARG}_1 & \text{ARG}_2 & \text{ARG}_3 & \text{ARG}_4 \\ \text{MINUSO} & \text{MINUSR} & \text{PLUSO} & \text{MINUSO} \end{array} \quad >$

- Formalising the mapping principles—two tasks:
  1. Associate each ARG value with its respective pair of GFs.
  2. Make sure this association is optional.
- For the first task, we simply use a defining equation, e.g.:

(21) $(\uparrow \text{MINUSR})_\sigma = (\uparrow_\sigma \text{ARG}_2)$

- Translating all of the default mappings, we obtain the following:

(22) a. $(\uparrow \text{MINUSO})_\sigma = (\uparrow_\sigma \text{ARG}_1)$
b. $(\uparrow \text{MINUSR})_\sigma = (\uparrow_\sigma \text{ARG}_2)$
c. $(\uparrow \text{PLUSO})_\sigma = (\uparrow_\sigma \text{ARG}_3)$
d. $(\uparrow \text{MINUSO})_\sigma = (\uparrow_\sigma \text{ARG}_4)$

- For the sake of brevity/clarity, mapping information like this can be captured in a template, MAP (Ash Asudeh, p.c.):

(23) MAP(D, A) =
$(\uparrow \text{D})_\sigma = (\uparrow_\sigma \text{A})$

- Rewriting the default mappings:

(24) a. MAP(MINUSO, ARG_1)
b. MAP(MINUSR, ARG_2)
c. MAP(PLUSO, ARG_3)
d. MAP(MINUSO, ARG_4)

- For the second desideratum, pure optionality, as in (25), is inadequate.

(25) $((\uparrow \text{MINUSR})_\sigma = (\uparrow_\sigma \text{ARG}_2))$

- We do not want the optionality of each mapping equation to be independent: when we say that the highest argument of a verb is $[-o]$ *and* $[+r]$ we do not mean that it can be just $[-o]$ *or* $[+r]$: if the argument is realised syntactically, it must meet *both* feature restrictions.

- For a particular argument, a verb must call *all* or *none* of the relevant mapping equations, not something in between.
- One way to achieve this is to use a disjunction which enforces the correct mapping *unless* the argument is unrealised:

(26) $\{@\text{MAP}(\textsc{minuso}, \textsc{arg}_1) | (\uparrow_\sigma \textsc{arg}_1)_{\sigma^{-1}} = \varnothing\}$

- This expression says that *either* a MINUSO GF maps to $\textsc{arg}_1$, *or* nothing does.
- When we have multiple expressions of this form, as in (27), if one of the disjunctions resolves to the MAP template, then the others must as well: any call of MAP which mentions $\textsc{arg}_1$ is incompatible with a constraint which states that nothing maps to $\textsc{arg}_1$:

(27) $\{@\text{MAP}(\textsc{minuso}, \textsc{arg}_1) | (\uparrow_\sigma \textsc{arg}_1)_{\sigma^{-1}} = \varnothing\}$
$\{@\text{MAP}(\textsc{plusr}, \textsc{arg}_1) | (\uparrow_\sigma \textsc{arg}_1)_{\sigma^{-1}} = \varnothing\}$

- Templates for each argument position:

(28) $\text{NOMAP}(\text{A}) =$
$(\uparrow_\sigma \text{A})_{\sigma^{-1}} = \varnothing$

(29) a. $\text{ARG1} =$
$\{@\text{MAP}(\textsc{minuso}, \textsc{arg}_1) | @\text{NOMAP}(\textsc{arg}_1)\}$

b. $\text{ARG2} =$
$\{@\text{MAP}(\textsc{minusr}, \textsc{arg}_2) | @\text{NOMAP}(\textsc{arg}_2)\}$

c. $\text{ARG3} =$
$\{@\text{MAP}(\textsc{pluso}, \textsc{arg}_3) | @\text{NOMAP}(\textsc{arg}_3)\}$

d. $\text{ARG4} =$
$\{@\text{MAP}(\textsc{minuso}, \textsc{arg}_4) | @\text{NOMAP}(\textsc{arg}_4)\}$

