

# A Note on Getting Started with FLBC

## Towards a User Guide for FLBC

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My aim in this note is to provide a series of examples that will serve to illustrate how to symbolize English sentences in a manner concurring with the theory I have been developing for an FLBC (formal language for business communication, cf. [3, 6, 8, 7, 5, 9, 4]). In that theory, which can be called the *lean event semantics with disquotation* (LESD) theory, first-order logic is used for (nearly) all representations. The version of FLBC being illustrated here I shall call Elementary FLBC. The presentation is example-driven. Theory is used and alluded to, but must be accessed in other writings as cited above.

## 1. THE APPROACH IN A NUTSHELL

### 1.1 Bob arrived

Ignoring tense, the standard FOL representation (without event semantics) would be:  $arrive(Bob)$ . That is, we would declare a predicate,  $arrive(x)$ , to have the intended interpretation “ $x$  arrives,” and a term,  $Bob$ , to have the intended interpretation of referring to Bob. We indicate this with dictionary entries in the following, general manner:  $arrive(x)$   $x$  arrives;  $Bob$  Bob. Under the LESD theory “Bob arrived” is seen as a stylistic variant of “There is an arrival event of which Bob is the subject.” In FOL we have:  $\exists e(arrive(e) \wedge Subject(e, Bob))$  Adding tense, we add that this arrival event happened (culminated, a technical term in the system:  $Cul$ ) at a time prior to the present:

EXPRESSION 1 (BOB ARRIVED.).  $\exists e\exists t(arrive(e) \wedge Subject(e, Bob) \wedge Cul(e, t) \wedge t <_T now)$ .

Now our dictionary has a different constitution:  $arrive(x)$   $x$  is an arrival event;  $Subject(x, y)$   $y$  is the subject of event(uality)  $x$ ;  $Cul(x, y)$  Event  $x$  culminates at time  $y$ ;  $x <_T y$  The time of  $x$  is before the time of  $y$ ;  $now$  the present moment in time;  $Bob$  Bob. Points arising: (1) Typographical convention: Capitalized predicates belong to the special technical vocabulary of the theory to hand;

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they should not be understood in their ordinary language senses. Uncapitalized predicates belong to a general vocabulary, not peculiar to the present theory. Predicates using symbols, such as  $x <_T y$ , are, I assume, clear from their definitions, from their dictionary entries. (2) The uncapitalized predicates can—and will—be characterized (in part) by linking them to generally-available definitions. For example, WordNet 1.6 produces the following report on *arrive*:

\* \* \*  
2 senses of arrive. Sense 1 01368651 <verb.motion> arrive#1, get#5, come4#2 – (reach a destination; arrive by movement or by making progress; “She arrived home at 7 o’clock”; “He got into college”; “She didn’t get to Chicago until after midnight”) EX: John will arrive angry  
\* \* \*

Clearly, our *arrive* matches well to WordNet’s *arrive#1* (and it does not match well to the other senses). We might thus modify our dictionary to use WordNet’s definition explicitly. (3) Here, point times are in use. Interval time is also permitted, but I shall not discuss it for lack of space.

### 1.2 Fido is a dog

Ignoring tense, we would standardly be tempted to represent this as:  $dog(Fido)$ . Under the present theory, a stylistic variant is “There is a state of being a dog and Fido is (now) in it.” Formally:  $\exists s(dog(s) \wedge In(Fido, s))$ . Adding tense:

EXPRESSION 2.  $\exists s(dog(s) \wedge In(Fido, s) \wedge Hold(s, now))$

Note that this formulation, as distinct from  $dog(Fido)$ , allows us easily to add temporal qualifiers, e.g., *now*.

Intuitively, events are happenings and states are beings. We say of events that they happen, or culminate ( $Cul$ ) at a time (point or interval). We say of beings that they are the case, obtain, or hold ( $Hold$ ) at a time (point or interval).  $In$  is a predicate from the theory. It is distinct from the ordinary language preposition, *in*. Finally, note what WordNet has to say about *dog*.

