The Problem of Verbal Inflection in Second Language Acquisition[*]

William O'Grady
University of Hawai'i

1. Introduction

Strictly speaking, the job of a linguist is to figure out how language works—how it is used, how it is acquired, how it is represented in the brain, how it changes over time, and so forth. Most linguists would, I think, steer clear of the sorts of practical issues that arise in the case of language pedagogy, such as the question of how a second language should be taught or the question of why it is so difficult to teach language in the first place. Nonetheless, it is always worthwhile to be on the lookout for ideas that might offer insights into the problems faced by language teachers in their every-day work.

With that in mind, the purpose of this paper is to explore a set of proposals pertaining to memory, learning, and grammar—three phenomena that lie at the heart of both language pedagogy and contemporary linguistic theory. Although I don't intend to say anything about how language should be taught, I will try to explore an apparent contribution that these proposals make to understanding why certain things are so difficult to teach.

I will focus my remarks on two phenomena—agreement and past tense marking. Both involve suffixes that are relatively low in perceptual salience, which is of potential importance since salience is known to have a facilitative effect in the case of first language acquisition (Li, Leonard & Swanson 1999) as well as second language learning (e.g., Goldshneider & DeKeyser 2005, Ellis 2006:171, Bayley 1994, 1996).

However, more than a lack of salience seems to underlie the difficulty of verbal inflection. Agreement and tense marking are known to be problematic even for instructed learners, who receive explicit training in their form and use. Moreover, learners who have no difficulty hearing or producing the final consonant in *raise* (/rez/) and *raid* (/red/), for example, may still say *pay* when they should say *pays* (/pez/) or *paid* (/ped/).[1]

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[1] Klein et al. (2004) claim that L2 learners' problems with tense inflection is phonological in nature, noting that the 66 adult learners in a study they conducted did better on the /ɪd/ allomorph than on /t/ or /d/, and that there was no effect for aspect. However, Klein et al's task involved writing verbs that were heard in a story read aloud by a native speaker. Such a task involves

I'll begin by outlining a view of memory and learning that has been central to my own recent work on syntax and language acquisition (e.g., O'Grady 2005). I'll then try to explain how this view can shed light on the difficulties associated with verbal agreement and past tense marking. Crucially though—and this is where linguistic analysis comes into the picture, an understanding of these difficulties draws not only on a theory of memory and a theory of learning, but also very crucially on a theory of how agreement and tense work.

2. Two types of memory

The starting point for my discussion is the distinction between two memory systems that dates back at least to Cohen & Squire (1984; see also Cohen 1980). Over the last two decades or so, an increasing amount of work has suggested that this distinction is crucial to understanding various important phenomena that arise in the acquisition and use of language.

The first system, *declarative memory*, underlies the learning and storage of facts and events, including arbitrary information (e.g., grizzly bears are brown, one was seen in Banff two days ago, and so on). According to Ullman (2001:106), learning of this sort is subserved by medial temporal lobe regions such as the hippocampus, although the memories eventually become dependent upon neuro-cortical regions, particularly in the temporal and temporo-parietal lobes.

From a linguistic perspective, the most crucial claim about declarative memory is simply that it underlies knowledge relating to words, including their meaning, their pronunciation, and their use. This is of course the sort of information that is normally associated with the lexicon (or mental dictionary) in contemporary linguistic theories.

A side effect of learning via declarative memory is that the stored information is often relatively accessible to conscious awareness. With only a little effort, we can explicitly recall that the Declaration of Independence took place in 1776, that Japan is to the east of Korea, that the noun *people* is inherently plural, that *destroy* is a transitive verb, and so forth.

The second memory system relevant to language, *procedural memory*, is involved in the learning and use of a broad range of motor and cognitive skills, especially those involving sequences (Pinker & Ullman 2002:457)—everything from skating, to playing the piano, to doing arithmetic. It is believed to be rooted in frontal/basal ganglia structures, especially in the brain's left hemisphere, with possible participation by inferior parietal regions as well (Ullman 2001:106).

On the linguistic side, procedural memory is thought to support the computations and symbol manipulation associated with what is traditionally called 'grammar,' including syntax, non-lexical semantics, morphology, and phonology (Ullman 2001:107).

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perception, and has nothing to say about why even instructed learners have so much trouble using the past tense in their own speech and writing.

In contrast to declarative memory, the operation of procedural memory is largely unconscious—we have essentially no awareness of what allows us to form or interpret sentences and (at least in the case of a first language) no recollection of ever having learned to do so.