- These argument selection templates can be added to the appropriate valency templates, such as AGENT-PATIENT-VERB:

(30) AGENT-PATIENT-VERB =
@ARG1
@ARG2

$\lambda P \lambda y \lambda x \lambda e. P(e) \wedge agent(e) = x \wedge patient(e) = y :$
$[(\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma] \multimap$
$(\uparrow_\sigma \textsc{arg}_2) \multimap (\uparrow_\sigma \textsc{arg}_1) \multimap (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$

5.2.1 Resolving the mapping equations

- The final instantiation of the mapping equations with particular grammatical functions will be achieved based on the ranking of the ARGs and the GFs, and crucially not by reference to any thematic hierarchy.

- The arguments are ordered by their subscript numbers:

(31) $\textsc{arg}_1 > \textsc{arg}_2 > \textsc{arg}_3 > \textsc{arg}_4$

- We also continue to assume the partial ordering on the GFs given above.

- With this in place, the mapping procedure is the same as in Kibort's theory: the highest arguments are linked with the least marked GFs.

- Various formal options: an Optimality-Theoretic framework, in the vein of e.g. Asudeh (2001)? Or the 'optimal linking' approach outlined in Butt et al. (1997)?

- Lexical entry for *devoured*:[2]

(32) *devoured* V $(\uparrow \textsc{pred}) = \text{`devour'}$
@PAST
@AGENT-PATIENT-VERB
$\lambda e.devour(e) : (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$

- Unpacking the valency template, we obtain (33):

[2]The template PAST contains the following information:

(i) $(\uparrow \textsc{tense}) = \textsc{past}$
$\lambda P.\exists e[P(e) \wedge past(e)] : [(\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma] \multimap \uparrow_\sigma$

This provides the appropriate value for the f-structure TENSE attribute, and introduces a meaning constructor which existentially closes the verb's event variable and specifies that the event is in the past.

(33) *devoured* V $(\uparrow \textsc{pred}) = \text{`devour'}$
$@\textsc{Past}$

$\{(\uparrow \textsc{minuso})_\sigma = (\uparrow_\sigma \textsc{arg}_1) | @\textsc{NoMap}(\textsc{arg}_1)\}$
$\{(\uparrow \textsc{minusr})_\sigma = (\uparrow_\sigma \textsc{arg}_2) | @\textsc{NoMap}(\textsc{arg}_2)\}$

$$\lambda P \lambda y \lambda x \lambda e. P(e) \wedge agent(e) = x \wedge patient(e) = y :$$
$$[(\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma] \multimap$$
$$(\uparrow_\sigma \textsc{arg}_2) \multimap (\uparrow_\sigma \textsc{arg}_1) \multimap (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$$

$$\lambda e. devour(e) : (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$$

- We can extract the following mapping equations from (33), with the disjunctions spelled out in the (b) examples:

(34) a. $(\uparrow \textsc{minuso})_\sigma = (\uparrow_\sigma \textsc{arg}_1)$
b. $(\uparrow \{\textsc{subj}|\textsc{obl}_\theta\})_\sigma = (\uparrow_\sigma \textsc{arg}_1)$

(35) a. $(\uparrow \textsc{minusr})_\sigma = (\uparrow_\sigma \textsc{arg}_2)$
b. $(\uparrow \{\textsc{subj}|\textsc{obj}\})_\sigma = (\uparrow_\sigma \textsc{arg}_2)$

- This gives four possibilities:

