Abstract

This paper presents a Synchronous Tree Adjoining Grammar (STAG) account of Information Structure, whereby Givenness-marking requires a link between nodes on a syntactic tree and LF nodes whose interpretation is supplied by a contextually determined set of Given semantic objects. By hypothesis, the interpretation of linked nodes bypasses a default interpretation principle that requires pragmatic reasoning to disambiguate elements and enrich semantic material. Thus, interpreting Given elements requires less cognitive effort than Focused elements. This, combined with some established insights from Game-theoretic pragmatics, yields empirical advantages over more traditional semantic/pragmatic analyses of equal simplicity.

1   Introduction

1.1   The problem

The default right-edge stress pattern of the English sentence is necessarily violated when certain pragmatic considerations license de-accenting in the sense of Ladd (1996), as illustrated by the following question-answer pairs (primary sentential stress in small caps).

(1)   Q: Did anything interesting happen at the party?
       A: Yes. Mary DANCED.

(2)   Q: Did anybody dance at the party?
       A: Yes. MARY danced. / #Mary DANCED.

The expectation that somebody was dancing at the party prohibits primary stress on *danced*. Although de-accenting in this sense is not found in every language, different effects of this pragmatic dimension are found in a variety of languages. For example, in Czech and other Slavic languages, syntactic configuration is affected.

(1')   Q: 'Did anything interesting happen at the party?'
        A: Ano. Marija tancovala.
             yes   Mary   danced
(2')   Q: 'Did anybody dance at the party?'
        A: Ano. Tancovala Marija.
             yes   danced   Mary
        (from Kucerova 2007, p.6)

Canonical SV word order is violated in (2'); the verb *tancovala* 'danced', which is also de-accented, moves across the subject.

Much ink has been spilled pinning down the semantic and pragmatic distinctions that determine such prosodic and syntactic behaviors. Under the umbrella of

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'Information Structure' (IS), these and related phenomena are most often analyzed using some combination of three distinct notions: Focus, Givenness, and Contrast.

The position taken here is that current conceptions of IS require all three of these notions, despite attempts to collapse them. I argue that a true simplification of the theory comes only when we view IS as a set of instructions to an online interpretive system rather than a part of grammar; I model the interaction between these two systems using a simple Tree Adjoining Grammar (TAG). This approach is similar in spirit to Vallduví's (1990) Informational Component, but unlike that work it does not rely on any particular semantic theory, and it makes no specific claims about the architecture of Universal Grammar. The main advantage of this approach is that it is easily folded into a Game-theoretic pragmatic framework of the type suggested by Clark (2011) and Parikh (2010), which simplifies UG by explaining linguistic phenomena in terms of general reasoning behaviors. The result accounts for a wide range of facts without sacrificing explanatory power.

The rest of this introduction reviews the relevant phenomena. Section 2 reviews relevant ways in which Game Theory and Decision Theory have been applied to language. Section 3 is a brief overview of TAG. Section 4 contains the current proposal. Section 5 discusses some empirical and conceptual advantages of this proposal, and Section 6 concludes.

1.2   Focus, Givenness, and Contrast

The primitive distinctions of IS are not agreed upon, but three notions are commonly invoked: Focus (and its complement Ground), Givenness (and Newness), and Contrast. The question is whether all of these notions are necessary to account for the problem outlined above. For the sake of convenience let's refer to the de-accenting in (2) and the syntactic movement in (2') with a theory-independent term, *G-marking*; the G might stand for Given or Ground, and is meant merely as a descriptor. G-marking is often seen as a way of marking constituents outside of the Focus of a sentence, where the Focus has the role of filling in some salient open proposition (e.g. 'somebody danced' in (2), see Prince 1986). Formally, this has been analyzed in a few different ways. One may reduce the distinction to a Focus feature in narrow syntax, whereby Ground is nothing more than lack of an F-feature (Rooth 1992). Alternatively, one may view Focus and Ground as primitives of a separate component of grammar which gives instructions on how to organize the storage of propositional content (Vallduví 1990). Under this view, knowledge is stored in file cards in the sense of Heim (1988) which contain salient open propositions introduced by discourse. Finally, Roberts (1996) adopts the view that discourse is structured into Questions Under Discussion (QUDs), and relevant declarative sentences address or answer QUDs. Under this conception of discourse, the Ground of a sentence can be seen as the QUD selector, while the Focus of a sentence can be seen as the QUD addresser.