The declarative/procedural distinction is potentially relevant to our understanding of at least some of the differences between first language acquisition and second language learning. As Ullman, Paradis (2004), and others have noted, there is reason to think that age diminishes the ability of procedural memory to support learning and computational operations, forcing adult second language learners to rely more heavily on declarative memory than do children acquiring a first language. This shift in resources has a wide range of consequences, at least some of which can be discerned in problems familiar to every second language teacher. The acquisition of verbal inflection in English is a case in point.

3. The agreement problem

At first glance, subject-verb agreement in English is an unusually simple phenomenon whose key properties can be stated roughly as follows.

(1)   A present tense verb agrees with its subject.

We see the apparent effects of this rule in contrasts such as the one exemplified below.

(2)a.   Verb in the present tense with a singular subject:
         That student *works* hard.
            IIISG   3sg

   b.   Verb in the present tense with a plural subject:
         Those students *work* hard.
            IIIPL   3pl

English verbal agreement is commonly described as 'easy,' 'simple,' 'transparent,' and 'straightforward' (Krashen 1982:17 & 97, Ellis 1990:167, Eubank 1994:84, Jiang 2004:624). Yet, it is enormously difficult for second language learners to use the third person singular suffix accurately in the course of normal speech. For example, in Stauble's (1984) cross-sectional case study of the acquisition of English by six adult native speakers of Spanish and six adult native speakers of Japanese, even the advanced learners had very significant difficulties. (The Japanese speakers produced the -*s* suffix correctly less than 20% of the time.) Along similar lines, Lardiere (1998a,b) reports that even after 18 years in the United States the Chinese-speaking subject she studied omitted agreement on thematic verbs 98% of the time, despite having mastered many other phenomena, including pronominal case, negation, and the relative ordering of adverbs and verbs.

See Dulay & Burt (1973, 1974), Andersen (1978), Makino (1980), Aaronson & Ferres (1987), and Hawkins (2003:38ff) for further documentation of the general difficulty of agreement.[2]

Why should subject-verb agreement be so difficult? The answer, I think, lies in a very fundamental misunderstanding involving the nature of the agreement phenomenon itself. In pedagogical grammar and even in discussions of second language acquisition, agreement is typically treated as a simple factual matter—the form of a (present tense) verb in English is determined by the person and number of its subject (see, e.g., (1) above). In other words, agreement is made to look like the type of information that can be learned and stored in declarative memory, alongside facts about the meaning and use of particular lexical items, the fact that the weather is warm in July, that Canada has ten provinces, and so forth.

This is, I believe, fundamentally wrong. As I see it, there is no rule of subject-verb agreement in the normal sense at all. Rather, the phenomenon of agreement in English can only be understood procedurally—that is, in terms of the on-line computational operations that are used to build sentences one word at a time from left to right in the course of production and comprehension. Any account that seeks to understand or explain agreement in terms of a static factual generalization is inherently unequipped to make sense of the properties associated with this phenomenon.

In fact, there are good linguistic reasons for believing that the factual/ declarative approach to agreement cannot be right. One indication of this comes from the existence of patterns such as (3) in which the verb agrees with an NP other than its subject.

(3)a.   There is **paper** on the desk.
             3sg   IIISG

    b.   There are **pencils** on the desk.
             3pl   IIIPL

Another indication comes from the fact that English has patterns in which the NP triggering agreement isn't even an argument of the inflected verb.

(4)   There seems [to be **paper** on the desk].
          3sg   IIISG

Moreover, at least in colloquial English, there are cases in which the verb agrees with just *part* of an NP—the first conjunct of the coordinate NP in (5), for instance.[3]

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[2] For discussion of verbal agreement problems in other second languages, see Prévost & White (2000). Nothing that I say here should be construed as inconsistent with their view that uninflected verbs in the speech of second language learners can nonetheless be finite.

(5)   There is   [**paper** and ink] on the desk.
                3sg   IIISG

What do facts such as these tell us about the nature of agreement in English? To answer this question, it is necessary to focus on the processing mechanisms that implement agreement in the course of actual speech.

4. The computation of agreement

As explained in much more detail in O'Grady (2005:90ff), agreement reflects the interaction of lexical and computational factors. On the lexical side, inflected lexical items introduce an 'agreement dependency'—they carry person and number features that must be matched at some point with features elsewhere in the sentence. The agreement dependencies associated with the inflected form of English verbs can be represented as follows.

(6) a.   *remains*: V
                   3sg

    b. *is*:   V
                   3sg

But how are such dependencies resolved? The lexicon is silent on this matter, and I don't believe that a grammatical rule in the traditional sense is involved either. Rather, the phenomenon must be understood with reference to the functioning of a particular type of computational system.

