

Cognitive Tags in Simultaneous Interpretation

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This paper proposes the notion of cognitive tag and a processing model of simultaneous interpretation (SI) using that notion. A cognitive tag, or c-tag, is typically evoked by some linguistic expression and assigned to a cognitive object, which is to become gradually enriched as discourse develops. A relation c-tag, one of the two proposed types of c-tag, holds a semantic relation among entities, each of which has an entity c-tag attached. A relation c-tag has more than one slot to be filled with an entity c-tag. In this model such coupling constitutes the backbone of speech comprehension and serves as the structural basis of SI at the cognitive level, which is free from idiosyncratic lexical constraints. Authentic SI records are examined to show the validity of the proposed theory.

1. Introduction

The hearer of an utterance first identifies units of incoming linguistic expressions, which will then be organized into messages helped by background knowledge and inference. Much research has been done to explore what works how in such processes of language understanding. Little has been made explicit, however, as to the exact mechanism of the on-line real-time processing by humans of incoming units of utterances. For instance, although it is widely recognized that working memory is put in use in the process of verbal comprehension, the nature of what is memorized is not known enough to answer such a question as whether an incoming piece of information is kept in a lexical form or as some meaning abstracted from it. The exploration of such micro-processes tends to be overlooked in the study of ordinary speech because the resultative understanding is usually obtained in a batch and there seems to be little practical need for finer analyses.

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When it comes to simultaneous interpretation (SI), where on-going processes are at stake, the micro-processes of incoming language awaits further research. We might note here that the micro-processes themselves are indeed part of ordinary human language processing and the study of SI records, which is expected to reveal what is usually concealed, aims to explore the human language processing in general as well as the SI processes.

Linguistic sources surface as linguistic forms, which accompany potential meanings. The hearer selects appropriate meanings out of the stored knowledge and organizes such meanings into some understandable messages, which may consist of propositions and propositional attitudes. A proposition is composed of entities and/or properties and/or relations (cf. Setton 1999). Although entities are prototypically referred to by nouns, properties by adjectives, and relations by predicates in linguistic expressions, such correspondences do not go beyond just superficial description of a conspicuous lexical organization of language. For instance, nouns often describe properties or relations. Therefore, labeling a content type cannot be automatic. There must be some cognitive work on the part of a hearer to mark a certain phrase as an entity, property, or a relation. In addition, close examination of SI data shows that cognitive work is also needed for coupling entities and relation because it is also not automatic. Although a predicate is often described in the lexicon as having some slots, which are to be filled by nouns, the interpreter's coupling of entities and a relation does not necessarily correspond to a predicate-argument relation expressed in the source language.

In the next section we are going to discuss specific cases where a relation among entities is established without strict regard to grammatical case frames or thematic roles, particularly where such semantic relations hold across clausal boundaries. In our discussion we use the general notion of grammatical and thematic relations which are considered to be commonly shared in linguistics.

We will propose a new notion called "cognitive tag" or "c-tag" for short in Section 3 to explain the phenomena observed in Section 2. It will be shown that once a c-tag is evoked by a particular linguistic form, the following processing may be carried out at the cognitive level without particular constraints from lexical information. We also suppose in this paper that the referents of entities range from physical objects in the real world to abstract notions in our mind. Although the latter are the product of conceptualization, they cognitively behave the same way as physical objects and can receive c-tags.

Section 4 will discuss the possibility of measuring cognitive load by c-tags. Funayama et al. (2002) observed delays in SI and proposed three dimensions to measure them. Although the two of them, time lag and word-count lag, are relatively easy to measure and conceptually clear, the third one, information load, defies conventional notions. We are

going to argue that c-tags being held may be counted to indicate the amount of cognitive load.