These different formalizations describe three different levels of the language faculty: for Rooth, information structure is a component of grammar as it is nar-

rowly defined within the Chomskyan paradigm; for Vallduví, it is part of a larger linguistic system that interacts with structured knowledge of the world; for Roberts, it is the product of communicative goals held by interlocutors situated within a discourse context. But these accounts all get at the same generalization. Linguistic objects that are de-accented in languages like English and fronted in languages like Czech all correspond to an open proposition that is salient to the hearer. This generalization can account for a wide variety of examples, including the question-answer pairs in (1) and (2), but it is not without its problems.

After Schwarzschild (1999), G-marking can alternatively be analyzed as marking Givenness rather than Ground. To illustrate, consider the following example.

(3)   PAT: I just got tickets to the BeeGees concert!
       CHRIS: I used to ROADIE for the BeeGees.

The prosodic contour of Chris's utterance is similar to that of example (2) above, where the default right-edge stress pattern is altered via de-accenting of some constituent, in this case the PP *for the BeeGees*. The broad Focus counterpart of this sentence (e.g. the response to "tell me something interesting about yourself") would maintain prominence on *BeeGees*. The sentence in (3), on the other hand, behaves like the answer to the question, "what is your relationship to the BeeGees?" But no such question has been posed or implied. Certainly there need not be an antecedent set of relevant propositions of the form $PAST(P(me, BGs))$ or an open proposition of the same form to be filled in by $P = roadie$. De-accenting here seems to be motivated by a different notion, Givenness.

Under the analysis given by Schwarzschild (1999), a constituent is Given when the discourse context saliently entails it under existential closure or existential type-shifting. If the Given element denotes a predicate (e.g. 'danced'), then the context entails its existential closure ('there exists an x such that x danced'). If the Given element denotes an entity (e.g. 'Mary'), then the context entails its existential closure after type-shifting ('there exists an x such that x is Mary'). Under this analysis, the G-marking of the BeeGees in (3) is licensed by the fact that the preceding context entails the existence of an entity called "the BeeGees" (and that this entailment is salient to the hearer).

In many contexts, Givenness subsumes the Focus-Ground account, and therefore it has been suggested (beginning with Schwarzschild himself) that Givenness is the only relevant pragmatic dimension affecting de-accenting. This runs into problems, however, in that there are numerous cases in which Given information must bear sentential stress, as in the following example.

(4)   A waiter walks up to a table with two customers holding a plate of chicken and a plate of tofu. The waiter has forgotten who ordered which meal and asks, "who ordered what?"
       A: HE ordered the TOFU. / #HE ordered the tofu.

In this case it is necessary to accent both the subject and the object, as both consti-

tute the answer to the multiple wh-question under discussion. Under Schwarzschild, one should be able to de-accent the entire VP *ordered the tofu*, as the context entails that somebody ordered a plate of tofu. In this case, the Focus-Ground distinction more straightforwardly accounts for the observed prosodic contour. Also, consider the following contrast.

(5) a. Q: Why are you limping?
         A: I fell down the STAIRS this afternoon.
     b. Q: Where did you fall and when?
         A: I fell down the STAIRS this AFTERNOON.

Broad Focus on the answer in (5a) does not prevent the de-accenting of "this afternoon" when the relevant time variable is easily inferable from context (notice that replacing "this afternoon" with "at lunch" no longer allows de-accenting). However, similarly to (4), the context in (5b) forces accent on "afternoon". From this it appears that accent is required on question-answering constituents. This is straightforward under the Focus-Ground approach to G-marking, but not under the Given-New approach.

The seemingly disjunctive nature of de-accenting in English is not an isolated phenomenon. Consider again the case of Czech.

(6) Q: 'Who gave Pavel the book and when?'
     A: Pavlovi   knížku   dala včera   Marie.
         Pavolv.dat book.acc gave yesterday Marie.nom
     (from Kucerova 2007, p.11)

(7) 'A little girl on her way to school lost a lollipop. And then…'

         lízátko   našel chlapec.
         lollipop.acc found boy.nom
     (from Kucerova 2007, p.3)

Here we see pragmatic similarities between Czech and English G-marking. In (6) both 'Pavel' and 'the book' are part of the multiple wh-question, mirroring example (5) above. In this case, the backgrounded elements must precede the rest of the elements in the sentence. As in example (5), the word meaning 'yesterday' cannot be G-marked, suggesting a Focus-Ground analysis. Example (7), on the other hand, defies a straightforward Focus-Ground analysis in that the G-marked element *lízátko* 'lollipop' is straightforwardly Given but not necessarily part of a salient open proposition or QUD (indeed the story could have continued about the girl rather than the lollipop). Given these facts, distinct notions of Givenness and Ground form a natural class within the linguistic system. The problem is to explain why this should be so.

