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Sentence Embedding Predicates, Factivity and Subjects

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1.1 Sentence embedding predicates

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In this paper,[1] we examine the subjects that embedding predicates can take. We limit ourselves to those proposition embedding predicates that fit into the sentential complement schema in (1), excluding predicates that only take expletive subjects:

(1) subject predicate [$_{CP}$ *that* ...]

This study reveals two generalizations, which demarcate a class of predicates which express a communicative act, or "discourse move", which we refer to as "communicative predicates", following Anand and Hacquard (2014). These include the verbs analyzed in Grimshaw (2015) as formed from the universal predicate SAY.

First, communicatives (e.g., *claim*, *say*) show unexpected flexibility in the types of subjects they can take (the **subject generalization**): they allow certain inanimate subjects, like "*books*" or "*reviews*", but not others, like "*plates*", as shown in (2). In this, they differ from **doxastic** (e.g., *believe*, *know*) and **emotive** (e.g., *love*, *hate*) predicates, which take animate subjects exclusively, as shown in (3). They also differ from **inferential** predicates (e.g. *demonstrate*), which allow inanimate

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[1]We would like to thank an anonymous reviewer for insightful comments and suggestions.

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subjects of any kind, as shown in (4).

(2) a. The critic claims that the food is good here.
     b. The (critic's) review claims that the food is good here.
     c. #The (critic's) empty plate claims that the food is good here.

(3) a. The critic {believes/hates} that the food is good here.
     b. #The (critic's) review {believes/hates} that the food is good here.
     c. #The (critic's) empty plate {believes/hates} that the food is good here.

(4) a. The critic demonstrated that the food is good here.
     b. The (critic's) review demonstrates that the food is good here.
     c. The (critic's) empty plate demonstrates that the food is good here.

Second, we show that communicatives exhibit an interesting generalization: while some doxastic (e.g., *know*) and emotive (e.g., *love*) predicates are factive (i.e., they entail and presuppose the truth of the proposition expressed by their complement), we find that no communicative predicate is truly factive (the **factivity generalization**).

Our starting point for the subject constraint is Anand & Hacquard (2009), who propose that the contrast illustrated in (2) and (3) diagnoses a difference in attitude predicate argument structure, indexed by semantic category: doxastic predicates like *believe* require subjects that are sentient (i.e., animate entities capable of cognitive states). In contrast "proffering" predicates such as *claim*, which express a communicative act, can take a limited set of inanimate subjects that are "Repositories of Information" (R-of-Is), such as *book* or *review*, i.e., entities that are associated with propositional content. But what exactly counts as such a repository? While *books* and *reviews* seem to work, *notepads* do not, as shown in (5). We will argue that the difference between *reviews* and *notepads* is that the former are possible discourse agents, that is, they are entities capable of making a move in discourse, as opposed to merely being associated with information content.

(5) #The critic's notepad claims that the food is good here.

In this paper, we report on a broader and deeper examination of such subjects. We examine four types of subjects — sentient animates, agentive R-of-Is (*book*, *review*), non-agentive R-of-Is (*notepad*), and general inanimates (*glove*, *plate*) — and four semantic categories of predicates — communicatives (*claim*), doxastics (*believe*), emotives (*love*), and inferentials (*demonstrate*), based on our intuitions about their meaning.

Drawing on several hundred verbs and adjectives across our four categories, we ask which of our subject types can combine with which of our semantic categories of predicates. Our main goal here is to test the robustness of the subject and factivity generalizations, and to see what apparent counterexamples can tell us about the semantic and syntactic profile of communicative predicates, and the nature of the communicative acts that they are used to report.

We find that communicatives split our subject classes in half. Sentient beings (e.g., *John*) and agentive R-of-Is (like *books*) are both felicitous subjects of these predicates, but non-agentive R-of-Is (*transcripts*) and inanimates more generally (*bloody gloves*) are not. The interpretation that we pursue here is that communicative predicates do not partition their subjects by notional sentience. That is, the contrast above between *believe* and *claim* with respect to the felicity of R-of-I subjects seems to exemplify a more robust generalization about cognitive and speech-act predicates in general. Still, we show that communicative predicates do not uniformly accept R-of-I subjects (e.g., *mumble*, *apologize*). Building on the analysis of say verbs in G (2015), we argue that such predicates involve meaning components that render them incompatible with R-of-I conversational agents.

Because the two generalizations distinguish communicative predicates, one further correlation emerges in the work we report here: there is a negative correlation between allowing R-of-I subjects and factivity. That is, no factive predicate allows agentive R-of-I subjects.

1.2 The subject generalization

1.2.1 Why subjects?

While "alternations" exhibited by various predicates have been a central focus of research in argument structure, predicates combining with clausal complements have been less intensively studied. And where work does exist on such predicates, it has focused primarily on the syntactic or semantic types of complements, not the restrictions on their subjects. The aim is to develop theories of predicate meaning and possible subject meanings that, when coupled, would predict subject-predicate felicity. In some domains we do seem to have met something akin to this goal. Consider the theory of thematic roles, and in particular the hypothesis that some predicates can combine only with Experiencers (sentient entities that necessarily experience a cognitive state). As Experiencers must be animate, a predicate which allows only Experiencer subjects (external arguments) will combine only with animate DPs and will never combine with CPs in subject position. This predicts the

paradigm in (6) for *hate*:

(6) a. #That stone hates the weather.
    b. The tourist hates the weather.
    c. #That it is raining hates the weather.

The predicates under discussion here may seem at first blush like *hate*, admitting only animate subjects. Minimally, they *allow* animate subjects quite naturally:

(7) a. John {believes, thinks, knows} that the earth is flat.
    b. John {claims, argues} that the earth is flat.
    c. John {demonstrated, implied} that the earth is flat.

However, once we turn to inanimate subjects, interesting restrictions emerge, cutting apart both the predicates in (7a-c) and the kinds of subjects they can combine with. Here, we review some of the distinctions that A&H (2009, 2014) make. First, while "doxastic" predicates like those in (7a) require a sentient subject, "proffering" predicates (what we refer to here as "communicatives"), i.e., predicates that express a communicative act, like those in (7b), can take inanimate subjects such as *book* or *review*. A&H (2009, 2014) argue that what allows proffering verbs like *claim* or *argue* to combine with such subjects is that these verbs only require agents capable of making discourse contributions. While books are not sentient, they can still be discourse participants in generic conversations. Being non-sentient, they are incapable of *thoughts*, and hence cannot combine with verbs like *believe* or *know*. This is illustrated in the examples below, adapted from A&H (2009).

