

Contributions of animacy to grammatical function assignment and word order during production

Holly P. Branigan^{*}, Martin J. Pickering, Mikihiro Tanaka

Department of Psychology, University of Edinburgh, 7 George Square, Edinburgh EH8 9JZ, UK

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Abstract

We examine how the relationship between animacy and syntactic structure might be explained in terms of an influence of animacy on the psychological processes that underlie the construction of syntactic structure during language production. In this account, animacy exerts its influence through its correlation with conceptual accessibility, or how easily a concept is retrieved from memory. Animate entities are conceptually highly accessible and are therefore retrieved more easily. Because language production is incremental, easily accessed information is processed first; animate entities therefore tend to be privileged during syntactic processes of production. We consider two possible models of how animacy might influence syntactic processing: through an effect on grammatical function assignment, or through a direct effect on word order. We argue that experimental cross-linguistic evidence supports a third model, in which animacy can simultaneously influence both grammatical function assignment and the determination of word order. Finally, we consider why animacy might not affect word order in conjunctions.

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1. Introduction

In this paper, we consider how the substantial evidence for a relationship between animacy and syntactic structure might be explained in terms of the psycholinguistic processes that underlie syntactic structure generation during language production. We examine previous proposals that animacy might affect the assignment of grammatical functions or the determination of word order, and argue that recent evidence favours a third model, in which animacy may directly influence both grammatical function assignment and choice of word order.

^{*} Corresponding author. Tel.: +44 131 650 8387; fax: +44 131 650 3461.

E-mail address: Holly.Branigan@ed.ac.uk (H.P. Branigan).

2. Evidence for animacy effects on syntactic structure

Substantial research in theoretical linguistics has shown that variations in animacy are associated with variations in syntax, such as possible case-marking and voice selection in some languages (e.g., Aissen, 2003; Comrie, 1989). Research on language use has also suggested a link between animacy and preferences for particular syntactic structures. Many researchers have reported experimental evidence that the default preference for active sentences over passive sentences is reduced or even reversed when the patient of the action is animate and/or human, in languages such as English (Bock et al., 1992; Ferreira, 1994; McDonald et al., 1993), German (Van Nice and Dietrich, 2003), and Spanish (Prat-Sala, 1997). More recent research has shown that word order preferences are influenced by animacy. For example, Japanese speakers tend to misremember OSV sentences as SOV sentences more often when the subject is animate than when it is inanimate (Tanaka et al., 2005). Similar influences have been identified in corpora of natural language, where animacy has been found to affect the choice of double object versus prepositional object structures in German (Kempen and Harbusch, 2004), and the choice of the *s*-genitive versus *of*-genitive in English (Rosenbach, 2005). Taken together, there seems to be a general preference for structures that place animate entities in syntactically prominent positions.

Some apparent effects of animacy may actually be due to other potentially important influences on syntactic structure (see Rosenbach, 2005, for discussion). For example, animate entities may often appear as subjects in English because they are often referred to using pronouns, and shorter elements tend to precede longer elements (Hawkins, 1994). The apparent link between animacy and syntactic structure could therefore really be due to a relationship between syntactic structure and another factor, in this case ‘weight’ (however defined; see Wasow, 1997), which happens to be correlated with animacy. Indeed, Silverstein’s (1976) ‘animacy hierarchy’ conflates animacy, person, and definiteness.

But although some effects might be explained in such a way, recent research has distinguished independent effects of animacy. Rosenbach (2005) showed experimentally that participants preferred English possessives in which the animate entity preceded the inanimate entity (*boy’s eyes*) rather than vice versa (*eyes of the boy*), even when the possessor and possessee were controlled for syntactic complexity and given/new information structure. Similarly, Kempen and Harbusch (2004) found that animate entities tended to precede inanimate entities independently of definiteness, in a corpus of German adverbial and complement clauses.

How might the effects of animacy on syntax be explained? In this paper we take a psycholinguistic perspective. The corpora studied by researchers such as Rosenbach (2005) and Kempen and Harbusch (2004) represent utterances that speakers (or writers) have produced—in other words, the end-product of psychological processes associated with language production. We suggest that syntactic preferences can therefore be interpreted as the expression of factors influencing such psychological processes. The fact that variations in animacy are systematically associated with patterns of syntactic variation in corpora thus provides evidence that animacy influences the psychological processes that are responsible for syntactic structure in production.