Büring (2007) combines the two notions into a single constraint that prohibits the de-accenting of a Given element when it is maximally Focused, i.e. not dominated by any other Focus. This accounts for the accent patterns in question-answer

pairs like in (4). Although it unsatisfyingly relies on a disjunction, the constraint covers the range of facts once we grant a distinction between Focus as it has been presented thus far (often called "information focus" after Kiss 2007) and Selkirk's (2007) Focus of Contrast (FOC). Selkirk notes that, contra the predictions of previous analyses (Rooth 1992, Schwarzschild 1999), there are distinct prosodic correlates of Focused constituents that receive a contrastive interpretation. As shown below, contrastive focus licenses the de-accenting of what follows, perhaps to avoid stress clash (see e.g. Speyer 2008), violating the normal question-answer congruence.

(8)   PAT: I heard your uncle bought you a blue convertible.
       CHRIS: No, he bought me a RED convertible. / #No, he bought me a CHEAP
               convertible.

In this case 'red' is a contrasting alternative to 'blue' (the two are mutually exclusive in this context), but 'cheap' is not. This leads Wagner (2006) to propose that the true license for de-accenting is local contrast, e.g. a contrastive interpretation relative to the sister of the G-marked node (*convertible* here). Büring (2008) points out a hole in the empirical coverage of the analysis, showing that FOC is more likely the feature that is marked here, rather than Givenness. This is consistent with Selkirk's (2007) argument that both Givenness and Focus of Contrast are marked in natural language.

   I should note that Wagner (2010) has proposed a unified analysis of Givenness, Ground, and Contrast that addresses the issues brought forth in Büring (2008); however, though Wagner's insights about local contrast are important, there are some conceptual and empirical problems with the unification. First, an unsatisfying disjunctive characterization of local contrast is required to account for all cases. Also, Wagner's analysis relies on Given elements moving to a propositional node at LF when no alternatives are introduced by the discourse context. This claim is suspicious, as some of its predictions are not borne out. For instance, Wagner predicts (9) not to be possible in the absence of an explicit contrast set for *friend*, since DPs do not have a propositional node to move to.

(9)   Q: Who did Jones's father vote for?
       A: He voted for a FRIEND of Jones.
       (from Büring 2007, p.8)

On these grounds, I am going to maintain that most elegant analysis of the facts thus far relies on distinct notions of Focus, Givenness, and Contrast. What we are left with is something like the following generalization: (1) a Given element is de-accented unless it is in Focus, and (2) accent can shift within a Focused phrase to yield a Contrastive interpretation.

   Although there are some subtleties beyond what has been said here, I take this descriptive generalization to be basically correct. The problem is that even under a concise formal statement of the pragmatic conditions on de-accenting, we are

left with a disjunction. We want to know why Givenness and Ground (or lack of Focus) form a natural class. A disjunctive generalization does not solve the problem. By getting rid of the disjunction, we will be able to explain the facts rather than merely describing them. The key to accomplishing this, I argue, is to model IS as a set of instructions to an interpretive system. The model set forth here conceives of G-marking as an instruction to retrieve a contextually entailed Logical Form (LF), overriding a default Game-theoretic interpretation mechanism. This analysis echoes Schwarzschild (1999), but by moving G-marking from grammar to online interpretation, broader behavioral principles can be called upon to explain cases which previously required a complication of the theory.

2 Game-theoretic Pragmatics

Linguistic communication is a cooperative process whereby interlocutors agree on intended propositional content. At the heart of pragmatics, beginning with Grice, is the observation that it is not enough to decode words and phrases from conventional semantic representations; interlocutors must be reasonable. Game-theoretic pragmatics is a simple mathematicization of this idea, founded on the premise that there is nothing specifically linguistic about the reasoning behaviors involved in choosing from among possible interpretations of an utterance.

We begin with the premise that language can be modeled as a game in which players use grammar strategically to accomplish shared goals. Because players' interests converge, it is a coordination game of a type first observed by Schelling (1960). Players receive a positive Utility (payoff) only when all players take the same action. The players in a linguistic game are a Speaker and a Hearer, who must both converge on the same meaning for an utterance to ensure a positive outcome. Utility in a linguistic game is the benefit of successfully communicating. A simple example of metaphor illustrates.

(10)   I need a new phone; this one's a <u>dinosaur</u>!