(8) a. #The book {believes, knows} that the earth is flat.
    b. The book {claims, reports} that the earth is flat.
    c. The book {demonstrates, implies} that the earth is flat.

Second, inanimate subjects that are not repositories of information, such as *plate* or *time of death*, cannot be discourse participants. They thus can appear with neither doxastics nor communicatives. Interestingly, predicates of "inference" such as *demonstrate* allow such subjects:

(9) a. #The time of death {believes, knows} that the butler is the murderer.
    b. #The time of death {claims, reports} that the butler is the murderer.
    c. The time of death {demonstrates, implies} that the butler is the murderer.

The cases in (7-9) suggest a complex interplay between predicate, subject, and felicity. Doxastics are only felicitous with sentient subjects, while communicative predicates like *claim* and *report* admit sentient subjects and agentive R-of-I subjects, and inferentials allow both of these and inanimates more generally. A&H (2009) split inanimates in two: the repository of information type (like *book*) and the inanimate (like *glove*). However, what counts as a repository of information is not entirely clear — Does it simply mean that the object is associated with content in some vague way? Or is there a more substantive notion?

1.2.2 Books, notepads, and plates

There are two types of distinctions in the literature that we may lean on to help answer the above questions. One comes from the literature on polysemy (e.g., Pustejovsky (1995), Cruse (2000), and Asher (2010)), which extensively discusses the ability of terms like *book* to predicate either of the physical object (e.g. *having a red cover*) or the propositional content encoded in the physical object (e.g., *being an adaptation of a film*). It is possible that this chimerical quality is necessary for being a "repository" of information. If it is necessary, it may or may not be sufficient. To investigate this further, we consider two kinds of repositories: items like *book* and items like *transcript* or *audio recording*. Both of these show physical object-propositional content polysemy: books and transcripts are both artifacts with natural physical forms that also allow us to speak of the content physically encoded (e.g., they can both be *confusing*). However, books can be seen as *adaptations* or *longwinded* or *conceited* (which pertain to the agent involved in the creation of the R-of-I), while transcripts cannot. This difference, we believe, connects to differences in the purposes driving the creation of books or transcripts (i.e., part of Pustejovsky's telic quale). Transcripts and recordings are made to memorialize some bit of action, which need not even be even linguistic. Books, on the other hand, can be created to encode arguments and claims for the reader to access and interact with.

But something more needs to be said beyond the terms "memorialize" and "encode" if we are to understand this distinction. Here, we will follow A&H (2009) in suggesting that books do not merely *encode* arguments, but *make* them as communicative agents within a discourse (see G (2015) for an alternative conception of nouns like *book* as locations rather than agents). Under this view, when one reads a book, one enters into a conversation with it. In this way, *the book* is an acceptable subject of a predicate like *claim* insofar as the book can be conceived of as making commitments within a discourse (Farkas & Bruce 2010,

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Condoravdi & Lauer 2012). This is a matter of course for books that set up argumentative claims, like many works of non-fiction. In contrast, works of fiction do not regularly establish a set of commitments in a rational exchange of information, and hence, like *transcript*, are less acceptable subjects for proffering predicates (10a). However, they may be used by predicates of intentional presentation (10b), unlike *transcript*:[2]

(10) a. The {biography, #novel, #transcript} claimed that Einstein was autocratic.

b. The {biography, novel, #transcript} portrays Einstein as autocratic.

Of course, it is still possible to single out the commitments a particular line of text would commit someone to, both for novels and for transcripts:

(11) The last line of the {novel, transcript} claims that Einstein was autocratic.

What this discussion suggests is a three way split among non-sentient subjects. On the one hand, there are elements without the object-propositional content polysemy, including artifacts like *glove* that lack any propositional content and proposition denoting elements which have no physical aspect, like the concealed question interpretation of the phrase *the time of death*. On the other, there are repositories of information like *transcript* and *book*, which do. But as we have seen, R-of-Is themselves need to be split in two. Some, like *book*, are capable of making commitments in discourse; we will call these Agentive R-of-Is. Those that cannot, like *transcript*, we will call Non-agentive R-of-Is. In what follows, we will sample from all three of these categories.

1.2.3 Subjects and predicates

Our goal in this work is to be as comprehensive as we can reasonably be in examining the space of predicates. For verbs, we examined a list of *that*-clause embedding verbs that one author (JG) has compiled over several years, and excluded all verbs that did not allow the frame in (1) with a non expletive subject. This yielded 436 distinct morphemes, with a larger number of verb senses (472), since some morphemes have more than one sense. Although we attempted to supplement this list with existing lexical resources (FrameNet and VerbNet) and corpus extractions, the manually-collected list turned out to be far more accurate and complete than those resources. For adjectives, there was

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[2]Thanks to an anonymous reviewer for suggesting we discuss the commitments of novels.

very little in existing resources, so we chose to extract them from text. First, we extracted all instances in Annotated Gigaword (Napoles *et al.* 2012) of adjectives that are found with a *that*-clause complement in the machine-generated parses. We then pruned that noisy list manually to those that fit the frame in (1) with a non expletive subject. This yielded 153 unique adjectives. We split our proposition-taking predicates into four semantic classes, based on their intuitive meaning, as described in (12). For each of these predicates, we judged whether they could take four different types of subjects, described in (13):

(12) **Types of predicates**
  – **Communicatives** (which include Grimshaw's say predicates, A&H (2009, 2014)'s "profferings"): predicates that express communicative acts (e.g., *claim*, *report*)
  – **Doxastics**: predicates that express beliefs (e.g., *believe*, *know*)
  – **Emotives**: predicates that express emotions (e.g., *hate*, *love*)
  – **Inferentials**: predicates that express demonstrations (e.g., *show*, *demonstrate*)

(13) **Types of subjects**
  – **Sentient beings**, which can be experiencers (*John*)
  – **Agentive repositories of information**: R-of-Is which can be discourse agents (*book*, *article*, *review*)
  – **Non-agentive repositories of information**: R-of-Is which cannot be discourse agents (*data*, *transcript*)
  – **Inanimates**: Inanimate objects that lack propositional content (*plate*, *time of death*)

As for the protocol for the investigation itself, the judgments were sufficiently subtle (involving keeping track of word sense and syntactic structure) that we decided to pursue an annotation study, leaving an experimental acceptability follow-up for another occasion. The procedure for this was the following: for each predicate, two of the authors were presented with the various subject possibilities as schematized in (14) below and had to specify whether the subject-predicate combination was valid, invalid, or unknown. We allowed ourselves to see all of the possible subjects at once. After performing this task independently, we met to discuss and adjudicate our results. Our pre-adjudication reliability was reasonably high (pairwise Cohen's kappa = .76), suggesting that this task was sufficiently well-founded for experts to perform it reliably. All of our predicates are listed and grouped by semantic class in the Appendix, along with information about whether they allow R-of-I subjects and whether they are factive.