2. Long-distance semantic relation

One candidate relational notion which a predicate may invoke is a grammatical case frame. A transitive verb, for example, provides for a subject slot and an object slot. Such a frame can be regarded as a sort of relation which a predicate contains as part of its lexical meaning. Observing authentic SI, however, we notice that relations conceptualized in the mind of the interpreter and reflected in her/his output are not necessarily those specified in the lexicon of the source language. In the following fraction of authentic interpretation, the slot in question is a grammatical object in the source language (1a), but it is reproduced as a subject in the target language (1b).

- (1) a. Does our wealth, our good economy, our power bring with it special obligations to the rest of the world?
b. この富というのは、そして素晴らしい経済力、国の力、何か義務が、特別な義務が生まれるとは思いませんか。

(Funayama (ed.) 2002: 224)

In the example (1), which is summarily taken from the record of authentic SI¹, the equivalent to the expression “obligations” appearing in the original speech (1a) as a grammatical object is put into a subject position in the output Japanese. In other words, the semantic relation between “our wealth, our good economies, our power” and “special obligations” in (1a) is mediated by the verb “bring” in the source English, but this grammatical construction is not kept in the target Japanese, yet the semantic relation between the two entities are preserved in a different way.

This kind of rearrangement of grammatical functions on the part of the interpreter is not unusual. It suggests that the grammatical relation a verb specifies can be dissociated from its lexical meaning and becomes a non-lexical element to be manipulated by the interpreter. This must be made possible by some mental operation of the interpreter and we propose to call the object of such operation a cognitive object, which is abstracted away from the lexical meaning. We are going to discuss cognitive objects more in detail in the next section.

We may note in passing that a possible reason for the particular grammatical

¹ Since we focus on the syntactic configurations of the source and target sentences, we simplify the original format of the SI record disregarding synchronicity. The same modification applies to the examples (2) and (3).

reconstruction in (1) may be that the subject “our wealth, our good economies, our power” in the original speech was too long and took a special effort to translate that portion, which led to the separation of the subject part of the incoming sentence. We may also note that the Japanese construction used in (1b), where two of the three topics “経済力” (economic power) and “国の力” (national power) are presented without case particles followed by an intransitive sentence, is minimally allowed in Japanese and it may be a clever technique. However, these technical how-to matters are not what we target ourselves to in this paper. We are focusing on what enables interpreters or hearers in general to come up with the outcomes observed here.

Another candidate relational notion in the conventional linguistic research would be thematic relation. We may presume that the syntactic transformations such as exemplified in (1) be supported by thematic relations, which are somewhat conceptual in nature. If we label both “obligations” in (1a) and “義務” (obligation) in (1b) as Theme, then the rearrangement of grammatical relations constitutes nothing but the expression of a single thematic relation.

The next question then is whether thematic relations are linked to lexical information or not. If yes, we could not rely on the notion of thematic relation to account for long-distance semantic relations. The following examples suggest that the notion of thematic relation or thematic role discussed so far in linguistic literature is too narrow as a notion for exploring the online process of long-distance semantic relations.

- (2) a. ... I think it makes sense for us to use our wealth in that way. Or do you trade debt for valuable rain forest lands?
- b. 私たちは我々の富を使ってこれを救済していかなくてはならないでしょう。あるいは大切な熱帯雨林を救うために、債務を救済してゆくということも必要でしょう。
- c. 全体をよくするためにはアメリカの富を使うことはいいことだと思います。またそれは、熱帯雨林を助けるということ、それもいいと思います。

(Funayama (ed.) 2002: 225)

It is interesting to note in this example that two different interpreters, whose outputs are (b) and (c) respectively, coincidentally produce a similar verb phrase meaning “to save rain forests” in translating the part “for valuable rain forest lands”, which is a prepositional phrase adjoined to the verb “trade” in the original speech. The semantic relation between “debt” and “lands” is preserved in both interpretations, yet in a quite different syntactic configuration. If a thematic relation is to be established based on argument-predicate relation, the example (2) violates the preservation of thematic roles. However, we find the

relevant semantics kept identical in the two syntactically different constructions (2b) and (2c). This suggests that thematic relations solidly connected to syntax is too narrow a notion to represent such conceptual processing by interpreters or hearers in general.