(36) a. $(\uparrow \textsc{subj})_\sigma = (\uparrow_\sigma \textsc{arg}_1)$
$(\uparrow \textsc{subj})_\sigma = (\uparrow_\sigma \textsc{arg}_2)$

b. $(\uparrow \textsc{subj})_\sigma = (\uparrow_\sigma \textsc{arg}_1)$
$(\uparrow \textsc{obj})_\sigma = (\uparrow_\sigma \textsc{arg}_2)$

c. $(\uparrow \textsc{obl}_\theta)_\sigma = (\uparrow_\sigma \textsc{arg}_1)$
$(\uparrow \textsc{subj})_\sigma = (\uparrow_\sigma \textsc{arg}_2)$

d. $(\uparrow \textsc{obl}_\theta)_\sigma = (\uparrow_\sigma \textsc{arg}_1)$
$(\uparrow \textsc{obj})_\sigma = (\uparrow_\sigma \textsc{arg}_2)$

- By appealing to some version of Function-Argument Biuniqueness, we can rule out (36a).

- Following our mapping principles, we simply link the highest argument with the highest GF; however this is achieved formally, (36b) will be the optimal linking, since the highest argument, $\textsc{arg}_1$, is matched with the highest GF, SUBJ.

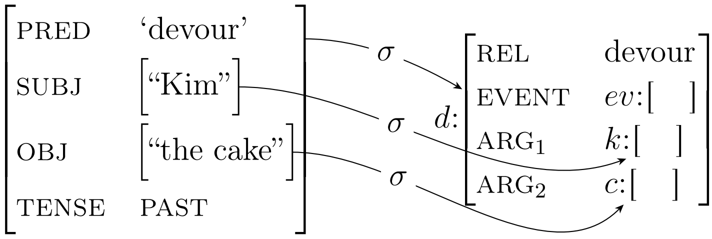

Figure 3: Structures and correspondences for *Kim devoured the cake*

- The resulting mapping between f-structure and s-structure is shown in Figure 3.
- The meaning constructor for AGENT-PATIENT-VERB in (30) will make ARG_1 the Agent and ARG_2 the Patient, as shown in the Glue proof in Figure 7 (p. 23).

6 Two argument alternations illustrated

6.1 Passive

- The passive involves further constraining the mapping to the ARG_1 position.
- We can define a template ADDMAP for monotonic addition of mapping constraints (Asudeh et al. 2014):

(37) ADDMAP(D,A) =
$\{@\text{MAP}(D,A) | @\text{NOMAP}(A)\}$

- The passive is then as follows:

(38) PASSIVE =
$(\uparrow \text{VOICE}) = \text{PASSIVE}$
$@\text{ADDMAP}(\text{PLUSR},\text{ARG}_1)$

$(\lambda P.\exists x[P(x)] : [(\uparrow_\sigma \text{ARG}_1) \multimap \uparrow_\sigma] \multimap \uparrow_\sigma)$

- The lexical entry for passive *devoured* is given in (39):

(39) *devoured* V $(\uparrow \textsc{pred}) = \text{`devour'}$
$@\textsc{Passive}$
$@\textsc{Agent-Patient-Verb}$
$\lambda e.devour(e) : (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$

- Extracting the mapping information from the two templates, we have the following information:

(40) a. $\{@\textsc{Map}(\textsc{minuso}, \textsc{arg}_1) | @\textsc{NoMap}(\textsc{arg}_1)\}$
b. $\{@\textsc{Map}(\textsc{plusr}, \textsc{arg}_1) | @\textsc{NoMap}(\textsc{arg}_1)\}$

(41) $\{@\textsc{Map}(\textsc{minusr}, \textsc{arg}_2) | @\textsc{NoMap}(\textsc{arg}_2)\}$

- Assuming both arguments are syntactically realised, we have the following mapping equations:

(42) a. $(\uparrow \{\textsc{subj}|\textsc{obl}_\theta\}) = (\uparrow_\sigma \textsc{arg}_1)$
b. $\{(\uparrow \{\textsc{obl}_\theta|\textsc{obj}_\theta\}) = (\uparrow_\sigma \textsc{arg}_1)$

(43) $\{(\uparrow \{\textsc{subj}|\textsc{obj}\}) = (\uparrow_\sigma \textsc{arg}_2)$