The computational system[4] that I have in mind is indistinguishable from a processor: it operates in a linear ('left to right') manner, it combines elements, and it checks to make sure that lexical requirements are being satisfied. Moreover, its functioning is constrained by a single general consideration: it seeks to reduce the burden on working memory by carrying out its operations at the first opportunity (the 'Efficiency Requirement').

Matters are straightforward in a simple sentence such as *One remains*. There, combination of *one* and *remains* creates an opportunity to resolve the verb's agreement dependency, leaving the appearance of subject-verb agreement. (I use a check mark to indicate resolution of an agreement dependency.)

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[3] In a survey of twelve native speakers, Sobin (1997:324) reports a mean acceptability rating of 3.58 out of 5 for sentences such as *There is a book and a pen on the table*, compared to just .81 for *There are a book and a pen on the table*, with the plural form of the verb.
[4] As explained in O'Grady (2005:4), the term 'computational' simply means that sentence formation and interpretation involve the application of operations ('computations') such as combination, feature matching, and so forth.

(7)   Combination of *one* and *remains*; resolution of the agreement dependency
       [**One   remains**]
        IIISG   3sg

However, a very different result comes about in patterns such as *There is paper on the desk*. Here the processor, working from left to right, first brings together *there* and *is*.

(8)   [**There   is**]
                     3sg

Because *there* lacks number features, no opportunity arises to resolve the verb's agreement dependency, whose resolution must therefore be postponed.

In the next step, the computational system combines *is* with the nominal to its right, creating the awaited opportunity to resolve the agreement dependency.

(9)   [There   [**is   paper**]]
                    3sg IIISG

This opportunity is immediately exploited, thereby yielding a pattern in which the verb agrees with a non-subject NP.

It takes even longer to come across an opportunity to resolve the verb's agreement dependency in a sentence such as *There seems to be paper on the desk*.

(10)a. Combination of *there* and *seems*:
        [**There   seems**]
                     3sg

   b. Combination of *seems* and *to*:
       [There   [**seems   to**]]
                     3sg

   c. Combination of *to* and *be*:
      [There   [seems   [**to   be**]]]
                   3sg

   d. Combination of *be* and *paper*; resolution of the agreement dependency:
      [There   [seems   [to   [**be   paper**]]]]
                   3sg   IIISG

Here again, the computational system does exactly what one would expect an efficiency-driven linear processor to do—it resolves the agreement dependency at the first opportunity, even though this opportunity does not involve an argument of the inflected verb.

Yet a different result occurs in the case of a pattern such as *There is paper and ink on the desk,* which is formed as follows.

(11)a. Combination of *there* and *is*:
    [**There**   **is**]
               3sg

   b. Combination of *is* and *paper*; resolution of the agreement dependency:
    [There   [**is**   **paper**]]
             3sg IIISG

   c. Combination of *paper* and *and*:
    [There   [is   [**paper** **and**]]]
             3sg   IIISG

   d. Combination of *and* and *ink*:
    [There   [is   [paper [**and** **ink**]]]]
             3sg IIISG

The key step here is the second one, in which the verb combines with just the first conjunct of the coordinate phrase, the nominal *paper*, creating an opportunity to resolve the agreement dependency. The end result is the phenomenon known as 'partial agreement'—the verb agrees with a subpart of a coordinate NP. As expected, this phenomenon is only possible when the coordinate NP follows the verb. Where it appears to the left, and is therefore fully formed before the verb is encountered, partial agreement is impossible.

(12)   [Paper and ink] are/*is on the desk.

In sum, there is no subject-verb agreement per se in English. There are just dependencies involving person and number features, which—like other dependencies—are resolved by the computational system at the first opportunity. If the verb's first argument (its 'subject') happens to carry features, then the agreement dependencies are resolved right away—giving the appearance of subject-verb agreement. And when the first argument carries no features, the verb must await another opportunity to resolve its agreement dependencies.

As a result, English ends up with a seemingly exotic system of agreement in which the verb variously agrees with its first argument (subject), its second argument, the argument of an embedded verb, and the first conjunct of a coordinate NP to its right.

(13)   English agreement patterns
   a. agreement with the first argument (the subject):
      Paper is on the desk.

b. agreement with the second argument:
   There is **paper** on the desk.

c. agreement with the argument of an embedded verb:
   There seems [to be **paper** on the desk].

d. agreement with the first conjunct of a coordinate NP:
   There is [**paper** and ink] on the desk.