3. Incrementality and accessibility

To understand how animacy might affect syntactic processing, we must first consider the characteristics of language production. Speakers operate under demanding constraints: they must produce utterances that are well-formed at many different levels, including semantic, syntactic, lexical, and phonological structure, and they must do so fluently, at a rate of two or three words

per second (Levelt et al., 1999). This is clearly a computationally intensive information-processing problem, and many researchers have suggested that speakers resolve it by processing different aspects of the utterance incrementally and in parallel (e.g., De Smedt, 1994; Ferreira, 1996; Kempen and Hoenkamp, 1987; Levelt, 1989). That is, the processor deals with fragments of information as and when they become available, and processing of different aspects of structure takes place simultaneously. Thus, speakers can begin to generate and articulate an utterance as soon as minimal input is available, rather than having to wait until all elements of the utterance have been retrieved. Incremental processing allows efficient management of working memory requirements so that processing load remains relatively even.

Under the assumption of incrementality, production is fundamentally influenced by the relative accessibility of information: information that is retrieved easily is processed before information that is retrieved less easily, and – all other things being equal – completes processing earlier; this in turn affects the ultimate realization of an utterance. In particular, factors that influence the accessibility of information forming the input to syntactic processing should be associated with syntactic variation. Two aspects of information might be relevant to syntactic processing: the relative accessibility of information specifying the syntactic structures licensed by a language (i.e., syntactic rules, or something corresponding to them), and the relative accessibility of the elements participating in those structures (i.e., entities and the relationships into which they enter, or the nouns and verbs that refer to them). There is good evidence that the accessibility of syntactic information influences syntactic choice; for example, speakers are more likely to use a particular structure if it has been made more accessible through previous production or comprehension (e.g., Bock, 1986b; Bock and Loebell, 1990; Branigan et al., 2000; Hartsuiker and Westenberg, 2000). But of more interest here is the extent to which syntactic preferences are influenced by the relative accessibility of individual entities, and how this relates to animacy.

4. Conceptual accessibility and animacy

Bock and colleagues suggested that animacy is one of a number of factors that affect how easily conceptual information is retrieved, through the notion of *conceptual accessibility*: '[T]he ease with which the mental representation of some potential referent can be activated in or retrieved from memory' (Bock and Warren, 1985:50). We adopt this definition below, although we will refine it somewhat by assuming that conceptual accessibility refers to the accessibility of *lexical concepts* (concepts with a corresponding lexical label; Levelt et al., 1999). There are many possible explanations of conceptual accessibility. For example, it might be linked to the codable perceptual features of an entity; see Johnson et al. (1996).

However, Bock and Warren (1985) suggested that conceptual accessibility is determined by the number of pathways that are available for retrieval: the more pathways, the more routes to the lexical concept and hence the easier it is to retrieve. They characterized the pathways in terms of predicability, or the range of conceptual relations into which an entity could enter (Keil, 1979). For example, a human being is highly predictable because he or she can enter into many relations (e.g., growing, eating, sleeping, talking, ironing, and arguing). Spiders can enter into fewer relations (e.g., growing, eating and sleeping, but not talking, ironing, or arguing), and clouds still fewer. This predicability hierarchy appears to mirror both the development of children's ontological knowledge and adult knowledge (Keil, 1979). Highly predictable entities tend to be both concrete and prototypical.

Importantly, animate entities also tend to be more predictable than inanimate ones. According to Bock and Warren's (1985) account, they therefore have high conceptual accessibility and so

are easy to retrieve. They are thus likely to enter into syntactic relationships more quickly than inanimate entities.

Under this account, animacy is not a privileged attribute with respect to syntactic structure. Just like concreteness and prototypicality, its effects on syntax stem from its correlation with conceptual accessibility. Because predicability – which determines conceptual accessibility – is graded, such that some animate entities (e.g., humans) are more predicable than others (e.g., jellyfish), animacy makes a graded rather than binary contribution to syntactic choice. Hence, it straightforwardly explains the animacy hierarchies that have been identified in previous research (e.g., Yamamoto, 1999), including the fact that inanimate entities that are highly predicable (e.g., dolls) behave like animate entities with respect to linguistic behaviour (e.g., Sridhar, 1988).