	Sentient	Agentive R-of-I	Non-Agentive R-of-I	Inanimate
	John	*book*	*transcript*	*bloody glove*
Commun-icative *claim*	√	√	#	#
Doxastic *believe*	√	#	#	#
Emotive *hate*	√	#	#	#
Inferential *imply*	√	√	√	√

TABLE 1   Predicted felicity of subject-predicate combinations.

	Sentient	Agentive R-of-I	Non-Agentive R-of-I	Inanimate
	John	*book*	*transcript*	*bloody glove*
Commun-icative 319	319	**199**	0	0
Doxastic 124	124	**35**	0	0
Emotive 159	159	**13**	0	0
Inferential 23	23	23	23	23
Total 625	625	270	23	23

TABLE 2   Counts of felicitous subject-predicate combinations.

(14) {*The book?; The transcript?; The glove?*} VERB/BE ADJ that the Earth was flat.

Our hypothesized interactions of predicate and subject are provided in Table 1, under the assumption that the Agentive/Non-Agentive R-of-I distinction is relevant for felicity with communicative predicates. Table 2 provides a summary count of the felicitous subject-predicate combinations for the forms we considered. For the most part, the expectations in Table 1 were confirmed: where we expected infelicity, there are very few predicates that seem to combine with the relevant subject, and where we expect felicity, the majority of predicates can take the relevant subject type.

Two kinds of exceptions to our predictions (bolded in Table 2) arise. First, some doxastic and emotive predicates seem to combine success-fully with Agentive R-of-I subjects (about 28% and 8% respectively). We would expect 0 instead of 35 and 13 in the doxastic and the emo-tive rows. Second, some communicative predicates do not combine with them (about 38%). We would expect 319, instead of 199 in the commu-nicative row. We consider each of these in the following sections: section

2.4. discusses communicative predicates, and why some do not allow R-of-I subjects; section 2.5 discusses doxastic and emotive predicates, and why some do allow R-of-I subjects.

1.2.4 Subjects of communicative predicates

Quite a few communicatives are infelicitous with Agentive R-of-I subjects, as noted above. The partial list in (15) illustrates. For a more complete list, see the Appendix.

(15) Communicatives infelicitous with Agentive R-of-I subjects:
   cackle, enthuse, exclaim, explode, frown, fume, gasp, gesticulate, mumble, whisper. . .

We propose that the behavior of these verbs is explicable in a more articulated theory of their semantic structure, based on Grimshaw's (2015) analysis of say verbs, the subset of communicatives which are compatible with CP complements, and combine with clausal quotations, as well as main clauses.

(16) a. "We will", the principal reported, "have the best record in the state".
   b. The principal claimed, "We will have the best record in the state".

Many verbs that are often grouped together (e.g. as *verba dicendi*) are not instances of say and do not share these characteristics, e.g. *discuss, speak, utter*. These verbs report events of linguistic formulation, or "speech events", but do not do so *in the same way* as say verbs. In particular they do not report the content or illocutionary force of what was linguistically encoded, and hence do not allow a CP or quoted clause as in (16). At most they report the topic, e.g. *speak for 10 minutes, discuss the situation.*

All of our communicative predicates take clausal complements, and a majority of them are say verbs. However we included some predicates such as *impart* and *guarantee*, which express a communicative act, but are not say verbs, and do not combine with quoted clauses (34 out of 319). As far as our subject generalizations are concerned, these additional predicates behave like the say verbs. The Appendix lists all of the communicative predicates, whether they are say verbs or not, and whether or not they allow agentive R-of-I subjects.

The proposal in G (2015) is that say verbs, including *ask, assert, mutter*, and *bitch* and even *think (to oneself)* all realize the schema (17), which can be enriched with additional material, such as the illocutionary force of the speech act or the means by which it is executed.

(17) SAY $\left\{ \begin{array}{l} \text{Agent} \\ \text{Linguistic Content} \\ \text{Goal} \end{array} \right\}$

They share the universal abstract core predicate SAY, which combines with clausal complements and direct quotations, because these correspond to the "Linguistic Content" component in (17). Canonically SAY verbs combine with an Agent that produces linguistic material potentially directed toward some Goal (i.e., Addressee). This core (without any additional enriching structure) is lexicalized in English by the verb *say*.

When SAY is enriched by illocutionary force it is realized as *ask*, *assert* or *report* among other possibilities. This hypothesis makes it possible to characterize complementation possibilities for these verbs in a principled fashion, see Grimshaw (in prep.). (*Force* is subsumed under "discourse role" in G (2015).) Alternatively SAY can combine with independent intransitive verbs which denote activities that can result in the production of linguistically coded information. The enriching element, "means" (to realize the verb as *mutter*) or affective "attitude" (to realize it as *bitch*), imposes its own constraints on the (now shared) subject.

(18) How SAY verbs are constructed

SAY-**plus-Force**	Question	SAY + Q	*ask*
SAY-**by-Means**	Means	SAY + mutter	*mutter*
SAY-**with-Attitude**	Attitude	SAY + bitch	*bitch*

When two components combine, the shared subject argument is subject to the restrictions governing both components. For *bitch*, for instance, the Agents of *bitch* and SAY are identified with each other. Informally, the subject of SAY-*bitch* is both a "bitcher" and a "sayer".