		HEARER	
		'very old thing'	'extinct reptile'
SPEAKER	'very old thing'	b,b	$0,0$
	'extinct reptile'	$0,0$	a,a

The diagram above states that some non-negative Utility a is awarded to both the Speaker and the Hearer for coordinating around the literal meaning of *dinosaur*, and some higher Utility b for coordinating around the metaphorical meaning. There is no reward for miscommunication. Utilities in a communication game are, generally speaking, degrees to which a common communicative goal is accomplished. If the purpose of an utterance is to convey information, we may use Relevance to model Utility. The metaphorical meaning in (10) is more Relevant than the literal

meaning iff it contributes information that is more useful given the discourse context. (The literal meaning is probably of no use at all as the resulting proposition is obviously false, so we may want to say that a is 0.) Given that the Speaker and Hearer both want a higher payoff, they will coordinate around the action with a higher payoff; the Speaker will intend to say something Relevant, and the Hearer will interpret it as such. Thus, the interpretation of (10) can be reduced to a simple Decision problem: choose the meaning with the highest degree of Relevance.

As pointed out by Clark (2011) and Parikh (2010), a game like the one in (10), while illustrative, needs an additional component to adequately model interpretation: probability. The game in (10) assumes that it is equally probable within the context for the Speaker to want to convey either the literal or the metaphorical meaning. Of course, this is not true. In reality, certain interpretations are far more frequent within certain contexts. This does not affect the outcome of (10), but in other cases it is very important. Consider the sentence, *My friend lives by the bank.* In a town with both a river and a financial institution, either meaning for *bank* would be equally Relevant (either resulting proposition could be true as far as the Hearer knows). However, if there are many densely populated neighborhoods by the nearest financial institution, and very few residential areas by the riverbank, the former meaning becomes much more probable *a priori*. Because of this, coordination is possible. The Hearer simply chooses the more probable meaning. The Speaker, knowing the Hearer will do this, will explicitly disambiguate if she intends the less probable meaning. From this we can posit that semantic Decision problems are solved by maximizing the product of Utility (Relevance) and contextual probability. Economists call this quantity Expected Utility, and it is a notion that factors into multiple aspects of human behavior. By applying the concept to linguistic interpretation, we are supporting the idea that pragmatics is the result of domain-general reasoning mechanisms. However, for clarity and ease of description it may be useful to give a formulation that is specific to language. Let's call it the Strategic Interpretation Principle (SIP).

Given an uttered word or phrase u, a set of possible meanings $\{M_1, \cdots, M_i\}$, and a discourse context C, the Hearer chooses a single interpretation M that maximizes the following quantity:

$prob(M|u, C) * Relevance(M)$

BOX 1: THE STRATEGIC INTERPRETATION PRINCIPLE

The way in which contextual probability and Relevance are quantified will of course vary from context to context, from speech act to speech act, and will often be difficult to achieve in practice. But in theory, all types of utterances are subject to this sort of reasoning, and in certain closed contexts (giving instructions for a task with a finite number of possible actions, for example), Game-theoretic pragmatics makes concrete and quantitative predictions. The nature of these predictions is a topic for another time; see Clark (2011), Parikh (2001, 2010), and Sally (2002) for

foundations. The rest of this paper is devoted to showing that the SIP does not apply to G-marked constituents, and that this may be the defining characteristic of IS. To formalize this, I model semantic interpretation with a Partially Synchronous Tree Adjoining Grammar, the components of which are reviewed in the next section.

3   Tree Adjoining Grammar

Tree Adjoining Grammar (TAG) is a mildly context-sensitive (Joshi 1985) grammar formalism in which complex tree structures are built up from atomic units called Elementary Trees, via two operations: Substitution and Adjoining. We see in Fig. 1 the elementary tree for the present tense verb *wants* being supplied with two DP arguments by substituting the DPs *Mary* and *pizza* in for the empty DP argument nodes.
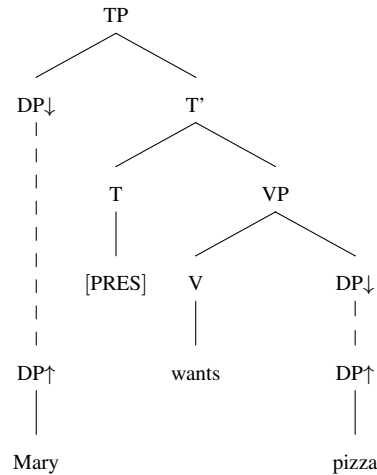