Seen from the perspective of the traditional agreement rule, this range of facts appears to be quite strange. In reality, things make perfect sense if sentences are formed by a linear computational system that simply resolves dependencies at the first opportunity.

5. The acquisition of agreement

As we have just seen, agreement is a procedural phenomenon in the sense that it is best understood in terms of real-time computational operations that seek to resolve agreement dependencies at the first opportunity. This is true not just for the patterns such as (13b-d) in which an NP other than the subject triggers agreement; it is true for ALL cases of agreement, including the much simpler (13a). Where the subject carries person and number features, it presents an immediate opportunity to resolve the verb's agreement dependencies and the computational system takes advantage of that opportunity, creating the illusion that English has a 'rule' of subject-verb agreement. In fact, though, the mechanisms at work in those sentences are no different from those used in the less common cases—the computational system is responsible for ALL agreement patterns.

The computational system whose effects we have been considering is of course embedded in procedural memory, just as other unconscious, automatized systems of operations are. This in turn helps shed light on at least four related and partially overlapping phenomena associated with the development of agreement in the course of second language acquisition.

Age effects

It is well known that there are strong age effects (sometimes called 'critical period effects') associated with the acquisition of morphosyntactic phenomena. Classic evidence for this comes from Johnson & Newport's (1989) study of 46 Korean- and Chinese-speaking subjects, who were alike in years of exposure to English (roughly 10 years) but differed in terms of when that exposure first occurred (prior to age 15 versus after age 17). Johnson & Newport's results, based on an aurally presented grammaticality judgment task, revealed a strong relationship between age of exposure to English and ultimate performance on a

number of grammatical phenomena, including agreement.[5] (See DeKeyser 2000 for a similar conclusion based on different data and for a defense of Johnson & Newport's methodology.)

This fits well with the declarative/procedural model of memory: whereas declarative memory continues to improve through childhood and into adolescence, the ability of procedural memory to support learning and computational operations diminishes with age (Ullman 2001:108-09, 2005:151-52). On the assumption that agreement is a procedural phenomenon, it is not surprising that it too is subject to age effects.

Task effects

It is well known that performance with regards to agreement varies a great deal depending on the task. Whereas learners typically do quite poorly on agreement in natural speech, their performance in test situations can be considerably better. For example, in Bean & Gergen's (1990) case study of an adult Chinese-speaking learner of English, the -s suffix was used correctly in narratives only 5% of the time, but was supplied in 70% of the relevant contexts in an oral morphology test (Long 2003:500). Along similar lines, Larsen-Freeman & Long (1991:89) report that performance on agreement tasks involving reading and writing was elevated compared to other tasks in a series of experiments conducted by Larsen-Freeman with 24 adult ESL learners.

Jiang (2004) devised an intriguing experiment to determine just how deep-seated L2 learners' problems with agreement are. Using a word-by-word self-paced reading task, he investigated the processing of patterns such as the following by native English speakers and by Chinese-speaking learners of English as a second language.

(14)a. The bridges to the island were about ten miles away.
   b. *The bridge to the island were about ten miles away.

Whereas native speakers exhibit elevated reading times at the verb in the second sentence type in reaction to the agreement mismatch, second language learners showed no such effect even though they demonstrated formal knowledge of the agreement facts on a written test.[6]

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[5] The correlation between age and success on agreement was a relatively weak .29 (p < .05), but this may have been because the task used by Johnson & Newport to assess performance involved grammaticality judgments rather than production. See the discussion of task effects below.

[6] English native speakers also showed a longer reading time for the verb in the second sentence below, in reaction to the fact that the immediately preceding noun is plural. The L2 learners showed no such sensitivity to number.

(i) a. The key to the cabinet was rusty from many years of disuse.
   b. The key to the cabinets was rusty from many years of disuse.

The picture that emerges from these studies fits well with the declarative/procedural model. According to Ullman's theory (2001:109; 2005:152), older L2 learners rely largely on declarative memory for morphosyntactic phenomena. As already noted, this type of memory is especially suited for the learning and use of factual generalizations that are at the level of conscious awareness—arguably the sort of information that people can access relatively easily in a test situation, where there is time to reason about and apply explicitly stated rules (e.g., Krashen 1982:17 & 101-02).[7] In fact, Flege et al. (1999:100) report that the best predictor of performance by 240 Korean-speaking subjects in a grammaticality judgment task involving agreement and other morphosyntactic phenomena was number of years of education in the U.S.—a variable that is plausibly associated with test-taking skills.

By contrast, factual generalizations are much less useful in natural speech, which calls for automatized operations that apply virtually instantly and beneath the level of conscious awareness—the sort of operations that make a heavy demand on procedural memory.