\* \* \*  
The noun dog has 6 senses (first 1 from tagged texts). 1. 01595188 <noun.animal> dog#1, domestic dog#1, Canis familiaris#1 – (a member of the genus Canis (probably descended from the common wolf) that has been domesticated by man since prehistoric times; occurs in many breeds; “the dog barked all night”)  
\* \* \*

In expression 2 *dog* is being used, I assume, in a sense that matches WordNet’s 01595188, or *dog#1* as a “noun.animal”. For the sake of avoiding ambiguity, we’ll call this *dog#1n* in

our dictionary. Here are additions to the Elementary FLBC dictionary: *dog#1n(x)*  $x$  is a dog-state (See WordNet 1.6: 01595188 <noun.animal> dog#1); *In(x, y)*  $x$  is in the state  $y$ ; *Hold(x, y)* State  $x$  holds or obtains at time  $y$ .

Using, as we do, precise senses of the predicates in the language helps to reduce ambiguity. This might not always be a virtue. Language, and creative expression generally, trades on ambiguity. In conversation, one might say “Bill is a dog” to suggest that Bill, dressed as a woman, is unattractive for a woman, and his character in a play now being conducted is grossly immoral. It is easy to multiply examples of clever, perhaps ironic, talk that makes essential appeal the multiple senses of the words it uses. This is beyond the scope of Elementary FLBC. One might consider the possibilities of treating, say, *dog* as an ambiguous reference to any of the senses of the word given in WordNet. One might; we won’t.

### 1.3 Bob owns Fido

Fido is a dog and Bob owns Fido. Stylistic variant: “Bob is owner of Fido.” Standardly, “owns” is a transitive verb (in English). It may (usually does) take a direct object, and may not take an indirect object. Let us use *Dir(e, o)* for “ $e$  has direct object  $o$ .” Then:

EXPRESSION 3.  $\exists s(\text{own}\#1v(s) \wedge \text{In}(\text{Bob}, s) \wedge \text{Dir}(s, \text{Fido}) \wedge \text{Hold}(s, \text{now}))$

We add these entries to the Elementary FLBC dictionary: *own#1n(x)*  $x$  is a state of ownership (See WordNet 1.6: 1 sense of own. Sense 1 01509295 <verb.possession> own#1, have4#4, possess#2 – (have ownership or possession of; “He owns three houses in Florida”; “How many cars does she have?”) \* > Somebody —s something); *Dir(x, y)*  $y$  is the direct object of eventuality  $x$ .

Does Bob own a dog? Indeed he does. Happily, expression 4 follows logically from expressions 2 and 3:

EXPRESSION 4.  $\exists s\exists s'(\exists s(\text{owner}(s) \wedge \text{In}(\text{Bob}, s) \wedge \text{Dir}(s, \text{Fido}) \wedge \text{Hold}(s, \text{now}) \wedge \text{dog}(s') \wedge \text{In}(\text{Fido}, s') \wedge \text{Hold}(s', \text{now}))$

Glossed into English: “Bob owns something, which something is a dog.” That such inferences go through so easily and correctly constitutes evidence in favor of theory.

### 1.4 Bob was delivering Fido to Jane

Bob’s arriving was presumably an instantaneous event, although nothing in the present theory requires this. Delivering something, however, can take time, an extended period of time. Moreover, there may have been some times at which Bob was delivering Fido, yet Bob never succeeds in getting Fido delivered. Something prevented him, he changed his mind or got lost. The idea is that there was a time at which the delivering was taking place. That time, or perhaps some interval, occurred before the present. Following Parsons [10], I will treat such cases as processes, events (rather than states), which may *Hold* at a given time. So a process is like an event in that it is a happening and like a state in that it obtains, or holds, at a particular time. The intuition is that a process is a being of happenings.

EXPRESSION 5.  $\exists e\exists t(\text{deliver}\#2v(e) \wedge \text{Subject}(e, \text{Bob}) \wedge \text{Dir}(e, \text{Fido}) \wedge \text{InDir}(e, \text{Jane}) \wedge \text{Hold}(e, t))$

WordNet 1.6 item (00985935) is the best, and indeed an excellent, fit for *q deliver#2v*. Here are the additions to

the dictionary: *deliver#2v(x)*  $x$  is a delivery event (See WordNet 1.6: The verb deliver has 12 senses (first 7 from tagged texts). 2. 00985935 <verb.contact> deliver#2 – (bring to a destination, make a delivery)); *InDir(x, y)*  $y$  is the indirect object of the eventuality  $x$ .

## 2. ADJECTIVES

### 2.1 Fido is brown

Stylistic variant: “There is a state of being brown, holding now, which Fido is in.”