- The only way to resolve the $\textsc{arg}_1$ mapping disjunctions without contradiction is for the argument to be realised as an $\textsc{obl}_\theta$. This gives us only two options for the mapping:

(44) a. $(\uparrow \textsc{obl}_\theta)_\sigma = (\uparrow_\sigma \textsc{arg}_1)$
$(\uparrow \textsc{subj})_\sigma = (\uparrow_\sigma \textsc{arg}_2)$

b. $(\uparrow \textsc{obl}_\theta)_\sigma = (\uparrow_\sigma \textsc{arg}_1)$
$(\uparrow \textsc{obj})_\sigma = (\uparrow_\sigma \textsc{arg}_2)$

- Since SUBJ > OBJ on our GF hierarchy, the optimal mapping is (44a), as we require. This is shown in Figure 4 (p. 16).
- Notice that regardless of whether $\textsc{arg}_1$ is syntactically realised or not, the optimal mapping for $\textsc{arg}_2$ will always, correctly, be from the SUBJ.

6.2 The benefactive

- Certain verbs in English, like *draw* or *cook*, have lexical alternants which take a core Beneficiary argument:

$$\begin{bmatrix} \textsc{pred} & \text{`devour'} \\ \textsc{subj} & \left[\text{“the cake”}\right] \\ \textsc{obl}_{\textsc{agent}} & \left[\text{“by Kim”}\right] \\ \textsc{voice} & \textsc{passive} \\ \textsc{tense} & \textsc{past} \end{bmatrix} \xrightarrow{\sigma} d{:}\begin{bmatrix} \textsc{rel} & \text{devour} \\ \textsc{event} & ev{:}[\ \ ] \\ \textsc{arg}_1 & k{:}[\ \ ] \\ \textsc{arg}_2 & c{:}[\ \ ] \end{bmatrix}$$

Figure 4: Structures and correspondences for *The cake was devoured by Kim*

(45) Alicia drew New York City.

(46) Alicia drew Harry New York City.

- The Benefactive template is given below:[3]

(47) Benefactive =
@Arg3

$\lambda x \lambda P \lambda y \lambda e.P(y)(e) \wedge \mathit{beneficiary}(e) = x$:
$(\uparrow_\sigma \textsc{arg}_2) \multimap$
$[(\uparrow_\sigma \textsc{arg}_2) \multimap (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma] \multimap$
$(\uparrow_\sigma \textsc{arg}_3) \multimap (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$

- As per the discussion of benefactives in Kibort (2007), this adds a new $\textsc{arg}_3$ argument to the verb's valency. In addition, the meaning constructor in (47) operationalises Kibort's notion of semantic participant realignment (Kibort 2008).

- The lexical entry for benefactive *drew* is given below:

(48) *drew* V $(\uparrow \textsc{pred}) = \text{`draw'}$
@Past
@Benefactive
@Agent-Represented-Verb
$\lambda e.draw(e) : (\uparrow_\sigma \textsc{event}) \multimap \uparrow_\sigma$

[3]This can either be introduced via an annotated c-structure rule (as in Asudeh 2013; Asudeh et al. 2014), or lexically via a zero-marked morpheme. Asudeh (2013) also uses the meaning constructor in (47), as well as the one in (53), below, to encode the requirement of animacy on the subject of the main clause; I omit this in order to simplify the analysis, but it could easily be reinstated.