Frequency effects

It is well known that second language learners have better control of agreement for copula and auxiliary *be* than for thematic verbs such as *work, study*, and so forth. This tendency has been found both in case studies of individual subjects (Lardiere 1998b) and in large cross-sectional studies (Dulay & Burt 1973—151 Spanish-speaking child subjects aged 5 to 8; Dulay & Burt 1974—60 Spanish-speaking child subjects and 55 Cantonese-speaking child subjects aged 6 to 8; Bailey, Madden & Krashen (1974—71 adult subjects, 33 Spanish speakers and 40 from a variety of other L1 backgrounds; Andersen 1978—89 Spanish-speaking college-level subjects; Makino 1980—777 Japanese-speaking adolescents; see Gold-schneider & DeKeyser 2005 for a review).[8]

Zobl & Liceras (1994:169) suggest that the contrast between *be* and thematic verbs reflects the free morpheme/bound morpheme distinction—agreement in the copula is expressed by the form of the entire word (e.g., *is* vs. *are*) rather than via suffixation (*see* vs. *see-s*).[9] Hawkins (2003:63 & 75) takes a someone different tack, proposing that development reflects the 'building of syntactic

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[7] The learning/acquisition contrast that Krashen proposes has many parallels in the SLA literature—explicit vs. implicit knowledge (Bialystok 1978), nonautomatic vs. automatic (Ellis 1984), conscious intellectual understanding vs. integrated linguistic competence (Hale 1988), metalinguistic knowledge vs. implicit linguistic competence (Paradis 2004), so on. See Jiang (2004:607) for a review.

[8] Some studies report greater success on copula *be* than on auxiliary *be* (but see Bailey et al. 1974, who report the reverse finding). As Zobl & Liceras (1994:169) observe, the two types of *be* are separated by no more than one rank in the studies they review, and Andersen (1978) does not order them with respect to each other. I will follow this practice here.

[9] However, it is perhaps worth noting that L2 learners are apparently not so successful with the auxiliary verbs *have* and *do* (Lardiere 1998b:366-67).

representations,' and that *be* acts as the 'trigger' for establishing the functional category Infl in which agreement features are ultimately represented.

Frequency presents an obvious confound here, though, since *be* (in its various forms) is the second most common word in English, after the determiner *the*. It makes up 4.23% of the words in the British National Corpus, and is 15 times more frequent than *say*, the most commonly used thematic verb.[10] Moreover, a Google search of the Internet suggests that the inflected form *is* is about 12 times more frequent than its third personal singular counterpart *says*. (The asymmetry would be much, much greater if we took into account the contracted form -*'s*.)

Interestingly, the declarative/procedural model has a place for frequency in its theory of learning. The key idea is that, even in the case of second language acquisition, information can be integrated into procedural memory with sufficient practice—that is, with frequent use in the course of production and/or comprehension (Ullman 2001:110, 2005:152; Paradis 2004:41).

There are various precedents for this idea. As noted by DeKeyser (1997:196-97), for instance, Anderson's (1992, 1993) model of cognitive architecture holds that declarative information ('knowledge that') can be converted into procedural information and undergo automatization in accordance with the power law of practice. In fact, DeKeyser himself proposes such a scenario for morphosyntactic development in second language acquisition.

I am NOT suggesting that frequency is the sole determinant of developmental order in second language acquisition (see Larsen-Freeman 1976 for such a proposal). To the contrary, I agree with Goldschneider & DeKeyser (2005), who concluded, based on a meta-analysis of 12 studies involving more than 900 participants, that frequency is only one of several factors relevant to morphosyntactic development in SLA (others include phonological salience, semantic complexity, and morphophonological regularity).

However, I AM suggesting that when differences in relative frequency reach the order of magnitude associated with the contrast between *be* on the one hand and thematic verbs on the other hand, there is a reasonable likelihood of influence that must be taken into account. This is especially the case if frequency of usage helps determine the type of memory system in which information is stored and accessed, as proponents of the declarative/procedural theory suggest.

Transfer effects

Finally, there is reason to believe that the nature of a learner's first language has some influence on the rate and success of inflectional development (e.g., Eubank 1994:88ff). An illustration of particular interest comes from Hawkins (2003:58), who suggests a transfer account for the fact that the two advanced-level Spanish-speaking learners in Stauble's (1984) study performed far better on

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[10] http://www.eecs.umich.edu/~qstout/586/bncfreq.html/

English verbal agreement than did their two Japanese-speaking counterparts. (Spanish, but not Japanese, has a rich system of subject-verb agreement.)