EXPRESSION 6.  $\exists s(\text{brown}(s) \wedge \text{In}(\text{Fido}, s) \wedge \text{Hold}(s, \text{now}))$

Note: Compare this with nouns, as in “Fido is a dog,” §1.2. Elementary FLBC treats nouns and adjectives more or less identically. We could—but won’t now—make a distinction by treating nouns as in the following example:

EXPRESSION 7.  $\exists x\exists s(\text{being}(s) \wedge \text{Dir}(s, x) \wedge \text{dog}(x) \wedge \text{In}(\text{Fido}, s) \wedge \text{Hold}(s, \text{now}))$

### 2.2 Fido is a brown dog

Stylistic variant: “There is a dog state, which Fido is in, and a brown state, which the dog is in.”

EXPRESSION 8.  $\exists s\exists s'(\text{dog}(s) \wedge \text{brown}(s') \wedge \text{In}(\text{Fido}, s) \wedge \text{Hold}(s, \text{now}) \wedge \text{Hold}(s', \text{now}) \wedge \text{In}(s, s'))$

Note how this formulation may be used to resolve the ambiguity in “Fido was a brown dog.” Is Fido dead or did Fido change his color?

Why isn’t Fido in both states at once? Fido is brown and Fido is a dog, after all. I don’t see any compelling reason to prohibit this. On the other hand, there is a nice picture: the dog state has two properties, viz., Fido is in it and it is in brown. The suggestion is that brown applies to dog directly, rather than to Fido.

### 2.3 Marcie is a former ballerina

Stylistic variant: “There is a state of being a ballerina prior to the present and Marcie is in it.”

EXPRESSION 9.  $\exists s\exists t(\text{ballerina}(s) \wedge \text{In}(\text{Marcie}, s) \wedge \text{Hold}(s, t) \wedge t <_T \text{now})$

Note that this is also the symbolization of “Marcie was a ballerina.” These are stylistic variants in Elementary FLBC.

## 3. ADVERBS

Adverbs, at least in English, are words that modify verbs, adjectives, and other adverbs (cf. [2, page 120]). As usual, we’ll proceed by example.

### 3.1 Bob spoke seriously

“seriously” is here an adverb modifying the verb form “spoke”. In Elementary FLBC, we formalize the stylistic variant, “Bob said (something) and the saying was serious.”

EXPRESSION 10.  $\exists e\exists x\exists t(\text{say}(e) \wedge \text{Subject}(e, \text{Bob}) \wedge \text{Dir}(e, x) \wedge \text{serious}(e) \wedge \text{Cul}(e, t) \wedge t <_T \text{now})$

Note that *Dir(e, x)* adds little here; it could be dropped.

## 3.2 Fido is a big brown dog

Stylistic variant: “There is a dog state, which Fido is in, a brown state, which the dog is in, and a big state, which Fido is in.”

EXPRESSION 11.  $\exists s \exists s' \exists s'' (dog(s) \wedge In(Fido, s) \wedge brown(s') \wedge big(s'') \wedge In(s, s') \wedge In(Fido, s'') \wedge Hold(s, now) \wedge Hold(s', now) \wedge Hold(s'', now))$

## 3.3 Fido is a light brown dog

This sentence is quite ambiguous. It may be true and Fido may be a dark (he’s brown) heavy (he’s fat) dog. What is light, Fido or Fido’s brown color? One interpretation, “There is a light-and-brown-and-dog state and Fido is in it,” has been effectively treated in §3.2. We’ll treat the other interpretation here: “There is a dog state, which Fido is in, a brown state, which the dog is in, and a light state, which the brown state is in.”

EXPRESSION 12.  $\exists s \exists s' \exists e'' (dog(s) \wedge In(Fido, s) \wedge brown(s') \wedge light(s'') \wedge In(s, s') \wedge In(s', s'') \wedge Hold(s, now) \wedge Hold(s', now) \wedge Hold(s'', now))$

## 4. PREPOSITIONS

Prepositions may often be dispensed with. In §1.4, in “Bob was delivering Fido to Jane,” we dispensed with “to Jane” in favor of  $InDir(e, Jane)$ . Nonetheless, prepositions will often be useful, even necessary. Here is a list for Elementary FLBC: about, across, after, against, among, at, before, between, by, from, in, off, on, over, through, to, under, up, with. Note WordNet does not cover prepositions. The list here is taken from Basic English. In each case, the preposition is a two-place predicate, the arguments being an eventually followed by a referring expression.<sup>1</sup> Prototypically:

### 4.1 Brutus stabbed Cæsar in the back with a knife, in the Forum

Stylistic variant: “There was a stabbing by Brutus of Cæsar in his back. This stabbing occurred in the Forum with something that at the time was a knife.”