(19) a. *bitch* $\left\{ \begin{array}{l} \text{Agent} \\ \text{Goal or Target} \end{array} \right\}$

b. SAY-*bitch* $\left\{ \begin{array}{l} \text{Agent} \\ \text{Linguistic Material} \\ \text{Goal or Target} \end{array} \right\}$

Since agentive R-of-I subjects are possible for the verb *say* itself, the ill-formedness of *book* as the subject of *whisper* or *bitch* must be attributed to a clash between the nature of the subject and the representation of the means or attitude component. While *bitch* as an activity predicate combines with *book* as a subject, *whisper* does not. This correctly predicts that SAY-whisper will not take agentive R-of-I subjects but SAY-*bitch* will:

(20) a. #The book whispered that the Governor never had a fair trial.
    b. #The book whispered about the trial.
    c. The book bitched (that the Governor never had a fair trial).
    d. The book bitched about the trial.

The effects in (20) reflect the difference between predicates characterizing the means of linguistic production on the one hand (*whisper, mutter*), and affective attitude on the other (*bitch, gripe*), i.e. the SAY-means versus SAY-attitude distinction. The SAY-by-means verbs describe the physical act of emitting language, and agentive R-of-I subjects are therefore incompatible with all of them.

Just as the internal structure of a SAY verb controls the subjects the verb is compatible with, it also affects compatibility with complements such as *a few words*, which describe emitted linguistic units rather than the content of the linguistic material. This is illustrated in (21), based on examples in G (2015). SAY-by-means verbs are grammatical with *a few words*, as shown in (21a). In contrast, verbs of affective attitude (21b) or force (21c) disallow such complements:

(21) a. John {whispered, muttered} a few words.
    b. *John {bitched, griped, grieved, rejoiced} a few words.
    c. *John {asked, reported} a few words.

This contrasts with affective attitude verbs like *bitch* and *gripe*, which cannot combine with linguistic units as their complements (21b).[3]

Recall that no communicative predicate is compatible with non-agentive R-of-I subjects (like *transcript, corpus, archive,* or *data*). We claim that this is because although these elements do denote repositories of information, they are incompatible with the SAY schema: they are not agentive in the relevant sense.

Given what we said above, this would suggest that such subjects should be infelicitous with *say*, a prediction that does not at first appear to be borne out:

(22) The {transcript, corpus, archive, data} says that Bill is the murderer.

Our proposal is that in felicitous instances, the subject is functioning not as an Agent in any respect, but rather as the grounding for a conclusion. These are instances where *say* is not a manifestation of the SAY schema, but is used as an inferential, like *show, demonstrate, tell,* and *imply.* As the argument structure of inferentials is itself a complex

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[3]A few additional communicatives cannot take R-of-I subjects. They are: *add in, put in, tell, throw in, publish, record, verbalize.*

topic, we simply provide two diagnostics that this is a distinct sense of *say*. First, we note that under this reading, *say*, like the inferentials, allows a host of subjects that SAY verbs do not — inanimates, facts, events:

(23) a. {The bloody glove, (The fact) that he is sweating, Him sweating} says that Bill is the murder.
      b. #{The bloody glove, (The fact) that he is sweating, Him sweating} claims that Bill is the murder.

Second, G (2015) notes that all SAY verbs allow their linguistic material to be instantiated by direct quotation; non-SAY verbs do not admit clausal quotation. Turning to *say*, we see that its compatibility with clausal quotation co-varies with the subject. Both sentient and agentive R-of-I subjects permit it, in contrast to the other subjects allowed by inferentials:

(24) a. {John, the book} says, "This is the best restaurant you'll ever go to."
      b. *{The transcript, The bloody glove, (The fact) that he is sweating, Him sweating} says, "This is the best restaurant you'll ever go to."

What (23-24) suggest, then, is that the use of *say* in (22) is not an instantiation of the SAY schema.

Let us now turn to the case of SAY-plus-force verbs, such as *assert*, *ask*, and *report*. These verbs enrich the SAY schema with a specification of the role of the linguistic material in discourse, which specifies how the speech act in question integrates into the larger conversational structure. Like other SAY verbs, these all combine with quoted clauses (see Grimshaw 2013, 2014). As SAY verbs, these all will be restricted to the usual SAY subjects: sentient elements and agentive R-of-I elements. Although, in principle, one could imagine additional restrictions that would militate in favor of sentient agents exclusively, our examination of SAY-plus-force verbs revealed none that prohibit agentive R-of-I subjects. Thus, sentient subjects and agentive R-of-I subjects are divided only by SAY-by-means verbs, which come with an inference of physical production.

Human speakers are not the only possible subjects for embedding verbs which canonically report human speech acts. Subjects of these verbs are governed by general principles which require compatibility between components of verb meanings and verbal arguments. As a further illustration, we note that the very factors which distinguish among verbs which take *that*-clause complements also partition speech-related

verbs that do not allow clausal complements at all. For instance, while *discuss* cannot take *that*-clauses, it shows the same subject properties as SAY-plus-force verbs and affective attitude SAY verbs: it allows sentient and agentive R-of-I subjects, and excludes the other subject types. The verb *speak* can only take sentient subjects, patterning like *whisper* in being a verb of physical linguistic unit emission. This suggests that the factors which govern subject-verb compatibility hold broadly.

1.2.5 Subjects of doxastic and emotive predicates

There are a few emotive and doxastic predicates that combine with agentive R-of-I subjects, several of which have communicative senses. Only a handful of **emotive** predicates allow R-of-I subjects (13 out of 159). They are listed in (25) below:

(25) **Emotives felicitous with agentive R-of-I subjects**: *deplore, exult, adamant, despair, fear, hope, hopeful, optimistic, obsess, pessimistic, sanguine, suspicious, worry*

When an emotive predicate combines with a R-of-I subject like *book*, the resulting sentence reports a preference expressed by the book. That is, despite being classed as emotive, all of the predicates in (25) can be used to report on speech acts, and hence should be acceptable with agentive R-of-I subjects. The sentence in (26), for instance, reports that the book expresses the hope/fear that our sources of fossil fuels will be depleted by 2030:

(26) The book {hopes/fears} that our sources of fossil fuels will be depleted by 2030.

One important question we leave aside here is why among the emotives only those in (25) seem to be acceptable as reporting expressed preferences (e.g., why *fear* and not *afraid*?).[4] However, we note in passing that, interestingly, most of these predicates encode both emotive and doxastic content (they correspond to Anand & Hacquard's (2013) "emotive doxastics"). The verb *hope*, for instance, not only expresses a preference for p, but further requires that p be a doxastic possibility for its subject. However, as the Appendix shows, many other "hybrid" attitudes do not allow agentive R-of-I subjects.