This fits well with the idea that transfer in second language acquisition involves computational routines (i.e., processing operations), as suggested by O'Grady (2006). (Carroll 2003 and Sharwood Smith & Truscott 2006 have put forward related ideas; see O'Grady 2006 for some discussion.) If this is right, then it is easy to see why learners whose first language has verbal agreement enjoy an advantage—they have already developed routines in their procedural memory for implementing subject-verb agreement that can be carried over to English, at least to a certain extent.[11] In contrast, learners whose native languages lack agreement have to learn the relevant routines from scratch, presumably via the less suitable declarative memory.

Summary

In sum then, I have suggested that despite its apparent simplicity, subject-verb agreement is difficult for second language learners because of the type of memory system that subtends its acquisition and use—procedural memory rather than declarative memory. The linguistic facts line up very well behind this hypothesis: for the reasons outlined in section 4, English agreement cannot be implemented as a factual generalization about the relationship between a verb and a subject. Rather, it reflects the operation of an efficiency-driven computational system that draws heavily on the resources of procedural memory.

This may well be where the problems begin for second language learners, since procedural memory is simply not as available to support learning in older subjects as it is in young children. As I have attempted to show, this is turn leads to the symptoms characteristic of agreement in second language acquisition—age effects, task effects, frequency effects, and transfer effects.

6. A note on past tense

Agreement is only one of several inflectional phenomena that create problems for second language learners. Space does not permit a comprehensive treatment, but consideration of the development of past tense inflection offers an opportunity to broaden the scope of our discussion.

Like agreement, past tense marking *appears* to be a transparent phenomenon subject to a simple factual generalization (e.g., Flege, Yeni-Komshian & Liu 1999:82).

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[11] The nature and motivation for transfer is a perennial mystery, and many questions arise with respect to agreement as well. As Kevin Gregg (p.c.) notes, for instance, it would be helpful to know whether speakers of English, which has relatively little agreement inflection, do better than speakers of Japanese (which has no agreement inflection) in learning Italian, which has a rich system of agreement, with different forms for each person and number category.

(15)   The past tense form is used when a verb denotes an event that occurs prior to the moment of speech.

And like agreement, past tense marking has long been known to be difficult for second language learners. For instance, in the 14 studies summarized by Goldschneider & DeKeyser (2005:72), the past tense suffix -*ed* never ranked higher than fourth out of the six morphemes surveyed for accuracy of usage.[12] (See also Zobl & Liceras 1994:170.) In Makino's (1980) study of the elicited speech of 777 Japanese-speaking 8th and 9th graders, the regular past and irregular past were ranked sixth and seventh, respectively, out of nine morphemes. Andersen (1978) uncovered a comparable low ranking for the past tense in the writing of 89 Spanish-speaking first-year college students. And so on.

Moreover, studies of the acquisition of the past tense in the course of second language acquisition have revealed evidence of age effects (Johnson & Newport 1989), of task effects (Long 2003:500, based on Bean & Gergen 1990), of transfer effects (Dulay & Burt's 1974 comparison of six-to-eight-year-old Spanish and Cantonese learners of English), and frequency effects (Ellis & Larsen-Freeman 2006).

This cluster of properties is by now familiar and it points toward an obvious conclusion—use of the past tense must draw on the resources of procedural memory. But what makes past tense a procedural phenomenon? In particular, what sorts of computations are required to use the past tense correctly?

Various suggestions have been made in this regard. For example, there is the widely held idea that use of the past tense requires morphological computation, at least for regular verbs where a productive rule of suffixation adds -*ed* to the stem (e.g., Pinker 1999).[13]   But this in itself cannot be enough to explain late mastery of the past tense since a similar computation is associated with the suffix -*ing* (*walk + ing*), whose acquisition is relatively unproblematic (e.g. Goldschneider & DeKeyser 2005).

At the other extreme, it has been suggested within the Principles-and-Parameters framework that tense is subject to various invisible computations, including the establishment of a relationship with the C(omplementizer) position, possibly via movement at LF (Enç 1987, Guéron & Hoekstra 1995).

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[12] The other five were -*ing*, plural -*s*, *the/a*, possessive -*'s*, and third person, singular -*s*.