In the following example, the syntactic mismatch is far larger, yet conceptual relations are preserved in interpretation.

(3) a. People watching here tonight are very interested in Middle East policy. And they're so interested that they want to base their vote on differences between the two of you as President, ...

b. 中東の政策に、大変皆さん関心を持って折られると思うわけですが、投票される際にもお二人の違いを伺ってから投票するわけですね。

(Funayama (ed.) 2002: 231)

While the semantic relation between “their vote” and “differences” is framed by the single verb “base” in the source speech, the two entities are expressed in two separate clauses in the output Japanese. Since thematic relations are designated by the predicate that governs its arguments, they cannot go beyond its clausal boundary and thus the conventional term “thematic relation” cannot explain such cases. As far as thematic roles are defined on the basis of argument-predicate relations, you cannot associate two roles in separate clauses. In (3b), the abstract entity “differences”, which is expressed in a prepositional phrase framed by the verb “base” in the source English, is expressed as a Theme of “伺う”(listen to), an additional verb inserted in the target Japanese. “Their vote” is expressed even as a verb, “投票する”(to vote), and it is in a clause separate from the one where “違い”(difference) occurs. Nevertheless, in spite of the difference in grammatical construction between the source and target languages, the two entities “differences” and “their vote” and their semantic relation are all preserved in the output Japanese. Such cases suggest that a certain semantic relation among participants may be detached from lexical information and kept as an independent concept. In the next section we are going to propose some notions to explain such a cognitive mechanism working to organize the incoming information.

3. Cognitive tags

A sequence of incoming lexical items gradually, not instantly, builds up mental pictures in the hearer's mind. This is evident from the fact that SI cannot be carried out literally “simultaneously.” There must be a certain delay from the moment a lexical item is heard and put into working memory to the point in time when the interpreter identifies what part

it contributes to understanding the message. The question raised here is how such would-be contribution is maintained as potential meanwhile in working memory. What is evoked to the hearer's mind by a lexical item is often called grossly as meaning or content, but at the initial stage it must be conceptual in a primitive way and "fluid" in the sense of being adjustable to the context. If it is an unstable object, however, it must be operated on in the process of message understanding. We propose that such a conceptual object is assigned a cognitive tag or c-tag for the processing work. Although what a c-tag is attached to is conceptually incomplete and fluid, a c-tag represents a separable concept serving as a building block for understanding.

We call each c-tag just as a c-tag with only a subscript to distinguish it from others without giving it any name. When it is memorized in working memory, the lexical form that has evoked it might be conceptually most approximate to it, but it is more abstract and it is not identical with the lexical form or the lexical meaning. The essential contents of a cognitive object should be taken from a dictionary but they are volatile and change according to discourse development, while a c-tag stays unchanged until its task is over. A c-tag, when evoked by an incoming lexical item, serves as the indicator of the entry of a certain cognitive object into the cognitive file.

There appear to be at least two types² of c-tag: entity c-tag and relation c-tag. An entity c-tag is typically evoked by a nominal expression, while a relation c-tag by a verb. But, as is the case with the correspondence between parts of speech and kinds of denotation, the kind of c-tag does not always correspond to a fixed group of linguistic expressions. Furthermore, a single linguistic form may evoke more than one c-tag as we will discuss later.

Although it is often a nominal expression which evokes an entity c-tag, a cognitive object which accompanies an entity c-tag should be considered not a linguistic form itself but whatever is conceptualized in the mind of a hearer as the result of identifying what the incoming form denotes in the physical or mental world. One of the characteristics of a cognitive object given a c-tag, therefore, is that the conceptualized entity evoked by the same lexical item may vary in the degree of abstractness according to different hearers as well as different contexts. For example, what the incoming lexical item "baseball" evokes in one hearer's mind may be such a specific entity as one of the American League games