EXPRESSION 13.  $\exists e \exists s \exists t \exists x (stab(e) \wedge Subject(e, Brutus) \wedge Dir(e, Cæsar) \wedge to(e, the-back) \wedge in(e, the-Forum) \wedge with(e, x) \wedge knife(s) \wedge In(x, s) \wedge Cul(e, t) \wedge t <_T now \wedge Hold(s, t))$

Points arising: (1) Note that “in the back” is treated as “to the back”, while “in the Forum” is handled with “in”. “Where was the stab?” is ambiguous between “What was stabbed?” and “Where did the stabbing take place?” This is how the ambiguity can be resolved. (2) Can “Where did the stabbing take place?” have more than one answer? In the Forum and in Rome (the Forum being in Rome)? What about in the Forum and in the street outside? In the former case, there is only one stabbing and it is both in the Forum and in Rome. In the latter, I’m inclined to say that there was more than one stabbing event. These events may belong to a larger stabbing process, but any single stabbing only occurs at one place. (3) Suppose Cæsar was standing astride the Forum and the street outside? Suppose, the knife entered Cæsar’s back and pierced his heart and a lung. Did Brutus stab him once in the heart and in a lung? Elementary FLBC elects to be silent on these matters.

<sup>1</sup> *between* is an exception, requiring two referring expressions.

## 5. FUNDAMENTAL SPEECH ACTS

For the sake of the discussion we may follow Searle and Vanderveken [11] in identifying five fundamental illocutionary forces: assertives, commissives (promises), declaratives, requestives, and emotives.<sup>2,3</sup> Everything that can be said, they claim, is, or involves, one or more of these five forces. What distinguishes the fundamental forces are their (fundamental) *points*. The point of an assertive is to say that something is true; the point of a requestive is to indicate a desire to get someone to do something, and so on.

I identify a characteristic success predicate for each of the various fundamental illocutionary forces. An assertive succeeds if what is asserted is true, in which case the assertion is *Veridical*. A request succeeds when what is requested occurs, in which case the request is *Honored*. A commissive, or promise, succeeds when what is promised in fact comes about, in which case the promise is *Kept*. A declarative succeeds if the declaration is made with sufficient authority (and under the right circumstances), in which case the declaration is *Authoritative*. Success criteria for emotives—such as “Yea!” and “Boo!”—are problematic, especially since they need not have any propositional content at all.<sup>4</sup> Nevertheless we can define fundamental expressions for them. What is problematic is finding general axiom schema (see below).

Consider now the fundamental speech acts. Besides asserting, we have fundamental schemas and axiom schemas for promising, declaring, and requesting. (See [9] and references therein for elaboration.) The fundamental schemas for the fundamental illocutionary forces are as follows.

FUNDAMENTAL SCHEMA 1 (ASSERT).  $\exists e (assert(e) \wedge Dir(e, [\Phi]) \wedge \Gamma)$

In Fundamental Schema 1,  $\Gamma$  holds the place of any additional qualifiers on  $e$ . The other fundamental illocutionary forces have corresponding fundamental schemas.

FUNDAMENTAL SCHEMA 2 (PROMISE).  $\exists e (promise(e) \wedge Dir(e, [\Phi]) \wedge \Gamma)$

FUNDAMENTAL SCHEMA 3 (REQUEST).  $\exists e (request(e) \wedge Dir(e, [\Phi]) \wedge \Gamma)$

FUNDAMENTAL SCHEMA 4 (DECLARE).  $\exists e (declare(e) \wedge Dir(e, [\Phi]) \wedge \Gamma)$

FUNDAMENTAL SCHEMA 5 (EMOTE).  $\exists e (emote(e) \wedge Dir(e, [\Phi]) \wedge \Gamma)$

The various fundamental illocutionary force success rules are straightforward. A promise is kept if and only if what was promised is/becomes true.

AXIOM SCHEMA 1 (PROMISE SUCCESS RULE).  $\forall e ((promise(e) \wedge Dir(e, [\phi])) \rightarrow (Kept(e) \leftrightarrow \phi))$

A request is honored if and only if what was requested is done/becomes true.