[13] It is sometimes suggested that second language learners initially do better on irregular past tense forms (*ate*, *went*, *ran*, etc.), which are taken fully formed from the lexicon, than on regulars (e.g., Ellis & Larsen-Freeman 2006). For instance, Hawkins (2003:58) observes that the four advanced adult learners (two Japanese speakers and two Spanish speakers) in Stauble's (1984) study all did better on the irregular past. And Housen (2002:183-84) reports that the early past tense forms in the 9-year old Dutch-speaking child he studied tended to be irregular.   However, Andersen (1978) reports no difference between the regular and irregular past in his study of 89 adult Spanish-speaking learners. Interestingly, Weist (2002:63) notes that the three children in Roger Brown's ground-breaking work on the acquisition of English as a first language (Adam, Eve and Sarah) were all initially more likely to mark tense on irregular verbs than on regulars.

I believe that a more promising place to look for the reasons underlying the relative difficulty of tense lies in its interaction with aspect—a grammatical category relevant to the internal temporal structure of events. In particular, I wish to explore the possibility that the computation of aspect creates difficulty for tense marking.

As frequently noted, there is an important sense in which tense is dependent upon the prior determination of aspect. One indication of this comes from the fact that in languages where aspect is expressed morphologically, it occurs closer to the verb root than does tense (Foley & Van Valin 1984:210).

(16)   Kewa (Papua-New Guinea)—a suffixing language
        ROOT ASP   TNS
        íra   -paa   -ru.
        cook-PERF-1SgPST
        'I finished cooking it.'

(17)   Tiwi (Australia)—a prefixing language
            TNS   ASP ROOT
        N´-ru-untiN-apa
        1Sg-PST-DUR-eat
        'I was eating it.'

In addition, in languages where aspect is expressed morphologically, it is acquired either before tense or at the same time as tense—but never after tense (Van Valin 1991:16).

An important aspectual phenomenon in English involves *Aksionsart*—the assignment of events to one of three classes—achievements, activities, and accomplishments (I set aside 'states' for now).

(18)   *Achievements*:   *Activities*:   *Accomplishments*:
       punctual & telic[14]   non-punctual &   non-punctual & telic
                                 atelic

        [.]   [.....   [.....]

       The glass broke.   They ran on the track They ran to the track.
       He caught the ball.   He walked along the trail.   He walked to the store.

As is well known, a verb's aspectual class shapes its behavior with respect to a wide range of phenomena. For instance, accomplishments can occur with a temporal *in*-phrase, whereas activities cannot.

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[14] An event is telic if it is 'bounded'—that is, if it has a well defined end point.

(19)a. They ran to the track *in an hour*. (accomplishment)
   b. *They ran on the track *in an hour*. (activity)

In contrast, the reverse is true for co-occurrence with a temporal *for*-phrase.

(20)a. *They ran to the track *for an hour*. (accomplishment)
   b. They ran on the track *for an hour*. (activity)

But what does this have to do with tense marking, and more particularly what does it have to do with computation?

Gavruseva (2002a,b) notes an important asymmetry in how membership in aspectual classes is determined in English. In particular, whereas membership in the achievement class is determined on the basis of the verb's inherent meaning, membership in the activity and accomplishment classes must be computed syntactically—by reference to the type of complement the verb takes.

(21)   PP headed by *on* versus PP headed by *to*:
   a. He ran on the track. (activity—the event is unbounded)
   b. He ran to the track. (accomplishment—the event ends when he reaches the track)

(22)   Bare plural NP versus singular NP:
   a. He wrote poems. (activity—He wrote poems for/*in an hour.)
   b. He wrote a poem. (accomplishment—He wrote a poem in/*for an hour.)

Could tense marking problems be related to the computation of aspect? If so, then past tense marking should be easiest on achievement verbs since their aspectual status can be determined on the basis of their inherent meaning, without the need for additional syntactic computation that might tax procedural memory. In contrast, past tense marking should be harder for accomplishments and activities, whose aspectual status requires syntactic computation involving procedural memory.

Suggestive support for this idea comes from the developmental facts themselves. A familiar and frequently cited finding in the study of second language acquisition is that past tense is more likely to be used with achievement verbs than with accomplishments or activities (Andersen & Shirai 1996:546-47, Rohde 1996, Shirai 2003, Collins 2004:263). Comparable results have been reported for the acquisition of Japanese as a second language by Chinese learners (Shirai 2002:463) and for the acquisition of Korean as a second language by English-speaking learners (Lee & Kim 2003). See Weist (2002) and Johnson & Fey (2006) for a review of similar findings for the acquisition of English as a first language.

The role of aspect in the development of verbal inflection is a major research theme in the literature on second language acquisition, but the interpretation of the results obtained thus far is difficult for a variety of reasons.

First, the literature on aspect in second language acquisition has for the most part failed to distinguish between two related, but ultimately separate questions:

◀Which types of verbs first exhibit tense marking?
◀Which types of verbs first manifest full mastery of tense marking?