² Although a third type may be stipulated for property, we propose only two types here. The proposed two types are distinguished by whether it has any slot or not. A property c-tag would have one slot and a relation c-tag corresponding to an intransitive verb also has one slot. Therefore we group the notion of property c-tag and relation c-tag together, and call the entire group as relation c-tag. Relation c-tags corresponding to adverbs are also included in this group.

going on at that time, while “baseball” may evoke a more abstract concept about what constitutes a game called baseball in another hearer’s mind. In a coarse sketch of language understanding, one first identifies the lexical form “baseball” in a putative single step and search for its meanings in one’s lexical knowledge to come up with the desirable interpretation. In fact this is only an overall model, neglecting micro-processes on the spot. Human brains seem to be capable of and in fact engaged in online conceptualization, which may be represented first as underspecified meaning to be held for a while. By underspecified meaning we mean something like an abstract concept available, yet to be specified in an actual context later. In another example, the concept of “power” may be held as an abstract notion but it may be specified as “wind power” later in the context. Full specification needs context and background knowledge and thus we need some underspecified meaning in the meantime until the specific meaning is finalized. A conceptual entity to which an entity c-tag is attached may change in its specification or abstractness in the course of discourse development.

We may note in passing that the notion of underspecified meaning resembles that of dot object espoused by Pustejovsky (1995) but differs on two crucial points. First, while dot objects are described as such in the lexicon, cognitive objects with c-tags are formed in discourse by the hearer. Second, those parts composing a dot object which serve as the bases for generating context-sensitive meanings are not underspecified in themselves, whereas the notion of underspecified meaning proposed here refers to the concepts which are incomplete in the sense of lexical specification and held in working memory as they are with temporary partial or abstract meaning until its meaning is fully specified. An underspecified cognitive object does not necessarily match any specific lexical item.

A relation c-tag is prototypically evoked by a predicate and the cognitive object thus given birth to retains some relational concept as well as a conceptualized version of the lexical meaning. Relation c-tags are characterized by embracing an entity-relating semantics, which is basically abstracted away from the meaning of a specific lexical item, leaving out some syntactic information particular to the language system to which it belongs. Since a relation c-tag is responsible for relating the entities participating in a certain event, it is considered to have open slots to be filled with entity c-tags. This is similar to the conventional notion of grammatical case frame: a predicate designates certain number of arguments to be filled with co-occurring noun phrases. A major difference between relation c-tags and predicates is that the slots of the latter are lexically designated, while the slots of the former are detached from the lexical property of the predicate which evoked the c-tag and coupled with appropriate entity c-tags in accordance with the hearer’s perspective. Let us now examine specific examples.

In (3) above, the lexical item “base” evokes a relation c-tag, which has three slots: one is to be filled with an entity c-tag which should be attached to the agent of “basing” activity, the second one with an entity c-tag assigned to the cognitive object evoked by “vote”, and the third one with yet another entity c-tag triggered by “differences”. The target Japanese (3b) shows that the three entity c-tags to fill the slots of the relation c-tag in question are assigned to phrases in a grammatically different way, the biggest difference being that the three c-tags are linked to the three phrases in a single sentence in the source speech, whereas they are distributed to three separate clauses in the target Japanese. The phrase “皆さん” (everyone) corresponding to the first entity precedes the two clauses where the other two entities are separately mentioned: the phrase “違い” (difference) is in the clause “違いを伺って” (listening to differences) preceding the conjunctive “から”(after) and “投票” (vote) is in the separate clause “投票する” (to vote) following “から” (after). The conjunctive “から” indicates that the event of listening to the differences and the event of voting are sequenced in this order.