In a further refinement of this approach, Prat-Sala and Branigan (2000) suggested that conceptual accessibility comprises two elements: inherent accessibility and derived accessibility. Bock and Warren's (1985) characterization of conceptual accessibility relates to inherent accessibility, which is based upon the inherent features of an entity, such as animacy. Thus, inherent accessibility is invariant across contexts. But Prat-Sala and Branigan argued that the conceptual accessibility of an entity is not fixed. Instead, it varies according to features of the communicative context. For example, semantic priming may make an entity temporarily more accessible within a particular context (e.g., Bock, 1986a). Givenness and salience within a particular context can also affect accessibility (Bock and Irwin, 1980; Prat-Sala and Branigan, 2000). Prat-Sala and Branigan therefore proposed that an entity's overall conceptual accessibility within a particular communicative context is the sum of its fixed inherent accessibility and its temporary derived accessibility. In keeping with this, they showed that discourse-salient entities were more likely to be syntactically prominent in English and Spanish picture descriptions (subjects of passive sentences in English and Spanish, and sentence-initial direct objects of left-dislocated actives in Spanish) if they were also animate.

Prat-Sala and Branigan's (2000) proposal can also account for the confound between animacy and other factors such as givenness. Animate entities are more likely to be worthy of discussion and hence more likely to be talked about across consecutive utterances. This makes them more likely to be given and salient information within a context. Hence animate entities are likely to be highly conceptually accessible because they are likely to have high derived accessibility in a specific communicative context, in addition to having high inherent accessibility.

5. Syntactic encoding: grammatical functions and word order

We have seen how an account based on variations in the conceptual accessibility of entities during grammatical encoding can explain the link between animacy and grammatical structure. But what exactly might this link be? Specifically, does the tendency for animate entities to be syntactically prominent refer to grammatical function or word order? For example, the tendency for English speakers to produce passive descriptions for pictures that involve inanimate agents and animate patients (e.g., Bock et al., 1992) might be due to a preference to make an animate entity the sentence subject. When the animate entity is an agent, this will result in the choice of an active sentence; when the animate entity is a patient, this will result in the choice of a passive sentence. However, this pattern of preferences can equally well be explained in terms of preferences for alternative word orders: speakers might prefer to position an animate entity early in the sentence.

These two accounts correspond to two different stages of processing in most theories of language production (e.g., Bock, 1982; Bock and Levelt, 1994; Garrett, 1976, 1980; Levelt, 1989). Based on naturalistic and experimental evidence, such theories distinguish between an

initial stage of functional processing and a subsequent stage of positional processing. Functional processing involves mapping grammatical functions to lexical elements. Specifically, it involves retrieving noun and verb lemmas (i.e., the syntactic component of a lexical entry; Levelt et al., 1999). Verb lemmas are assumed to be specified for the grammatical functions with which they can be associated (e.g., most transitive verbs in English are associated with two sets of grammatical functions: the subject and direct object functions, associated with an active structure; and the subject and oblique object functions, associated with a passive structure). Each noun lemma in the functional representation is tagged for one of the grammatical functions specified by the relevant verb lemma (e.g., subject, object).

Functional processing therefore specifies which element will play which grammatical role in the eventual realization of the sentence. However, it does not contain specifications of hierarchical relationships between elements, nor their ordering. These are subsequently determined during positional processing, at which point the functional representation is mapped onto a fully-specified constituent structure. Experimental evidence suggests that hierarchical structure and linear order are simultaneously computed during positional processing (Pickering et al., 2002; see also Haskell and MacDonald, 2003). A particular functional representation may uniquely determine the constituent structure realization; for example, a functional representation such as *see*[*boy*-SUBJECT, *book*-DIRECT-OBJECT] can only be realized in English as *The boy sees the book*. In other cases, a functional representation may have more than one possible realization; for example, the same functional representation could be realized in Greek in (at least) the subject–verb–object (SVO) and object–verb–subject (OVS) word orders. Hence, during positional processing, speakers must choose a word order.