The proportion of **doxastic** predicates that allow R-of-I subjects is larger (35 out 124). Many of these predicates also have a communicative sense, which we take to be responsible for allowing these R-of-I subjects.

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[4]An anonymous reviewer suggests that those emotive predicates that disallow R-of-I subjects are ones with greater "mental agitation", and hence ones that require sentience. We leave a more detailed exploration of this idea to future work.

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The remaining verbs fall into three subclasses: predicates of "forecast"; predicates of "assumption"; and predicates of "reasoning":

(27) **Doxastics felicitous with Agentive R-of-I subjects**
   Communicative sense: *calculate, conclude, deem, determine, forecast, generalize, hold, judge, predict, rationalize*
   Forecast: *anticipate, envisage, envision, forecast, foresee, predict, prognosticate, project*
   Assume: *appreciate, assume, discern, make out, recognize, accept, assume, estimate, figure, presuppose, posit, postulate, suppose, surmise, trust*
   Reason: *diagnose, establish, reason, reckon, verify*

We believe that the felicity of these predicates with agentive R-of-I subjects is a symptom of something larger: these are not intrinsically predicates involving a sentient "thinker". For instance, the fact that agentive R-of-Is can appear as subjects of predicates of forecast follows from the fact that discourse agents can make predictions about the future, independent of sentience. Similarly, when *book* subjects combine with predicates of reasoning, the resulting sentence describes a chain of argumentation that is made explicit in the book. Again, discourse agents are capable of delivering an argument, without necessitating sentience. Finally, the ability of *book* subjects to combine with the class of predicates of assumption show that agentive R-of-Is can not only make discourse moves (assertions), but they do so against a set of background assumptions, which can explicitly be described using these predicates of assumption. Again, assumptions do not require sentience.

1.3 Factivity and subject variation

1.3.1 Factivity and communicatives

As we have seen, agentive R-of-I subjects differentiate communicative predicates from doxastics and emotives. This leads us to ask what other properties cut the pie the same way. One possible place to go hunting is factivity, since the classic factive attitude predicates are cognitive factives (*know, figure out, realize*) and emotive factives (*love, hate, be surprised*) (Kiparsky & Kiparsky 1970, Karttunen and Peters 1979). And yet, there seem to be some communicative predicates that are also understood as factive (*acknowledge, admit*).

In order to ascertain the robustness of the doxastic/emotive-factivity correlation, we investigated which of the predicates described in section 2 were factive, veridical or neither. While different authors make different assumptions about veridicality and factivity, here we understand

these terms as follows: both factives (e.g., *know*) and veridicals (*be true that*) have a veracity entailment. As an illustration, both factive *know* in (28a) and veridical *be true* in (28b) entail (28c):

(28) a. John **knows** that it is raining.
 b. It is **true** that it is raining.
 c. It is raining.

Factives differ from veridicals in that this veracity entailment gets foregrounded with veridicals, but backgrounded ("presupposed") with factives. Evidence for this backgrounding comes from the fact that the veracity inference typically projects out of negation, questions and antecedents of conditionals. Unlike in (30), a speaker uttering any of the sentences in (29) seems to presuppose that it is raining.

(29) a. John doesn't **know** that it is raining.
 b. Does John **know** that it is raining?
 c. If John **knows** that it's raining, he'll take an umbrella.

(30) a. It's not **true** that it is raining.
 b. Is it **true** that it is raining?
 c. If it's **true** that it's raining, John will take an umbrella.

We thus subjected each of the predicates from section 2 to the family of sentences test. What we found upon close investigation of all of these predicates is that none of the putatively factive communicative predicates are actually factive. We thus have the following generalization (see A&H 2014 on communicatives, G 2015 on SAY verbs).

(31) **The factivity generalization**: No communicative predicate is factive. We only find factivity amongst the doxastics (*know, discover, learn. . .*), and emotives (*hate, love. . .*).

In what follows, we discuss several potential counterexamples to this generalization and show that the predicates are not factive.

1.3.2 Some potential counterexamples

To begin with, certain speech reports have been argued to be factive (Schlenker 2010, Egré & Spector, *to appear*):

(32) Did Mary tell her parents that she's moving to Australia?

A speaker uttering (32) seems to be presupposing that Mary is moving to Australia. Note, however, that while verbs like *tell*, *announce* or *say* can have factive *uses* as in (32), where the speaker seems to take for granted the truth of the complement clause, these verbs do not have a veracity entailment, as the lack of contradiction in (33) shows:

(33) Mary told her parents that she's moving to Australia, but she's not.

Hence, these verbs are not truly factive (and are not listed as factive in the Appendix): they lack a veracity entailment that can be backgrounded. Given our understanding of factivity as backgrounding of an entailment, (33) would come out contradictory. We argue that the apparent factivity in (32) has to do with how speakers use attitude and speech reports in context, and the flexibility in what they can foreground and background with an attitude report (see also Simons 2007, Simons *et al.* 2010; Dayal and Grimshaw 2009).

With the assertion of a speech report, the speaker can either foreground the speech report, or its content. Consider the contexts in (34) and (35). In (34), the "main point" of B's utterance seems to be about what Mary said: it is carried by the main clause of the predicate report. In (35), on the other hand, the main point of B's utterance seems to be carried by the complement clause. In this context, what matters is Mary's whereabouts, not her claims. The main clause gets a parenthetical interpretation, and seems to merely play an evidential role (see Simons 2007).

(34) A: What kind of crazy claim is Mary making these days?
     B: She told her parents she's moving to Australia.

(35) A: Is Mary going to be here next month? I'd like to invite her to my party.
     B: She told her parents she's moving to Australia.

Hence, with communicative predicates, the speaker can easily appear to proffer the content of the complement clause, and choose to foreground the main clause or the complement clause.

Returning to (32), the speaker seems to take for granted that Mary is moving to Australia, and to ask about whether she informed her parents of that fact. Why should this be? All else equal, we assume that Mary should be a reliable source of information about whether she's moving to Australia or not. All else equal then, we assume that the interesting question is whether she has informed her parents of that fact. But here again this assumption can easily disappear, depending on context. If we know Mary to be a compulsive liar, we might assume that the question in (32) is not so much about Mary's whereabouts, but about her claims, in which case the factivity illusion disappears.