The notion of relation c-tag makes it possible to explain the fact that one and the same semantic relation among entities may be expressed in different syntactic configurations, or even in different languages. Such devices are not needed as far as syntactic transformations or equivalent configurations established over different languages are rule-based and storable independent of actual contexts. Such putative property does not hold in (3) for example. Although the relation among the three participants may be written as a rule, the insertion of “伺う” (listen to) in the target Japanese (3b) cannot be. The choice of the lexical item “伺う” (listen to) depends on the semantic characteristic of “differences”, whose semantic characteristic in turn depends on what those differences are. If they are not differences of opinions, but those of appearance, for instance, then the choice of an inserting verb may be “見る” (see) or “感じる” (sense) or possible others. If the grammatical object of “base” is “our judgment” instead of “their vote”, then the insertion of a verb presents an entirely different story. Thus there are an infinite number of combinations, which defy any realistic operable rules. A relation c-tag links itself with appropriate entity c-tags on the cognitive level to endorse a certain syntactic configuration. A hearer would abstract such skeleton from the incoming grammatical and lexical information. A speaker would select appropriate construction, based on the coupling of c-tags. A simultaneous interpreter would coordinate the input as well as output information along c-tags.

A cognitive object may be assigned both an entity and a relation c-tags. The lexical item “vote”, for example, refers only to a voting action when used as a noun, but conceptually this voting action accompanies the one who votes and for what office one votes. In the case

of (3), it is understood and made use of in language processing that the vote is by (American) people and for electing President. Whether such a relation is evoked or not would be decided in principle by each hearer based on the context and background knowledge. A similar argument could be made for another entity discussed above. “Differences” means here the differences of opinions between the two Presidential candidates and thus it may receive a relation c-tag as well.

4. Cognitive load

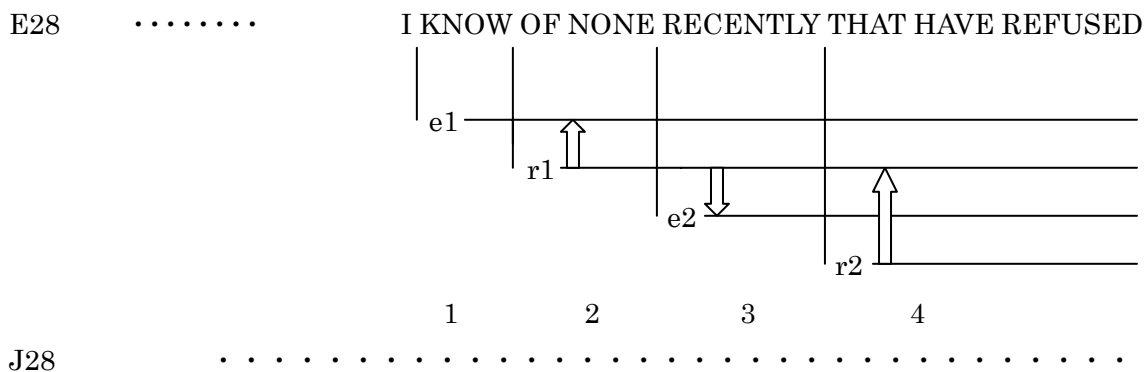
Funayama et al. (2002) proposed to measure the ear-voice span (EVS) “separating words in the interpreter’s speech from corresponding words in the source speaker’s speech” (Anderson 1994: 102) in terms of three dimensions: time lag, word-count lag, and information-load lag. We can obviously measure the time and the number of words between the end of a certain expression in the source speech and the initiation of its equivalent in the target speech. But how can we measure the information-load lag? ³

The notion of cognitive tag seems necessary to explain long EVS. The close examination of SI records reveals that EVS is sometimes, not always, extended long. We need some instrument other than time and word count to identify the conditions which enable long EVS because the two kinds of measurement cannot distinguish the quality of the burden on the interpreter. Funayama et al. (2002) suggests that there is a significant tendency for predicates held longer than nominals. But this qualitative characteristic cannot be explained solely by time and word count.