It is clear that animacy might affect either or both of these stages of processing. That is, animacy might affect how speakers assign grammatical functions to lemmas, such that lemmas representing animate entities tend to be assigned the subject function. Alternatively, it might affect speakers' choice of word order, such that lemmas representing animate entities tend to be assigned early sentence positions. Finally, it might affect both stages of processing, resulting in tendencies both for animate entities to be sentence subjects and for them to appear early in sentences.

Relating this back to conceptual accessibility and incremental processing, the greater accessibility of animate entities might lead them to be at an advantage during functional processing, positional processing, or both. This advantage might result in them tending to claim the subject function, an early word order position, or both. The observation that animate entities tend to appear as the subjects of transitive sentences in English is of course compatible with all three of these possibilities. However, experimental research can help us to distinguish them.

6. Does animacy affect grammatical function assignment only?

According to the *grammatical function model* of animacy effects, animacy influences choice of grammatical function but has no direct effect on word order (Bock, 1987; Bock and Warren, 1985). Bock and Warren proposed that during this stage, grammatical functions are assigned in accordance with Keenan and Comrie's (1977) NP accessibility hierarchy. Although the NP accessibility hierarchy was originally proposed to capture cross-linguistic regularities in relative-clause licensing, Bock and Warren suggested that it also applies to online syntactic processing, such that the order of function assignment follows the hierarchy. The subject function is assigned first, followed by the direct object, indirect object, oblique, genitive, and object of comparison.

Assuming incremental processing, the subject function is therefore assigned to the lemma that is retrieved first. Because lemmas associated with conceptually accessible entities are retrieved

more quickly, conceptually accessible entities tend to appear as subjects. And because animate entities tend to be conceptually accessible, the grammatical function model predicts that noun phrases referring to animate entities tend to receive higher grammatical functions than noun phrases referring to inanimate entities.

Crucially, Bock and Warren (1985) proposed that conceptual accessibility influences only functional processing; it does not influence positional processing. Conceptual accessibility (hence, animacy) does not therefore directly influence word order. Any apparent link between conceptual accessibility and word order arises from the fact that, in English at least, higher grammatical functions tend to precede lower grammatical functions (e.g., subjects precede objects). Grammatical function effects can therefore easily be misinterpreted as word order effects. Bock and Warren argued that when grammatical function effects are excluded, there is no independent preference to place conceptually accessible items in early word order positions.

Support for this model comes from studies in which participants recalled previously presented sentences. Many studies suggest that the form in which participants recall sentences reflects the normal biases of production (see Bock and Irwin, 1980); for example, English participants tend to recall passive sentences in an active form, mirroring an observed preference for active over passive sentences (e.g., Quirk et al., 1985). By manipulating features of the sentences, and examining how this affects participants' recall of sentence form (given that they correctly recall sentence meaning), it is possible to draw inferences about the nature of the production system. It should, however, be noted that such correlations may in fact hide real differences between recall and simple production. Even if recall always involves regenerating the utterance (as claimed by Potter and Lombardi, 1999), it may be that biases (at least partly) occur because participants are more likely to remember the form of certain types of sentences than others. It is also conceivable that the procedure of cued recall leads to biases, if the cue happened to be more effective at activating memory traces for particular types of sentences than others.

In Bock and colleagues, recall studies, the experimental manipulation involved sentences containing pairs of nouns that varied in conceptual accessibility. McDonald et al. (1993) used animacy as an index of conceptual accessibility. Participants listened to active and passive transitive sentences containing an animate agent and an inanimate patient (*A farmer purchased a refrigerator* versus *A refrigerator was purchased by a farmer*) or an inanimate agent and an animate patient (*The music soothed the child* versus *The child was soothed by the music*), and to sentences containing NP conjunctions in which the first noun was animate and the second noun was inanimate, or vice versa (*He sat in front of a roaring fire with his cat and some whiskey* versus *some whiskey and his cat*). Participants were then prompted by short vignettes to recall and write down the original sentences.