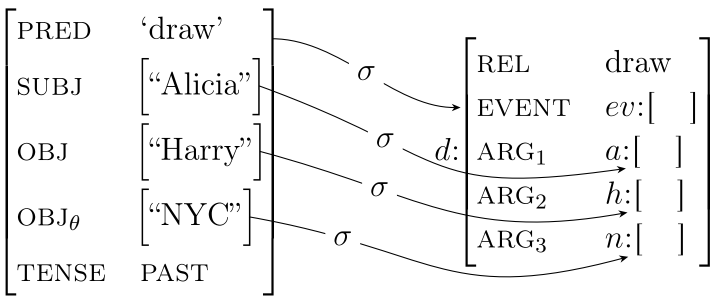

Figure 5: Structures and correspondences for *Alicia drew Harry New York City*

(49) $\textsc{Agent-Represented-Verb} =$

$\quad$ **@**$\textsc{Arg1}$

$\quad$ **@**$\textsc{Arg2}$

$$\lambda P \lambda y \lambda x \lambda e. P(e) \wedge \mathit{agent}(e) = x \wedge \mathit{represented}(e) = y :$$
$$[(\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma] \multimap$$
$$(\uparrow_\sigma \text{ ARG}_2) \multimap (\uparrow_\sigma \text{ ARG}_1) \multimap (\uparrow_\sigma \text{ EVENT}) \multimap \uparrow_\sigma$$

- The mapping proceeds without problem. Since all arguments will have to be realised syntactically, we have the following three mapping equations:

(50) $(\uparrow \text{ MINUSO})_\sigma = (\uparrow_\sigma \text{ ARG}_1)$

(51) $(\uparrow \text{ MINUSR})_\sigma = (\uparrow_\sigma \text{ ARG}_2)$

(52) $(\uparrow \text{ PLUSO})_\sigma = (\uparrow_\sigma \text{ ARG}_3)$

- The mapping is thus as shown in Figure 5.

- Notice that the OBJ/ARG$_2$ no longer corresponds to the drawn entity, but rather to the Beneficiary. This is what Kibort (2008, 2013a) refers to as semantic participant re-alignment: in other words, the semantic role of a particular argument position has changed.

- We achieve this in Glue with the meaning constructor introduced by the BENEFACTIVE template. This specifies that the ARG$_2$ is the Beneficiary, and then modifies the main verbal meaning so that ARG$_3$ rather than ARG$_2$ is passed to it in the position of the Represented argument. This is shown in the Glue proof in Figure 8 (p. 24).

- Lexical alternation is not the only way that English can introduce a Beneficiary argument. It can also do so syntactically, using the preposition *for*.

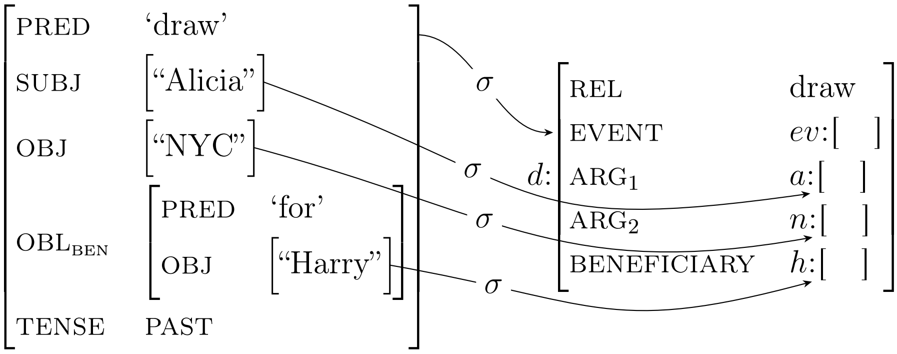

Figure 6: Structures and correspondences for *Alicia drew New York City for Harry*

- In this case, the Beneficiary is a derived argument, and so there is no argument alternation, strictly speaking: this is evidenced in the fact that the basic mapping for the Agent and Represented arguments does not change.