A few communicatives (*acknowledge* and *admit*; listed as "factive" in the Appendix) seem less prone to contextual manipulation, and thus more stubbornly factive. These verbs allow *book* subjects, and are hence

communicative given our analysis.

(36)   a. The book acknowledges that the earth is flat.
       b. Does the book acknowledge that the earth is flat?

Both (36a) and (36b) seem to presuppose that the earth is flat. However, even in this case, A&H (2014) argue that there is no veracity entailment, which means that there is no factivity. However, these verbs have other presuppositions, which can be exploited to yield an inference very close to a factive presupposition. Verbs like *acknowledge* and *admit* seem to presuppose that their subject was the last hold out for acceptance of their complement in the common ground of the reported communicative act. Once the subject acknowledges or admits p, p becomes accepted in the reported common ground. Assuming that no further relevant information leads to p being removed later from the common ground, we assume that p still holds in our common ground. However, p is not entailed in our world. This can be seen by creating enough distance from the reported common ground and our common ground (from A&H 2014: 75)

(37) In Ancient Greece it was widely accepted that the Earth was flat. Eratosthenes however thought that it was round. After his peers demonstrated to him that he couldn't be right, he finally {acknowledged/admitted} that the Earth was flat.

Based on this evidence, A&H (2014) propose that there is a gap in factivity: no communicative is factive. In section 3.5, we briefly explore what might underlie this gap.

1.3.3   Factivity and subjects

Given our factivity generalization, according to which no communicative is factive, and our subject generalization, according to which only communicatives allow agentive R-of-I subjects, (putting aside the inferentials, which allow all kinds of inanimate subjects), we expect that no factive predicate will take R-of-I subjects. There are, however, counterexamples to this generalization from both the emotives and the doxastics, which we briefly discuss here.

There are two emotive factives that seem to allow R-of-I subjects, namely *exult* and *deplore*. These verbs interestingly seem to lose their factivity when they combine with a R-of-I subject, as the lack of contradiction in (38) seems to show.

(38) The book$_1$ deplores that Iraq$_2$ has weapons of mass destruction, which it$_2$ doesn't.

Several factive doxastics also allow R-of-I subjects, namely those in

(39):

(39) *appreciate, discern, make out, recognize.*

These verbs all seem to be predicates of assumption. As we argued in section 2.5, such predicates make reference to background assumptions that discourse agents (including agentive R-of-Is) can make. Perhaps what explains the apparent factivity of these predicates is the backgrounded status of such assumptions, which may give rise to an illusion of factivity, as we argued for *acknowledge*. Predicates of assumption would refer to backgrounded commitments in the reported common ground. Barring reasons to assume that our common ground differs from the reported common ground, we would expect these presuppositions to hold in our common ground as well, making these predicates appear factive. And again, with enough distance, the use of such predicate would not require that the speaker be commited to the truth of the complement in a sentence like (40):

(40) Eratosthenes' book recognized that the Earth was flat.

1.3.4 Factivity and frame

A particularly powerful case for the allergy of communicatives to factivity comes from predicates that can appear in multiple argument structural frames. Consider the cases of *worry* and *obsess* which can (atypically uniquely) appear with its individual argument as either subject or object (trading with the proposition denoting CP):

(41)			Factive?	Agentive R-of-I?
	a.	{Mary, The book} worries that the plan will fail.	N	Y
	b.	That the plan will fail worries {Mary, #the book}.	Y	N

As indicated in (41), the alternation simultaneously affects both the factivity of the predicate and whether it admits agentive R-of-I individuals. When the subject is the individual argument, agentive R-of-I elements are felicitous, and there is no veracity entailment for the proposition denoted by the CP (instead, it is taken to be epistemically possible for the subject). In contrast, when the proposition-denoting CP is the subject, a factive inference arises (and hence a speaker asserting (41b) seems to be committed to a rather definitive claim about the future) and agentive R-of-I subjects are infelicitous.

To our knowledge, *worry* and *obsess* are unique in being possible in both the syntactic frames in (41) without overt morphological modification. However, the pattern in question is more general. In general, the

	that-clause-V-DP	DP-V-*that*-clause	DP-be-A-*that*-clause	
obsess	Factive	**Non factive**	Non factive	*obsessed*
worry	Factive	**Non factive**	Non factive	*worried*
concern	Factive	*	Non factive	*concerned*
distress	Factive	*	Factive	*distressed*
upset	Factive	*	Factive	*upset*
doubt	*	**Non factive**	Non factive	*doubtful*
resent	*	Factive	Factive	*resentful*
scare	Factive	*	Non factive	*scared*
frightened	Factive	*	Non factive	*frightened*
fret	*	**Non factive**	Non factive	*fretful*
hope	*	**Non factive**	Non factive	*hopeful*
grieve	Factive	Factive	*	

TABLE 3 Predicate-frame correlations with factivity and admission of agentive R-of-I subjects. Forms in a frame that allow agentive R-of-I subjects are in **boldface**.

frame *that*-clause-V-DP is uniformly factive, and agentive R-of-I objects are systematically forbidden. DP-V-*that*-clause and DP-be-Adj-*that*-clause frames (where the adjective is derived from the relevant verb), in contrast, are more diverse: sometimes they are factive (*be surprised*) and sometimes they are not (*be obsessed*). What we find is that agentive R-of-I subjects are systematically excluded from factive sentences, regardless of whether they are formed from a passive verb or not. For instance, in the DP-V-*that*-clause frame, *obsess* and *worry* are able to take a R-of-I subject (42a). However, in the *that*-clause-V-DP, which is exclusively factive, these verbs cannot take a *book* subject (42b). Table 3 provides several instances of this pattern.

(42) a. The book {worries, obsesses} that Iraq has weapons of mass destruction.
b. # That Iraq has weapons of mass destruction {worries, obsesses} the book.

We take the existence of this pattern, regardless of which predicate is possible in any given frame, as an argument that communicative predicates are incompatible with factivity.

1.3.5 Explanations for the factivity gap generalization

We have seen three kinds of distributional evidence that communicative predicates cannot be factive: first, there are very few potentially factive communicative predicates; second, the potentially factive ones do not

seem to actually be so under further scrutiny; finally, factive predicates seem to lose their factivity in frames/forms where they take agentive R-of-I subjects. What then might be the source of this incompatibility?