FIG. 1: SUBSTITUTION

Simple sentences are built up this way, inserting argument constituents into lexically determined verbal structures. The Adjoining operation (Fig. 2) inserts structure into a tree by splitting a node and performing two substitutions. In the following example, the DP node dominating *pizza* is pulled apart from the main tree, at which point the structure $[_{DP}$ DP $[_{PP}$ from Gino's $]$ $]$ is substituted for the direct object DP node of *wants*. Then, the separated DP *pizza* is substituted in for the sister DP of *from Gino's*, creating the structure $[_{DP}$ pizza $[_{PP}$ from Gino's $]$ $]$. This transforms the sentence *Mary wants pizza* into *Mary wants pizza from Gino's*.
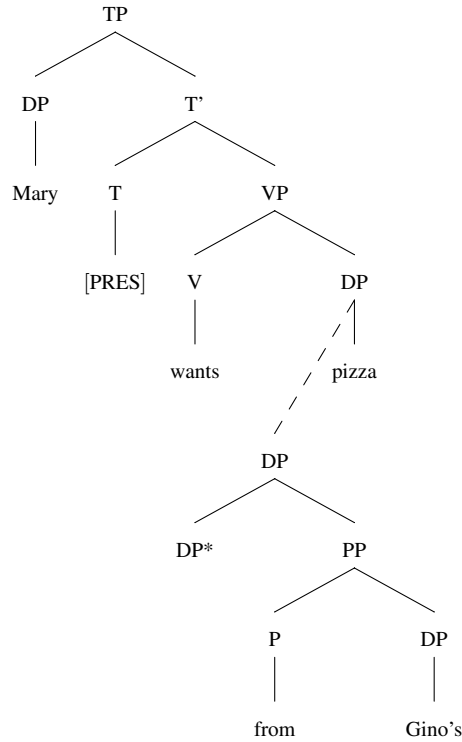
FIG. 2: ADJOINING

The mildly context-sensitive status of TAG gives it enough power to derive crossed dependencies (via Adjoining), but is more constrained than other context-sensitive systems (Joshi 1985). Also, the formalism has proven to have advantages in deriving certain locality phenomena that are found in natural language (Kroch and Joshi 1985, Frank 2002). As we see from the examples given above, the Elementary Trees of TAG are highly lexicalized. Proposed derivational operations such as movement are accounted for within a TAG framework by constraints on the inventory of Elementary Trees in a language. These meta-constraints may themselves be modeled with a grammar formalism, such as a Minimalist Grammar (Frank 2002).

Schabes and Schieber (1990) propose Synchronous TAG (STAG) to formalize the isomorphism between syntax and semantics. Simply put, a STAG formalism builds a logical form (LF) for a sentence as a separate tree with nodes that are "linked" to nodes in the syntactic tree. Every Substitution or Adjoining operation that affects a particular node on the syntactic tree must analogously affect its linked node on the LF tree. So, substituting *Mary* and *pizza* in for the DP arguments of *wants* is necessarily accompanied by the substitution of those constituents' denotations into the LF tree corresponding to *wants*, which is shown in Fig. 3.

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                        t
              ┌─────────┴─────────┐
            e↓                    et
             │           ┌────────┴────────┐
             │        <et,et>              et
             │           │          ┌──────┴──────┐
             │          pres     <e,et>          e↓
             │                      │             │
            e↑                    want           e↑
             │                                    │
           mary                                 pizza
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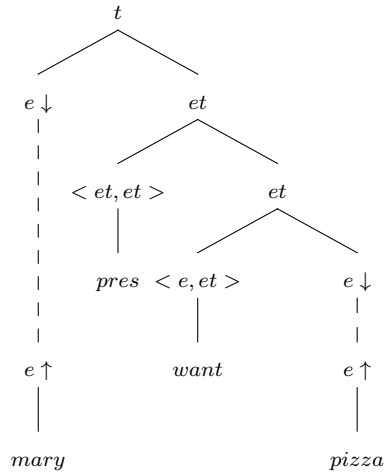
FIG. 3: SUBSTITUTION AT LF

I offer a simple extension, a Partially Synchronous TAG structure (PSTAG), to model how utterances are interpreted. Utterances are parsed online and placed into TAG structures that are interpreted as they are built. At any given time, there is some set of Given semantic objects available to the Hearer. For now, we adopt Schwarzschild's definition: all meanings that are entailed by the salient preceding context (possibly under existential closure and/or type-shifting) are in the Given set. If a constituent is G-marked, its interpretation is linked to a node on the corresponding LF tree, and linked LF nodes are filled in with meanings from the Given set. Focused constituents are not linked (thus the structure is Partially Synchronous), and thus do not receive an interpretation in this way. Focused constituents are interpreted via the SIP.

4   Parallel Tree Building

Recall the Strategic Interpretation Principle, and consider how it applies to (a) and (b) below.

(11)   PAT: I need a new place to live. I looked into those new condos on the riverfront, but they're too expensive. Do you have any suggestions?