<sup>2</sup>This is a simplification for the sake of getting on with the discussion. There are several competing theories of speech acts. The disquotational theory can for present purposes be considered neutral with respect to speech act theories.

<sup>3</sup>This section contains material modified from [4].

<sup>4</sup>That is the view in [11]; I see no reason to challenge it here.

AXIOM SCHEMA 2 (REQUEST SUCCESS RULE).  
 $\forall e((request(e) \wedge Dir(e, \lceil \phi \rceil)) \rightarrow (Honored(e) \leftrightarrow \phi))$

Sometimes saying so makes it so. If the umpire says “You’re out” then you’re out, provided that the umpire’s saying this is authoritative (properly done under the right circumstances). And a declaration is/becomes true if (but not only if; someone else could call you out) what was declared was declared with the requisite authority.<sup>5</sup>

AXIOM SCHEMA 3 (DECLARATION SUCCESS RULE).  
 $\forall e((declare(e) \wedge Dir(e, \lceil \phi \rceil)) \rightarrow (Authoritative(e) \rightarrow \phi))$

And, as hinted, we’ll have no success rule for emotives. It is tempting, however, to combine all of these into a more general schema,

AXIOM SCHEMA 4 (GENERAL SUCCESS RULE).  
 $\forall e((\Psi(e) \wedge Dir(e, \lceil \phi \rceil)) \rightarrow (Successful(e) \leftrightarrow \phi))$

letting  $\Psi$  stand for any member of a proper list of illocutionary forces.

Although convenient, these axiom schemas do come with a certain amount of baggage: they fail to rule out very many—indeed any—invalid or otherwise flawed utterances. Some examples. First, suppose at time  $t$  a promise is made—or rather an utterance to that effect is given—that something will be done at time  $t'$ , where  $t'$  is before  $t$ . Well, usually you can’t promise to do things in the past. To say “I promise that I did it” is to make a solemn avowal perhaps, but it is not to make a promise. The representational devices to hand—the fundamental schemas and the axiom schemas—do not support exclusion of flawed utterances of this sort. If we are to model our practices and conventions pertaining to promising, we need to do better.

Second, the axiom schemas other than that for assertions seem too strong in that the biconditional should be replaced by a plain conditional. Suppose I request to you that the beer arrives by 6, you do everything in your power to prevent the beer from arriving at all, and yet the beer does arrive on time. Axiom Schema 2 would have it that my request has in fact been honored, contra received intuitions. Similarly, suppose in response to my request you (disingenuously) promise to get the beer here on time. Despite all your good efforts it does arrive as promised. Has the promise been kept? Not likely. Finally, suppose that I am a policeman and acting on my believed authority I declare you under arrest for a certain charge. Unknown to me, another policeman has arrested you for the charge and my authority has been destroyed because I have also been charged with a crime and been stripped of my position. Since in fact you are under arrest for the specified charge, Axiom Schema 3 implies—contra assumption—that I have the authority to place you under arrest (but see the previous footnote).

I draw two lessons from these examples. First, validity conditions for the Fundamental Schemas need to be defined and instances of the schemas should be taken as true only if valid. In this way, we simply rule out, e.g., promises about the past. Second, the schemas themselves tell us something about the validity conditions for the modeled utterances.

<sup>5</sup>If  $\phi$  is defined in the right way the conditional can be strengthened to a biconditional. The right way is to have  $\phi$  say that  $e$  brings about, e.g. causes, a specific state of affairs. Details are beyond the scope of this note.

Requests to an agent (addressee) must be for the *agent* to do something, e.g., cause or try as best it can. For example, one ( $s$  the speaker) cannot validly request of (addressee)  $a$  (only) a delivery of something,  $g$ .