- The lexical entry for beneficiary-*for* is given in (53) (after Asudeh 2013):

(53) *for* P $(\uparrow \text{PRED}) = \text{`for'}$
$(\uparrow \text{OBJ})_\sigma = ((\text{OBL} \uparrow)_\sigma \ \text{BENEFICIARY})$

$\lambda x \lambda P \lambda e.P(e) \wedge \mathit{beneficiary}(e) = x :$
$(\uparrow \text{OBJ})_\sigma \multimap$
$\quad [((\text{OBL} \uparrow)_\sigma \ \text{EVENT}) \multimap (\text{OBL} \uparrow)_\sigma] \multimap$
$\quad ((\text{OBL} \uparrow)_\sigma \ \text{EVENT}) \multimap (\text{OBL} \uparrow)_\sigma$

- The mappings for *Alicia drew New York City for Harry* are shown in Figure 6 (the ARG_1 and ARG_2 mappings will proceed as for active voice *devour*).

- The third line of *for*'s lexical entry is a meaning constructor which introduces the appropriate Beneficiary meaning. Using the lexical entry for *draw* given in (54), the Glue proof in Figure 9 (p. 25) shows this in action.

(54) *drew* V $(\uparrow \text{PRED}) = \text{`draw'}$
@PAST
@AGENT-REPRESENTED-VERB
$\lambda e.draw(e) : (\uparrow_\sigma \ \text{EVENT}) \multimap \uparrow_\sigma$

7 Conclusion

- If we follow A&G's proposal and do away with argument structure as a separate level of representation, our grammar is ontologically simpler, and we have a whole new connected structure with internal relations that can be exploited in semantic analyses.
- However, in the absence of a satisfactory theory of the mapping between arguments and grammatical functions, we lose a great deal of the explanatory power that an a-structure-based LMT granted us.
- In this talk, I hope to have shown that such a theory can be developed, and have chosen to base my approach on recent work in LMT by Kibort.
- One of the things which sets her proposal apart from earlier versions of LMT is that it argues for a separation of thematic role information and argument structure, which makes it eminently compatible with the A&G proposal, since these authors advocate a very similar position.
- It is surely encouraging that independent strands of research should have converged in this way.

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$$
\dfrac{
\begin{array}{l}\textbf{[Past]}\\ \lambda P.\exists e[P(e) \wedge past(e)] :\\ [ev \multimap d] \multimap d\end{array}
\qquad
\dfrac{
\dfrac{
\begin{array}{l}\vdots\\ \textbf{[the cake]}\\ \iota z[cake(z)] :\\ c\end{array}
\qquad
\dfrac{
\begin{array}{l}\textbf{[devoured]}\\ \lambda e.devour(e) :\\ ev \multimap d\end{array}
\qquad
\begin{array}{l}\textbf{[Agent-Patient-Verb]}\\ \lambda P \lambda y \lambda x \lambda e.P(e) \wedge agent(e) = x \wedge patient(e) = y :\\ [ev \multimap d] \multimap c \multimap k \multimap ev \multimap d\end{array}
}{
\begin{array}{l}\lambda y \lambda x \lambda e.devour(e) \wedge agent(e) = x \wedge patient(e) = y :\\ c \multimap k \multimap ev \multimap d\end{array}
}
}{
\begin{array}{l}\lambda x \lambda e.devour(e) \wedge agent(e) = x \wedge patient(e) = \iota z[cake(z)] :\\ k \multimap ev \multimap d\end{array}
}
\qquad
\begin{array}{l}\textbf{[Kim]}\\ kim :\\ k\end{array}
}{
\begin{array}{l}\lambda e.devour(e) \wedge agent(e) = kim \wedge patient(e) = \iota z[cake(z)] :\\ ev \multimap d\end{array}
}
}{
\exists e[devour(e) \wedge agent(e) = kim \wedge patient(e) = \iota z[cake(z)] \wedge past(e)] : d
}
$$