   CHRIS:
   a.   My friend lives by the BANK, and she loves it.
   b.   My FRIEND [$_G$ lives by the bank], and she loves it.

In this context, it is much more helpful for Chris to be talking about a financial institution rather than a riverbank, since Chris has already been informed that the riverbank neighborhood is too expensive for Pat. Also, let's pretend (as we did in Section 2) that there are well-populated neighborhoods near the Savings & Loan in our fictional town, and that the riverbank is by comparison sparsely populated.

In this case, both contextual probability and Relevance are on the side of one particular interpretation for the ambiguous word *bank*: by the SIP, Pat should gather from Chris's utterance that Chris's friend lives near the Savings & Loan, not the riverbank. This is borne out in (a), but not in (b). In (b) the riverbank interpretation is favored, resulting in an unhelpful utterance. The intonation pattern affects how *bank* is disambiguated.

As outlined in Section 1, response (b) is only allowed when one of the possible meanings for *bank* is Given; manipulating the context to exclude mention of the riverfront results in infelicity. The G-marked constituent *lives by the bank* is licensed by the mention of a riverfront neighborhood (the existence of which entails that people live near the bank of a river), and the corresponding meaning must be chosen, rendering the SIP completely irrelevant to interpreting the predicate. The subject *my friend*, being in Focus, still requires the SIP to arrive at the specific indefinite meaning for *my friend*.

This is easily modeled with a PSTAG. As the syntactic structure of the sentence is built up in real time, only the G-marked nodes are linked to an LF tree. The terminal nodes of the LF tree are supplied by the Given set, containing all and only those semantic objects that are entailed by the salient preceding discourse context. In (b), the predicate is G-marked, and thus Logical Forms for each terminal node dominated by T' are determined by intersecting the corresponding sets of possible conventional meanings with the Given set. These are composed to yield the intended meaning for the predicate. The subject, being in Focus, does not receive an LF, and therefore must be assigned one through different means: the Hearer must use pragmatic reasoning to solve for the most likely and Relevant interpretation for the subject.

So far, this shows only that the kind of pragmatic reasoning entailed by the SIP is unnecessary to derive meaning from G-marked linguistic material. It has not yet been shown whether the SIP is vacuously at work, with G-marking merely whittling the set of possible meanings down to a singleton. Also, no predictions have been discussed beyond those shared by Schwarzschild (1999). The next section shows that circumventing Strategic Interpretation in the presence of G-marking leads to better predictions, and that the resulting analysis accounts for the problematic examples discussed in Section 1. Most importantly, this analysis relies only on the simple model sketched above and established general principles of human behavior. Separate linguistic notions of Focus and Givenness are not needed.
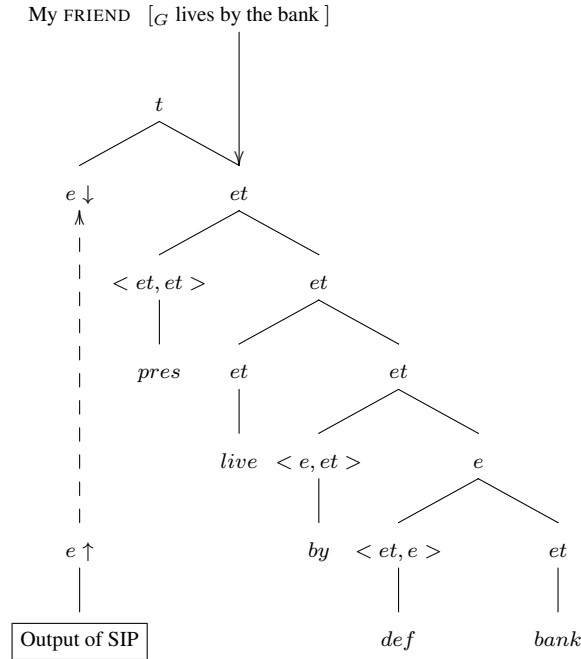
My FRIEND $[_G$ lives by the bank $]$

t

$e \downarrow$ et

$< et, et >$ et

$pres$ et et

$live$ $< e, et >$ e

$e \uparrow$ by $< et, e >$ et

Output of SIP def $bank$

FIG. 4: LINKING G-MARKED NODES

5 Unifying Givenness and Focus

5.1 Effort minimization and forward induction

The chief difference between the current analysis and Schwarzschild (1999) is that the current analysis does not place IS inside the conventional semantics. Rather than determining the meaning of an utterance directly, IS determines *how* an utterance's meaning is to be derived. This places the PSTAG account somewhere between Schwarzschild (1999) and Vallduví (1990). A further point of differentiation is the congruence of the current analysis with Game-theoretic pragmatics. This allows well-established behavioral principles to be brought to bear on why IS looks the way it does. The interaction of two such principles explains why answers to QUDs are not G-marked, even when Given: effort minimization and forward induction.