Most of the currently available data bears on the first issue, where there is perhaps a near-consensus that some sort of 'aspectual effect' (to use Rohde's 2002:216 apt term) exists—with achievement verbs enjoying an advantage of some sort. However, matters are much less clear with respect to the second question, and Rohde reports (p. 202) that whereas achievement verbs are used more often than activity verbs in past contexts, they are often not inflected for past tense (see also Housen 2002:173). In other words, first *use* may not entail first *mastery*.

A second matter has to do with the status of verbs denoting states—non-dynamic eventualities with no clear starting point or end point (e.g., *know, like,* etc.). To the extent that membership in this class is determined on the basis of inherent meaning rather than syntactic computation, we might expect states to exhibit early inflection for past tense. I know of no large-scale investigation of this matter, but it is perhaps worth noting that Rohde (2002:208) reports that nearly all stative verbs received a past inflection in obligatory contexts in the speech of the four children he studied. It would indeed be interesting if adult second language learners exhibited a similar pattern of behavior.

Third, a variety of confounding factors need to be taken into account. One such factor, widely acknowledged in the literature, is frequency: past tense marking apparently occurs more often in the input on verbs denoting achievements than on those denoting activities (e.g., Andersen & Shirai 1996:549ff, Shirai 2003:204). Opinions on why this is so vary widely. Shirai (2002) attributes it to a prototypicality effect (the prototypical past is punctual and telic—hence an achievement), whereas Olson & Hornstein (1999) attribute it to an innate link between perfectivity and telicity.

Another potentially important factor involves whether the verb is regular (e.g. *walk/walked* vs. *run/ran*); see note 13. For example, in Housen's (2002) case study of a Dutch child, most early past forms involved irregular verbs, with stative and telic predicates being equally represented. In contrast, the regular past occurred 'first and foremost' with achievements. Housen (p. 188) suggests that irregular forms may escape aspectual effects by being 'directly mapped onto a given conceptual scene and then stored as one specific form-meaning unit in lexical [i.e., declarative—WDO] memory.' If this is right, we might expect to find aspectual effects only with regular past tense forms, which are the product of computational operations supported by   procedural memory.

Yet another potentially relevant factor in the case of regular verbs has to do with the allomorph used to express the past tense (/t/ in *walked* vs. /d/ in *judged* vs. /id/ in *handed*). Rohde (2002:201) notes that none of the four German-speaking children in his study ever used the /id/ allomorph. At the same time, as Ellis & Larsen-Freeman (2006) observe, following work by Bayley (1994, 1996), the /t/ or /d/ allomorph in *kissed* and *raised* creates a phonologically challenging consonant cluster that invites reduction, especially when the next word begins with yet another consonant (compare *kissed Pam* with *kissed it*).

In sum then, it would be premature to conclude that we have clearcut independent evidence for the aspectual account of difficulties in tense marking, although the matter is surely worth pursuing.

7. Conclusion

Understanding the nature and difficulty of second language acquisition is a long-standing and valid goal of linguistic research—and a necessary first step for an eventual 'science' of language teaching. As I've tried to illustrate with the help of English verbal inflection, there are in fact plausible explanations for the difficulty that particular linguistic phenomena present to language learners. Crucially, these explanations involve deep-seated properties of the cognitive mechanisms underlying the acquisition and use of language—mechanisms that are involved in memory, learning, and computation.

If the ideas put forward here are on the right track, a key to understanding these mechanisms and their operation lies in the distinction between declarative memory and procedural memory, each of which is associated with a fundamentally different type of linguistic knowledge. On the one hand, there is factual knowledge—such as information about the categorial and combinatorial properties of words—that is relatively easy to describe and teach. On the other hand, there is a much less tangible type of knowledge that consists not of facts but of procedures. These procedures correspond to the unconscious operations of the computational system that forms and interprets sentences in the course of language use and that is ultimately responsible for the morphological and syntactic contrasts that make up much of what is traditionally called 'grammar.'

An advantage of the declarative/procedural contrast is that it opens the door to a better understanding of second language acquisition, especially if it is true, as various scholars have now suggested, that second language learners are (initially at least) much more dependent on declarative memory than are first language learners. As I have tried to show here, once we understand the computational nature of phenomena such as agreement and past tense marking, it is possible to begin to make sense of the age effects, task effects, frequency effects, and transfer effects that influence and impede morphosyntactic development in second language learners.

Further exploration of these ideas holds the promise of substantial progress in understanding the nature of second language acquisition and may ultimately contribute to the more practical pedagogical concerns of teachers and curriculum designers.

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