EXPRESSION 14.  $\exists e(request(e) \wedge Subject(e, s) \wedge InDir(e, a) \wedge Dir(e, \lceil \exists e_1(deliver(e_1) \wedge Dir(e_1, g) \wedge InDir(e_1, s)) \rceil))$

Instead, one must specify that  $a$  in some appropriate sense *do* the delivering.<sup>6</sup>

EXPRESSION 15.  $\exists e(request(e) \wedge Subject(e, s) \wedge InDir(e, a) \wedge Dir(e, \lceil \exists e_1(deliver(e_1) \wedge Sub(e_1, a) \wedge Dir(e_1, g) \wedge InDir(e_1, s)) \rceil))$

Finally, for present purposes, we need a means of linking a specific event to the, here, request that occasions it. Two different request events may request delivery by  $a$  of  $g$ , particularly when  $g$  is stuff of a particular type, rather than an identified object. The car you buy has a unique VIN (vehicle identification number), but your order for the car does not mention it. Instead, you specify a make and model number, etc. Similarly, you order a dozen eggs of a particular grade and quality. We need a means of mapping a particular delivery to a particular request, and  $g$  or its analogs will not do that for us. We need to add a predicate, *Sake*( $e', e$ ): event  $e'$  is for the sake of event  $e$ .

This presents us a problem: How can we quantify into a quoted sentence? The solution is straightforward. Think of our special quotation marks as notation for a function that takes its argument and quotes it (turns it into a string in the argot of programming languages). In addition, we have a concatenation operator,  $+$ , that quotes its arguments if they aren’t already quoted, and then concatenates them. Thus, e.g.,  $\lceil Now is the time \rceil = \lceil Now is \rceil + \lceil the time \rceil$ . Similarly,  $\lceil Now is the time \rceil = \lceil Now is \rceil + x + \lceil time \rceil$ , provided that  $x = the$ . I’ll use a shorthand notation for this:  $\boxed{\cdot}$ . So we have  $\lceil Now is the time \rceil = \lceil Now is \boxed{x} time \rceil$ , provided that  $x = the$ . Boxing is a kind of disquotational operator:  $\boxed{\phi} = \lceil \phi \rceil + \phi + \lceil \cdot \rceil$ . So:<sup>7</sup>

EXPRESSION 16.  $\exists e(request(e) \wedge Subject(e, s) \wedge InDir(e, a) \wedge Dir(e, \lceil \exists e_1(deliver(e_1) \wedge Sub(e_1, a) \wedge Dir(e_1, g) \wedge InDir(e_1, s) \wedge Sake(e_1, \boxed{e})) \rceil))$

Similarly, we can stipulate that a valid promise requires that the Subject of the promising event specifically be also the subject of the event promised and that that event is to occur on or after the time of the promise itself. Finally, *Sake* can be used as a required part of the content of a declaration. The declaring event is authoritative if and only if the declared event obtains for the sake of, or in virtue of, the declaring event. Let’s see how this works.  $s$  declares that  $a$  is under arrest:

<sup>6</sup>There are some subtle issues here, which can be noted without our having to be much troubled by them for present purposes. Suppose  $a$  hires the carrier FedEx to deliver the goods and this succeeds. Do we have  $Sub(e_1, a)$ ? Do we have  $Sub(e_1, FedEx)$ ? Both? Neither? I’m inclined to say that  $a$  delivered the goods, but that FedEx was the carrier or transporter for this event. I don’t think this is at bottom a serious problem for the theory.

<sup>7</sup>Certain subtleties are required in specifying how to form (disquote) the various axiom schemas. This is a technical, and quite solvable, problem, which I pass over for now.

EXPRESSION 17.  $\exists e(\text{declare}(e) \wedge \text{Subject}(e, s) \wedge \text{InDir}(e, a) \wedge \text{Dir}(e, [\exists e_1(\text{arrest}(e_1) \wedge \text{Sub}(e_1, s) \wedge \text{Dir}(e_1, a) \wedge \text{Sake}(e_1, [e])]))))$

The problems identified above, e.g.,  $a$  has been arrested but not by  $s$ , are obviated with this representation.

## 6. QUESTIONS

How should questions be represented in LESD theory and Elementary FLBC? The current theory—with event semantics and the disquotation theory—will supply us with the essential tools. We build upon an essential insight, articulated by Huddleston:

While a statement is prototypically assessable as true or false and a directive specifies action or behaviour that would constitute compliance, a question has the distinctive property of defining a set of logically possible answers. [2, page 135]

Rephrasing Huddleston’s comment to fit the terminology of Elementary FLBC (and more generally the terminology of LESD theory), we would say that it is characteristic of an assertion that it is veridical or not, and characteristic of a request that it is honored or not. Questions work similarly, but introduce complications.

Elementary FLBC recognizes three kinds of questions: yes/no-questions and w-questions (“w” as a mnemonic for *who*, *what*, *where*, *when*, *which*, etc.), and why-questions (e.g., “Why is George Bush such an idiot?”).<sup>8</sup> Each type will be handled with its own illocutionary verb, although there will be much similarity among the three accounts.