Effort minimization is somewhat obvious: given the choice of two ways of accomplishing the same goal, people will generally choose the one that is less effortful. This applies to pragmatics in ways originally recognized by Grice, e.g. the Maxim of Manner (containing the humorously redundant decree, "be brief; avoid unnecessary prolixity"). For our purposes it is enough to say that the Speaker is expected to minimize production effort as well as cognitive effort for the Hearer, all things being equal. This is at odds with the idea that cases like (4), reproduced below, involve forgoing a possible G-marking. After all, G-marking causes de-

accenting in English and other languages, which reduces phonetic effort. And if it bypasses the SIP entirely, then G-marking requires less cognitive effort for the Hearer, with the resulting interpretation relying only on the retrieval of conventional meanings and the Given set (assumed to be quite accessible cognitively, as the phenomenon of priming suggests). Interpreting Focus requires an implicit calculation (or estimation) of contextual probability and a consideration of Relevance, as well as the retrieval of conventional meanings. In a cooperative discourse, the Speaker should G-mark whenever possible.

(12)   A waiter walks up to a table with two customers holding a plate of chicken and a plate of tofu. The waiter has forgotten who ordered which meal and asks, "who ordered what?"

   A: HE ordered the TOFU. / #HE ordered the tofu.

A second principle can be brought in to account for examples like this: the principle of forward induction. Applied to language by Sally (2002), forward induction simply states that agents assume others' past actions to be rational (Utility-maximizing). This is crucial to deriving Gricean implicatures. Implicature calculations always rely on reasoning of the form, 'The Speaker could easily have said X, but instead said Y, and thus must have intended to convey something by choosing Y...'. This is forward induction at work. When a Maxim is violated, there must have been a reason for it. More generally, when Utility is sacrificed, it must signal a gain down the road. In this way language involves *signaling*. Assuming the Speaker to be rational, unnecessary effort is a signal of higher Utility, just as a large bet in a poker game signals (perhaps dishonestly) a good hand. If certain elements in an utterance contribute more Utility than surrounding material, then forward induction predicts an effortful formulation of these elements. Such a formulation is intended to convey to the Hearer that these elements constitute the important contributors to the shared communicative goal.

The combination of forward induction, effort minimization, G-marking, and Strategic Interpretation yields a unified account of IS based purely on general pragmatic behaviors, which is explicated below.

5.2   When not to G-mark

There are many possible communicative goals, and thus many ways for linguistic material to contribute Utility, but consider the special case of Questions under Discussion (QUDs). In (4)/(12) above, there is a clear QUD: 'which person ordered which dish?' The communicative goal is the answer to the QUD, a set of pairs of the form $\{< A, tofu >, < B, chicken >\}$ pairing the right patron with the right food. The QUD-answering elements (A, B, $tofu$, $chicken$) are particularly important to the Hearer in that those contribute to the identity of the set which the Hearer is trying to discover. Thus, any of these elements is a more useful/Relevant contribution than the surrounding elements which only serve to identify the QUD. If the QUD is obvious from the context (as it is here, where it's made explicit), then

the QUD-answering elements are solely responsible for the Utility of the utterance. The rest of the utterance is redundant. This is obvious from the fact that when syntax allows it, everything but the Utility contributors is elided (Q: Who ordered the fish? A: Bob.) Syntactic requirements notwithstanding, answers to a QUD in a context where the QUD is explicit constitute the minimal set of linguistic material that accomplishes the communicative goal. This privileged status is signaled by the increased effort associated with failing to G-mark. The result is the following principle of linguistic behavior.

> G-marking bypasses the SIP to reduce interpretive effort for elements in the Given set, and is omitted to signal QUD-answering status.

BOX 2: THE EFFICIENCY PRINCIPLE

Applied to (4)/(12) above, we can derive the intonation pattern with the following steps: (1) for each word in the utterance, if its meaning is in the Given set, G-mark it (in this case, G-mark all of the words), (2) identify the QUD (x ordered y), (3) remove any G-marking from the elements that correspond to the open variables in the QUD (*he* and *tofu*), and (4) ignore G-marked words when assigning prosodic prominence. The Hearer will vacuously apply the SIP to *he* and *tofu* and take the ordered set of those elements to be the answer to the question, 'who ordered what?'