Figure 7: Proof for *Kim devoured the cake*

$$\dfrac{\dfrac{\textbf{[drew]}\ \lambda e.draw(e) : ev \multimap d \qquad \textbf{[Agent-Represented-Verb]}\ \lambda P \lambda y \lambda x \lambda e.P(e) \wedge agent(e) = x \wedge represented(e) = y : [ev \multimap d] \multimap h \multimap a \multimap ev \multimap d}{\lambda y \lambda x \lambda e.draw(e) \wedge agent(e) = x \wedge represented(e) = y : h \multimap a \multimap ev \multimap d} \qquad [u : h]^1}{\lambda x \lambda e.draw(e) \wedge agent(e) = x \wedge represented(e) = u : a \multimap ev \multimap d}$$

$$\dfrac{\lambda x \lambda e.draw(e) \wedge agent(e) = x \wedge represented(e) = u : a \multimap ev \multimap d \qquad \textbf{[Alicia]}\ alicia : a}{\lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = u : ev \multimap d}$$

$$\dfrac{\lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = u : ev \multimap d}{\lambda u \lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = u : h \multimap ev \multimap d} \multimap_{\mathcal{I},1}$$

$$\dfrac{\textbf{[Harry]}\ harry : h \qquad \textbf{[Benefactive]}\ \lambda x \lambda P \lambda y \lambda e.P(y)(e) \wedge beneficiary(e) = x : h \multimap [h \multimap ev \multimap d] \multimap n \multimap ev \multimap d}{\lambda P \lambda y \lambda e.P(y)(e) \wedge beneficiary(e) = harry : [h \multimap ev \multimap d] \multimap n \multimap ev \multimap d}$$

$$\dfrac{\lambda P \lambda y \lambda e.P(y)(e) \wedge beneficiary(e) = harry : [h \multimap ev \multimap d] \multimap n \multimap ev \multimap d \qquad \lambda u \lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = u : h \multimap ev \multimap d}{\lambda y \lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = y \wedge beneficiary(e) = harry : n \multimap ev \multimap d}$$

$$\dfrac{\lambda y \lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = y \wedge beneficiary(e) = harry : n \multimap ev \multimap d \qquad \textbf{[NYC]}\ NYC : n}{\lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = NYC \wedge beneficiary(e) = harry : ev \multimap d}$$

$$\dfrac{\textbf{[Past]}\ \lambda P.\exists e[P(e) \wedge past(e)] : [ev \multimap d] \multimap d \qquad \lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = NYC \wedge beneficiary(e) = harry : ev \multimap d}{\exists e[draw(e) \wedge agent(e) = alicia \wedge represented(e) = NYC \wedge beneficiary(e) = harry \wedge past(e)] : d}$$

Figure 8: Proof for *Alicia drew Harry New York City*

[drew]
$\lambda e.draw(e) :$
$ev \multimap d$

[Agent-Represented-Verb]
$\lambda P \lambda y \lambda x \lambda e.P(e) \wedge agent(e) = x \wedge represented(e) = y :$
$[ev \multimap d] \multimap n \multimap a \multimap ev \multimap d$

$\lambda y \lambda x \lambda e.draw(e) \wedge agent(e) = x \wedge represented(e) = y :$
$n \multimap a \multimap ev \multimap d$

[NYC]
$NYC :$
n

$\lambda x \lambda e.draw(e) \wedge agent(e) = x \wedge represented(e) = NYC :$
$a \multimap ev \multimap d$

[Alicia]
$alicia :$
a

$\lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = NYC :$
$ev \multimap d$

[Harry]
$harry :$
h

[for]
$\lambda x \lambda P \lambda e.P(e) \wedge beneficiary(e) = x :$
$h \multimap [ev \multimap d] \multimap ev \multimap d$

$\lambda P \lambda e.P(e) \wedge beneficiary(e) = harry :$
$[ev \multimap d] \multimap ev \multimap d$

$\lambda e.draw(e) \wedge agent(e) = alicia \wedge represented(e) = NYC \wedge beneficiary(e) = harry :$
$ev \multimap d$

[Past]
$\lambda P.\exists e[P(e) \wedge past(e)] :$
$[ev \multimap d] \multimap d$

$\exists e[draw(e) \wedge agent(e) = alicia \wedge represented(e) = NYC \wedge beneficiary(e) = harry \wedge past(e)] : d$

Figure 9: Proof for *Alicia drew New York City for Harry*