### 6.1 Yes/No-Questions

“Did Bush really get more votes than Gore in Florida in 2000?” This is a question that can be answered with a yes or a no. It can also be answered with “I don’t know” or some similar disclaimer. There is always the possibility that the question is not clearly enough formulated. Do we mean votes cast, votes officially counted, votes that were cast plus votes that would have been cast but the voters were intimidated, or what? So let us add a fourth possible response: “I don’t understand the question.”

Formalizing Huddleston’s informal comment in terms of Elementary FLBC, the intuition is that a yes/no-question, having the underlying form “Is it true that  $\Phi$ ?”, has the structure:

FUNDAMENTAL SCHEMA 6 (YES/NO QUESTION).  
 $\exists e(\text{AskYN}(e) \wedge \text{Dir}(e, [\Phi]) \wedge \Gamma)$

As usual  $\Gamma$  holds place for all other predicates, e.g., *Subject* for the speaker and *InDir* for the addressee. The key to representing yes/no-questions is in the axiom schemas.

AXIOM SCHEMA 5 (YES/NO-QUESTION DEFAULT).  
 $\forall e \forall s \forall a ((\text{AskYN}(e) \wedge \text{Subject}(e, s) \wedge \text{InDir}(e, a) \wedge \text{Dir}(e, [\Phi])) \rightarrow (\text{Answered}(e) \leftrightarrow \exists e'(\text{assert}(e') \wedge \text{Subject}(e', a) \wedge \text{InDir}(e', s) \wedge (\text{Dir}(e', [\Phi]) \vee \text{Dir}(e', [\neg \Phi])))$

<sup>8</sup>There are other kinds of interrogatives, but these typically are not really questions after all. Examples: “Why don’t you see a doctor?” would often be a suggestion or even a request that you see a doctor; “Can you close the door?” is normally a request to close the door.

What this says is that a yes/no-question regarding  $\Phi$  is *Answered* if and only if the addressee asserts to the speaker of the question either that  $\Phi$  or that not  $\Phi$ . Of course, this formulation does not countenance “I don’t know” or “I don’t understand”. These possibilities are easily added. In Elementary FLBC this is done by asserting that you are in a state of ignorance regarding  $\Phi$  or that you are in a state of confusion regarding  $\Phi$ . I leave the details to the reader. Note that *Answered* augments our list of illocutionary force indicators (*Kept*, *Veridical*, *Honored*, *Authoritative*). Is this a new kind of illocutionary force?

There are further complications. By when must the addressee reply in order to honor the speaker’s request? Since it is the speaker’s question, we assume there is a convention by which the speaker can set a time limit—and more generally a condition—on honoring the request. This holds for requests in general, not just questions. In effect the speaker gets to declare an axiom schema for each question. When this is done, we have a *compound speech act*. The event is both (here) an *AskYN* and a *declare* event. So be it. Space prevents elaboration; see below on compound speech acts.

### 6.2 W-Questions

When we ask w-questions we assume that what we are asking about has occurred or is true. In asking “Who robbed the bank?” we are assuming that the bank has been robbed. Similarly, “When did Stella finish?” assumes that in fact she did. Notoriously, “When did you stop beating your wife?” assumes you did beat your wife. Under the analysis used by Elementary FLBC, a w-question is a speech act compounded (at least) of an assertion and a request for information about some aspect of the fact asserted. So, “The bank was robbed. Who did it?” is a stylistic variant on “Who robbed the bank?” and “Stella finished. When did this happen?” is a variant on “When did Stella finish?” These variants are closer to the formalization we employ in Elementary FLBC.

#### 6.2.1 Who robbed the bank?

Stylistic variant: “Someone robbed the bank and  $s$  requests of  $a$  that  $a$  describe who that was to  $s$ .” We will neglect time and tense for the sake of simplicity. Nothing turns on this.