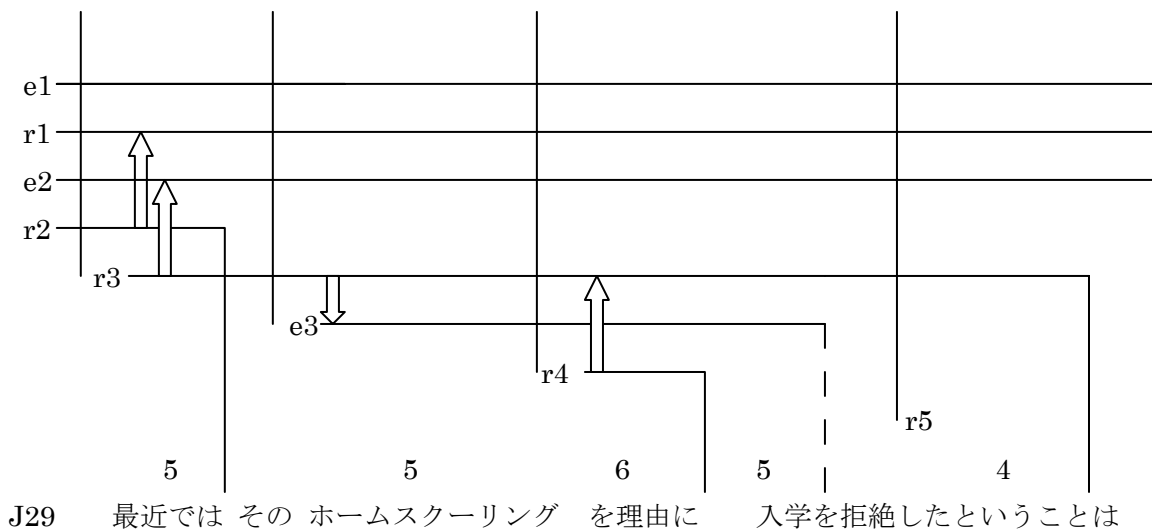
Cognitive tags present themselves as a good candidate for a tool to measure information-load lag. In processing incoming strings of linguistic units, the simultaneous interpreter would identify a conceptualized entity out of some nominal expression or other clues and give it an entity c-tag. When the interpreter encounters a linguistic unit, often a predicate, relating entities, (s)he would identify a relational concept and assign a relation c-tag to it. A relation c-tag has more than one slot and those slots must be filled by appropriate entity c-tags. Now the number of c-tags to be held at a time may represent the information load at that moment. In the following example, taken from Funayama et al (2002: 22), the number of c-tags changes in the course of the passage as indicated by the numbers below the lines, each of which shows the holding of each c-tag.

³ The author thanks Daniel Gile for personally initiating the discussion on this problem, which has led to the presentation of this idea.

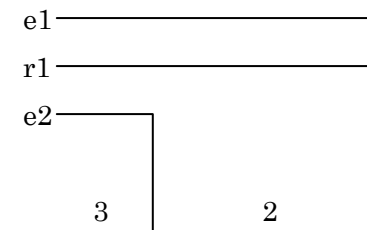
(4)



E29 THE CHILD ONLY BECAUSE THEY HOME SCHOOLED.



E30



Basically a noun phrase evokes one entity c-tag as is the case with “I”, “none”, and “the child” in the above example, where they are connected by a vertical line with the abbreviated symbols e1, e2, and e3 respectively. The horizontal line starting at a c-tag shows the duration of its stay in working memory, which terminates at the point where it is

rendered into some target linguistic expression connected by the second vertical line in (4).

This schematic diagram by no means implies that c-tags are attached to lexical items occurring in the incoming speech. They are given to conceptualized entities and those cognitive objects may differ from lexically delimited referents in many ways. One example is seen in the handling of “the child” on the line E29 in (4). This part of the source speech is not directly translated but conceptually reorganized into the phrase roughly meaning that “admittance was refused for the reason of home-schooling.” The incoming phrase “the child” appears to be conceptually enriched so that it refers to the home-schooler. This assumption is actually suggested by the phrase “ホームスクーリング” (home schooling) on J29, which seems to come from nowhere but it would be possible to insert it based on the preceding context. The Japanese phrase “入学” (admittance) on J29 reflects the topic for this passage and we cannot say that this part is a wrong translation even if there is no word-to-word correspondence, which is indicated by a broken line. The source speaker is talking about the college admittance of home-schoolers and the output information is essentially correct. The conceptual entity e3 is evoked by the source phrase “the child,” but it is conceptually enriched to the child who is not only a child but a home-schooler who wishes to get enrolled in a college. Such enrichment is made possible in our theory by assigning an additional relation c-tag to the cognitive object already given an entity c-tag.