In principle, it is possible that the combination of a communicative event and factivity is somehow conceptually inconceivable, independent of language. Absent a clear logic for conceptual combination, it is hard to know how to investigate such an idea. Nonetheless, there is some indirect evidence that inconceivability isn't driving things, namely, the fact that we had to argue that *tell* and *admit* are not factive. If such interpretations were not possible, we would expect that the pragmatically enriched meanings for (32)-(35), which have a very similar profile, would also be impossible.

While we are skeptical of an explanation based on conceptual incompatibility, it may be the case that we are witnessing a linguistic constraint on lexical meaning. For example, if lexical meaning can be decomposed into formal representations in some logical system, it may be that the representations of "being a communicative event" and "being factive" are syntactically incompatible. Formalizing this in a satisfactory way requires careful consideration about what the representation for "being factive" should be, especially since most argument structural representation systems focus on encoding relational concepts (agent, goal, etc.). Thus, while we remain interested in examining this kind of approach, saying anything more requires going well beyond the scope of this paper.

In closing this speculative discussion, we would like to highlight a different possible explanation that is less often invoked in formal semantics circles: functional pressures on lexicalization. Horn (1972) observes systematic gaps in the kinds of logical operator meanings that get lexicalized in natural language. While we find words like *some*, *all*, and even *no*, there do not seem to be words *nall*, that express the meaning *not all*. Similarly, while we find words like *and*, and *or*, there do not seem to words *nand*, that express the meaning *not and*. Why should this be? Horn argues that these lexical gaps can be provided a functional explanation by considering not just the semantics of particular words, but also what (enriched) meanings can be expressed with just a few words. In particular, the meanings *not all* and *not and* can easily be conveyed via scalar implicatures: a speaker using some in a context where the stronger term all would have been appropriate seems to imply *not all* from their choice of using *some* rather than *all*. Because such meanings can easily be pragmatically derived, there is no need for a language to lexicalize such words, and hence such lexicalizations should be rare.

As we have seen in (32)-(35), the kind of enrichment we see with *not all* occurs with speech reports. That is, speech reports are pragmatically employed by a speaker in order to commit to the truth of the complement clause, especially when the complement is most relevant to the topic of conversation. A speaker can thus use a speech report to indirectly assert the complement clause (this is why Hooper 1975 calls such predicates "assertives"). As a result, pursuing an analogy with Horn's explanation for *nall*, there is no functional pressure to lexicalize a factive communicative, since such meanings are easily pragmatically communicated.

The problem for this kind of explanation is making sure it does not run amok. If all lexicalization were subject to stringent functional utility pressures having to do with relevance-based pragmatics, open class vocabularies should be very tiny indeed. Figuring out how to respond to this concern will likely come with more precisely formalizing the nature of the pragmatic calculations being invoked, a challenge we leave to further work.

1.4   Conclusions and prospects

In this paper we have reported on a fairly systematic investigation of the subject-taking properties of several hundred *that*-clause embedding predicates in English. We have argued on the basis of this investigation that the preliminary claims of A&H (2009) are largely right: sentence embedding ("attitude") predicates split between those that select for sentient entities (experiencers) and those that select for communicative agents. These are what A&H (2009) called agentive repositories of information —- entities that can be understood as interlocutors in generic conversations. We also showed that a finer-grained understanding of the landscape of SAY-verbs can derive why not all of them are compatible with these arguments. The subjects that SAY-verbs occur with follow general principles which relate the semantic components of the verbs to their complement-taking capacities as well as their subject possibilities. In future research, we hope to extend this to other communicatives, and to further pursue the properties of communicative verbs.

We also showed that this same split in attitudes is reflected in a somewhat orthogonal-seeming dimension: which predicates are factive. We find that no communicative predicate is truly factive. Given the relatively large attitude and speech vocabulary under consideration, this gap is rather surprising, and calls for an explanation. We've briefly touched on various lines that one could pursue.

We see this investigation as a start toward a more articulate understanding of attitude meaning and, more generally, *that-clause* embedding predicates. One large hole in our understanding at present is the structure of inferential predicates. We have argued that *say* has an inferential sense, but we do not at present know what restrictions, if any, inferentials possess. The structure of inferentials also looms large in our exploration of factivity. We have argued that there are no factive communicatives, but what we have in fact shown is that several putative counterexamples do not even possess a veracity entailment. If that is the case generally, then it is not merely the case that there are no factive communicatives. Rather, we would have a stronger generalization: communicative predicates are incompatible with veracity entailments. Examining this stronger claim will require us to take a closer look at putative veridical communicatives and determine if they truly are veridical. Inferentials may be one case to examine: *John demonstrated that it's raining* seems to entail that the complement is true, an entailment that does not survive questioning or negation. But is *demonstrate* actually veridical (what happens when one adds an overt experiencer *to Mary*)? And is it truly a communicative, or something else? Answering this seemingly minor question could be central in understanding how communicative predicates may be enriched with additional meaning.

Lastly, we hope that this investigation can eventually help to shed light on the (natural language) metaphysics of discourse moves — who can make such a move, what is required for such a move, and what such moves require of the context and the participants. We have shown that the answer is far from trivial, since some, but not all, repositories of information are licit subjects of such predicates. Karttunen (1977) was instrumental in showing us that the semantics and pragmatics of questions are best disentangled by looking at embedded questions. In turn, we hope that looking at the subjects of predicates referencing speech acts can similarly help to clarify issues where the pragmatics and semantics seem at first inextricably mixed.

Appendix

Doxastics		
√*agentive* **R-o-I subject**	**Factive**	*appreciate, discern, make out, recognize*
	Non factive	*accept, anticipate, assume, **calculate, conclude, deem, determine,** diagnose, envisage, envision, establish, estimate, figure, **forecast**, foresee, **generalize, hold, judge,** presuppose, posit, postulate, **predict**, prognosticate, project, **rationalize**, reason, reckon, suppose, surmise, trust, verify*
#*agentive* **R-o-I subject**	**Factive**	*absorb, acknowledge, ascertain, aware, catch on, catch, comprehend, conscious, detect, discover, figure out, find out, forget, get, glimpse, grasp, hear, ignorant, intuit, know, learn, mindful, mystified, notice, observe, puzzled, realize, recall, recollect, register, remember, see, smell, surprised, take in, unaware, understand, uninformed, unsurprised, well-aware*
	Non factive	*agree, believe, bet, certain, clueless, cocksure, cognizant, conceive, confident, consider, convinced, decide, deduce, disagree, doubt, doubtful, dream, dubious, expect, fancy, fantasize, feel, find, gather, guess, hallucinate, imagine, infer, internalize, note, overhear, paranoid, perceive, positive, pray, presume, resolve, ruminate, sense, skeptical, sure, suspect, think, uncertain, unconvinced, unsure, visualize, wish, work out*

Boldface: predicate also has a communicative sense.