EXPRESSION 18.  $\exists e, e', x (\{\text{AskW}([e, e']) \wedge \text{Subject}([e, e'], s) \wedge \text{InDir}([e, e'], a)\} \wedge \{\text{assert}(e) \wedge \text{Subject}(e, s) \wedge \text{InDir}(e, a) \wedge \text{Dir}(e, [\exists e(\text{robbing}(e) \wedge \text{Subject}(e, [x]) \wedge \text{Dir}(e, \text{the-bank}))])\} \wedge \{\text{request}(e') \wedge \text{Subject}(e', s) \wedge \text{InDir}(e', a) \wedge \text{Dir}(e', [\exists e(\text{describe}(e) \wedge \text{Subject}(e, a) \wedge \text{InDir}(e, s) \wedge \text{Dir}(e, [x])])\})$

Some comments to help interpret expression 18. (1)  $\exists e, e', x$  is short for  $\exists e \exists e' \exists x$ . (2)  $s$  (the speaker) and  $a$  (the addressee) are constants, not variables; they are names. (3) *AskW* (for asking a w-question) is a compound speech act predicate. Instead of just one eventuality as its argument, it takes a list of eventualities. We use the list notation of Prolog:  $[\dots]$ . From the perspective of first-order logic, a list is a function (two arguments, possibly null) and so names an individual. It is a referring expression, not a predicate. (4) Expression 18 can be put into English more or less directly as “ $s$  is asking  $a$  a w-question.  $s$  asserts to  $a$  that someone, call him  $x$ , robbed the bank.  $s$  requests that  $a$  describe  $x$  to  $s$ .” The claim is that this, however stodgy, is a stylistic variant of “Who robbed the bank?”. It does have the virtue of making explicit what is involved in the question and of

doing so in a way that can be represented in Elementary FLBC.

What axiom schema should we have for w-questions?

AXIOM SCHEMA 6 (W-QUESTION DEFAULT).

$$\forall e \forall e' \forall e'' \forall s \forall a (\{ AskW([e, e']) \wedge assert(e) \wedge Subject(e, s) \wedge InDir(e, a) \wedge Dir(e, [\Phi]) \wedge request(e') \wedge Dir(e', [\Psi]) \} \rightarrow \{ Answered([e, e']) \leftrightarrow \exists e'' (\{ assert(e'') \wedge Subject(e'', a) \wedge InDir(e'', s) \wedge Dir(e'', [\neg\Phi]) \} \vee \Psi) \})$$

Some comments to help interpret expression 6. (1) This is a default rule and leaves out temporal considerations. These, and other conditions, could be added as part of a governing convention for w-questions. (2) The gist of the rule is that a w-question is answered if the addressee either denies the assumption of the question or supplies the requested description. (3) As in the case of yes/no-questions, we might want to add as a permissible answer the addressee's asserting that he doesn't know or doesn't understand. Or we might want to say there is a response to the question, but no answer, if the addressee replies in this way. (4) What counts as a valid and responsive description? The analysis could go further here, but won't. Some brief remarks will have to suffice. I would make three points. First, the speaker is always free to be more specific in his or her request. In the present example, the speaker might request the name (or Social Security number, or finger prints, or DNA) of the bank robber. Second, conventions might be developed, e.g., via more precise axiom schemas, that articulate specific requirements for descriptions. Third, in ordinary language there is considerable wiggle room in this sort of situation. As Grice has pointed out, there is operating a general rule that responses should be made in a cooperative spirit [1]. So something may be an answer to a question without being fully satisfactory, e.g., because the respondent hasn't been fully forthcoming. At the end of the day there probably cannot be any fully formal and complete solution to this problem. I believe that for many practical purposes workable solutions can be found.

### 6.3 Why-Questions

Why-questions, like yes/no-questions and unlike w-questions, are about whole propositions. "Why is it that  $\Phi$ ?" is about the proposition  $\Phi$ . Like w-questions, why-questions (implicitly) make an assertion and a request regarding that assertion, in this case to explain it. Here is a schema for why-questions. Compare it to expression 18.

$$\text{EXPRESSION 19. } \exists e, e' (\{ AskW([e, e']) \wedge Subject([e, e'], s) \wedge InDir([e, e'], a) \} \wedge \{ assert(e) \wedge Subject(e, s) \wedge InDir(e, a) \wedge Dir(e, [\Phi]) \} \wedge \{ request(e') \wedge Subject(e', s) \wedge InDir(e', a) \wedge Dir(e', [\exists e (\text{explain}(e) \wedge Subject(e, a) \wedge InDir(e, s) \wedge Dir(e, [\Phi])])]) \})$$

Interestingly, axiom schema 6 also works for why-questions, given obvious modifications.

\* \* \*

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