When a predicate comes in, it typically evokes a relation c-tag. For example, the verb “know” in E28 evokes a relation c-tag, which may be rendered into a function such as “ x KNOW y .” Any relation c-tag is to be coupled with appropriate entity c-tags. Thick arrows indicate such coupling and relation c-tags serve in this regard as organizer for entity c-tags.

One indication of the interpreter’s cognitive load is the number of lines at each point. The diagram (4) shows that the number ranges from 1 to 6. The higher the number increases, the heavier burden the interpreter shoulders. Although the function of relation c-tags in grouping c-tags into fewer number of cognitive objects, and thus reducing the burden of cognitive operation, should be explored more in light of actual mental operation of cognitive objects, it does not seem unreasonable to assume that an increased number of in-process c-tags simply hampers further assignment of c-tags. There must be an individual’s saturation point where the work collapses. The loss of surface-level translation around the number 6 above in (4) may mean the interpreter’s capacity decreased. On the other hand, when the number of c-tags are kept limited, considerably long EVS may be possible.

A relation tag is abstract in nature and constitutes the backbone of the hearer’s perspective, which is being built based on incoming phrases, associated background knowledge, and other available sources of information including general logics. Traces of

c-tags show how knowledge results in hearer's perspective by representing how entity c-tags and relation c-tags are unified in cognitive filing of the incoming information.

The conceptualized objects evoked by incoming lexical items vary according to different interpreters and different actual developments of interpreting on the spot. This is quite natural in view of the commonly observed variability of interpretation. The c-tag development seen in (4) above shows just one example of possible c-tag developments. Different interpretations do not merely derive from different choices of lexical translation but, more than that, from different ways of conceptualization of the incoming lexical clues and contextual information.

5. Conclusion

It may be generally believed that incoming lexical forms should be memorized until they are put into their equivalents in the target language. Close examination of SI reveals, however, that lexical forms themselves are not necessarily the objects to be memorized. What is held in working memory seems to be more conceptualized and abstract in nature. We proposed in this paper that the information coming from the source speech is held by the interpreter as cognitive objects, each assigned a cognitive tag, and they are operated on at the cognitive level. C-tags enable the interpreter to memorize, reorganize, and express cognitive objects in a unified way according to our theory.

In addition to the adequacy claimed for modeling the SI micro-process, our c-tag theory has two more potential advantages. One is that it is capable of narrowing down the reasons for performance variability among different interpreters for the same source speech or among different occasions of interpreting by the same interpreter. By depending on individual conceptualization rather than static lexical information and assuming that the conceptual contents of cognitive objects change as the source speech develops, our model could trace the mental processes of the interpreter in a fine-tuned manner.

The second additional advantage of our c-tag model is its capability of accounting for nonlinguistic stimuli including background knowledge and situational nonverbal signs. Although much research should still be carried out, the present theory presents a promising opportunity for integrating linguistic and nonlinguistic information.

Although the present model aims to explain the phenomena observed in SI, it gives us insight into human language processing in general. We consider that its most important contribution to general theory is the proposed nature of cognitive objects operated on by the interpreter, or the hearer of utterance. Some linguistic efforts such as Discourse Representation Theory (cf. Kamp and Reyle 1990) try to trace the entities entering into discourse in a way similar to ours but they regard every entity as a conceptually fixed one

and do not allow the change in its content. That may not pose serious problems so far as we are concerned with the stage-by-stage discrete description of language processing. Since SI is of course a continuous process and moment-by-moment multifaceted operations are needed, we cannot be indulged in stage-by-stage model. We should note, however, that SI processes are visible traces of what humans are doing in understanding speech.

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