Some of these doxastics further fall into the following sub-classes:

Forecast predicates:	*anticipate, envisage, envision, **forecast**, foresee, **predict**, prognosticate, project*
Assume predicates:	*appreciate, discern, make out, recognize, accept, assume, estimate, figure, presuppose, posit, postulate, suppose, surmise, trust*
Reason predicates:	*diagnose, reason, reckon, verify, establish*

EMOTIVES		
√*agentive* R-o-I subject	**Factive**	*deplore, exult*
	Non factive	*adamant, despair, fear, hope, hopeful, optimistic, obsess, pessimistic, sanguine, suspicious, worry*
#agentive R-o-I subject	**Factive**	*abashed, abhor, accept, admire, adore, aggrieved, aghast, agonize, amazed, amused, angry, anguished, annoyed, apologetic, apoplectic, appalled, appreciate, appreciative, ashamed, astonished, astounded, awed, bear, befuddled, bemused, bewildered, bitter, calm, care, celebrate, cherish, concerned, delighted, delirious, depressed, depressing, despairing, despise, detest, disappointed, disgruntled, disgusted, dislike, dismayed, displeased, dissatisfied, distraught, ecstatic, elated, embarrassed, enjoy, envious, euphoric, excited, exhilarated, exultant, face, flabbergasted, fortunate, frantic, freak out, frightened, furious, giddy, glad, gleeful, grateful, gratified, grieve, happy, hate, heartbroken, heartsick, impatient, incredulous, indignant, irate, jealous, joyful, jubilant, leery, like, livid, loathe, love, lucky, mad, mind, nervous, oblivious, outraged, overjoyed, pained, peeved, pissed, pleased, proud, regret, regretful, remorseful, rejoice, relish, resent, resentful, respect, rue, sad, satisfied, scared, self-aware, shocked, sorrowful, sorry, stand, thankful, tolerate, unabashed, unconcerned, uneasy, unfazed, ungrateful, unhappy, unimpressed, unlucky, uptight, value, wistful, worry, wrathful*
	Non factive	*afraid, anxious, apprehensive, desire, dread, fearful, fretful, keen, maniacal, overconfident, petrified, prefer, resolute, self-assured, upbeat, wary, worried*

Boldface: also has a (nonfactive) communicative sense.

Inferentials		
$\sqrt{}$*agentive* R-o-I subject	**Factive**	*betray*
	Non factive	*assure, certify, confirm, demonstrate, guarantee, highlight, hint, illustrate, implicate, imply, indicate, manifest, mean, prove, reassure, show, signal, reveal, suggest, teach, underline*
#agentive R-o-I subject	**Factive**	—
	Non factive	—

Communicatives		
√agentive R-o-I subject	**Factive**	*acknowledge, admit*
	Non factive	*add, admonish, **advertize**, advise, advocate, affirm, agonize, agree, allege, **animadvert**, announce, answer, argue, ask, assert, assure, attest, aver, bark, bawl, beef, beg, bellow, beseech, bitch, blabber, bleat, blubber, bluster, boast, brag, bray, **bring in, bring up**, burble, calculate, caution, **certify**, charge, **cite**, claim, clarify, clear, command, comment, complain, concede, conclude, concur, confess, confirm, conjecture, contend, continue, [be] **correct**, corroborate, counter, **criticize**, declare, decree, **deem**, demand, demur, **deny, deplore**, detail, **determine**, dictate, **disagree**, disclose, dispute, divulge, **document**, elaborate, emphasize, **emphatic**, explain, **explicit**, expostulate, exult, forecast, foretell, forewarn, fret, fuss, **generalize**, gloat, go on, grant, gripe, grouse, grumble, **guarantee**, guess, gush, hazard, hint, hold, hypothesize, **impart, incorrect**, indicate, inform, insinuate, **insistent**, instruct, intimate, jest, joke, josh, judge, kvetch, lament, lay out, leak, **leave out**, let slip, lie, maintain, marvel, **mean**, mention, muse, note (down), object, observe, **omit**, opine, **overemphasize**, philosophize, plead, pledge, point out, preach, predict, proclaim, profess, promise, prophesy, propose, protest, **publicize**, put out, question, quip, radio in, ramble, rant, rationalize, rave, reaffirm, reassure, recommend, reemphasize, reflect, reiterate, rejoice, relate, relay, remark, remind, remonstrate, repeat, reply, report, request, respond, retort, reveal, **right**, say, **share**, signal, soliloquize, specify, speculate, spell out, state, **steadfast**, stipulate, stress, submit, suggest, swear, tease, telegraph, theorize, threaten, **tout, unveil**, urge, **unanimous, vehement**, venture, vow, warn, whine*

#agentive R-o-I subject	**Factive**	—
	Non factive	*add in, apologize, **apprise**, babble, blurt, blurt out, boom, burst out, cackle, call, call in, call out, carol, chant, cheer, chime in, chirp, chortle, chuckle, cluck, confide, coo, cry, cry out, editorialize, enthuse, exclaim, explode, fib, frown, fume, gasp, gesticulate, gesture, get in, get out, giggle, glare, grimace, grin, groan, grunt, harrumph, hiss, holler, insist, jot down, laugh, let out, moan, move, mumble, mutter, notify, order, pray, pretend, pronounce, **publish**, put in, rage, read, read out, recite, **record**, roar, rule, scoff, seethe, shout, shout out, shrug, sigh, sign, sing, smirk, snap, snarl, sneer, snicker, sniff, snort, snuffle, sob, splutter, sputter, squall, squawk, squeak, squeal, stammer, stutter, tell, testify, text, think, throw in, thunder, tisk, trill, trumpet, tweet, twitter, **verbalize**, wail, warble, wave, wheeze, whimper, whisper, whistle, whoop, write, yammer, yap, yell, yell out, yelp, yodel*

Boldface: communicative predicates that are not SAY verbs.

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