So far, we have not said anything about Focus of Contrast. I will leave an in-depth discussion of FOC for another time, but it should be clear that effort minimization and forward induction are general enough to apply to cases that do not fall under the QUD umbrella. Failure to G-mark has to do with QUDs in the illustrative case of 'who ordered what?', but this type of signaling should be possible in other contexts as well, as long as it is possible to derive higher Utility from the signals. Tentatively, this same principle could be responsible for cases of Contrastive Focus. FOC serves to exhaustively identify an element in a contextually given set (see Kiss 2007), and if Utility is proportional to the amount of information conveyed (and it is, up to a point, by Grice's Maxim of Quantity), then forward induction could be used to derive an exhaustivity presupposition from an unnecessarily effortful instantiation of a word or phrase. Future work will determine the degree to which the generalization is useful. For now, we can say that Givenness and Focus are one in the same, that the pragmatics of utterance choice and interpretation is responsible for the data we see, and that it should be tested whether the same pragmatic mechanisms can explain Contrast.
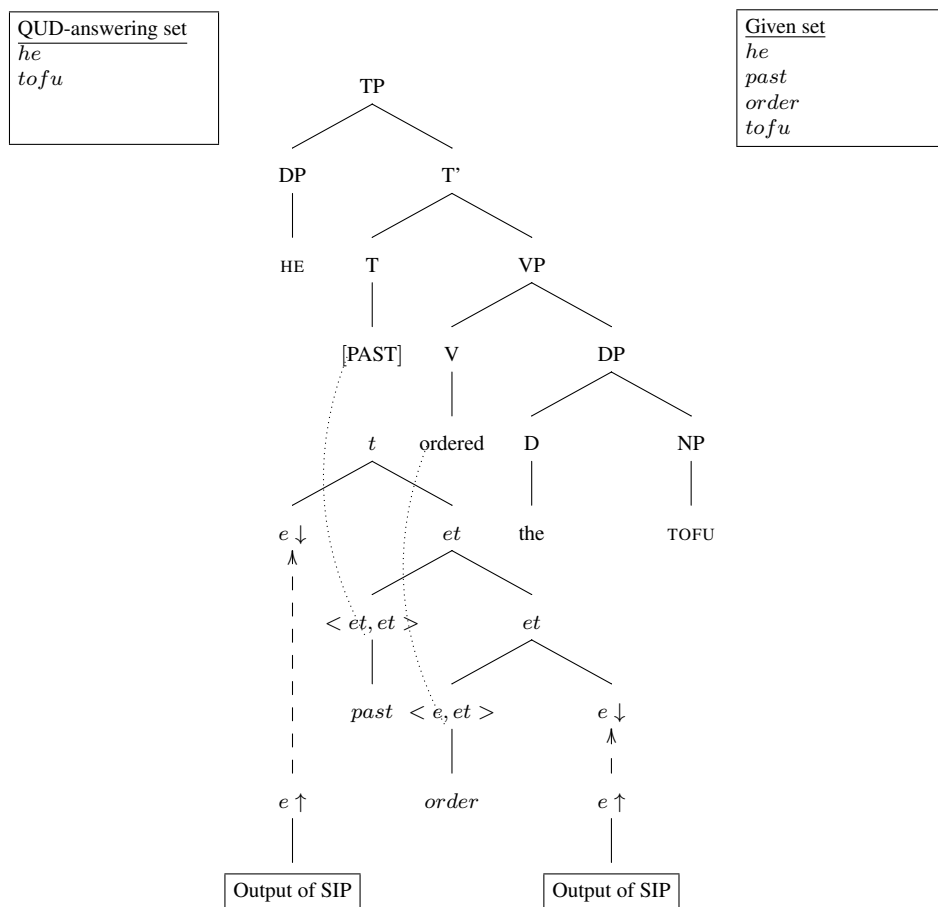
FIG. 5: WHO ORDERED WHAT

6 Summary

I have proposed a pragmatic account of Givenness that draws upon the insights of Vallduví (1990), Roberts (1996), Schwarzschild (1999), and others. This account conceives of Information Structure as a set of instructions for how to interpret utterances, and analyzes Givenness as a way of simplifying the interpretive process. I have modeled the interpretive process with a Partially Synchronous Tree Adjoining Grammar. Consistent with the paradigm of Game-theoretic pragmatics, this account allows general principles of rational behavior to explain discrepancies that trouble more traditional accounts. This represents an explanatory unification of the notions of Givenness and Focus, and I have tentatively suggested that Contrastive Focus should be handled in the same way. Hopefully further research will illuminate the strengths and weakness of this approach.

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