McDonald et al. (1993) found that participants tended to recall transitive sentences in a form allowing the animate entity to appear as sentence subject (e.g., they recalled *The music soothed the child* as *The child was soothed by the music* more often than they recalled *A farmer purchased a refrigerator* as *A refrigerator was purchased by a farmer*). Bock and Warren (1985) found the same pattern for another index of conceptual accessibility, concreteness. Both sets of findings are compatible with the grammatical function model. But they are also compatible with an explanation in terms of word order preferences, because the subject was always sentence-initial.¹

¹ Bock and Warren (1985) also examined other positions on the NP accessibility hierarchy, namely direct and indirect objects, and found a tendency for concrete entities to appear as the object directly following the verb. This finding can also be interpreted as a grammatical function effect or as a word order effect.

In NP conjunctions, however, it is possible to tease apart grammatical function from word order, because both conjuncts have the same grammatical function. The grammatical function model predicts no tendency to recall animate conjuncts before inanimate conjuncts. But a word order account of animacy effects predicts that animate conjuncts should tend to be recalled before inanimate conjuncts. McDonald et al. (1993) found no such tendency. Similarly, Bock and Warren (1985) found no tendency for concrete conjuncts to precede abstract conjuncts. In other words, conceptually accessible entities preceded conceptually less accessible entities only when they also bore a higher grammatical function. These findings suggest that variations in animacy are associated with variations in grammatical function assignment but not word order.

Further supporting evidence comes from Bock et al. (1992). Many researchers have shown that speakers tend to perseverate syntactic structure across otherwise unrelated sentences. For example, Bock (1986b) found that participants in a task that involved repeating sentences and describing pictures were more likely to describe a picture using a passive structure (*The church is being struck by lightning*) after repeating a passive sentence (*The boy is being woken by the alarm clock*) than after repeating an active sentence (*The alarm clock is waking the boy*). This *syntactic priming* effect reflects repetition of abstract constituent structure (Bock and Loebell, 1990; Branigan et al., 2006; Hartsuiker and Westenberg, 2000; Scheepers, 2003).

Bock et al. (1992) used the same sentence-repetition/picture-description task with sentences that varied in both structure (active versus passive) and grammatical function assignment (animate versus inanimate subject). Participants tended to perseverate constituent structure (producing active sentences after repeating actives more often than after repeating passives). But they also tended to perseverate the assignment of an argument with a particular animacy to a particular grammatical function. Participants were more likely to produce a description with an inanimate subject (*The alarm clock woke the boy*) after repeating a prime with an inanimate subject (*The boat was carried by five people*) than a prime with an animate subject (*Five people carried the boat*). Crucially, the two priming effects were independent: participants were just as likely to produce active descriptions with animate subjects (*The alarm clock woke the boy*) after passive primes with inanimate subjects (*The boat was carried by five people*) as after active primes with inanimate subjects (*The boat carried five people*). So, repeating syntactic structure did not interact with the tendency to repeatedly assign an argument with a particular animacy to a particular grammatical function. The absence of an interactive effect suggests that animacy only affected grammatical function assignment; it did not also affect the determination of syntactic structure.

Taken together, the evidence from such studies is compatible with the proposal that animacy affects functional processing only, and hence that animacy influences the assignment of grammatical functions but not word order during sentence production. But there are good theoretical reasons to question this model. For example, Bock et al.'s (1992) effects could be interpreted in terms of word order, as a tendency to repeat particular animacy assignments to particular word order positions (pre-verbal versus post-verbal NP).

In addition, the model cannot account straightforwardly for production in languages with less restrictive word order than English (Branigan and Feleki, 1999). In English, when speakers choose a particular function assignment, they also implicitly commit to a particular word order, with few exceptions. For example, selecting a function assignment that makes the patient the subject and the agent the oblique object not only commits the speaker to a passive structure but also to a word order in which the patient precedes the agent, because subjects precede objects in English. But many languages do not require the subject to come before the object (e.g., Greek). How then might Bock and Warren's (1985) model account for production of these structures? In

their model the subject function is always assigned first; assuming incremental production, the subject should therefore undergo positional processing first and hence claim the earliest word order position. But this wrongly predicts that speakers of languages such as Greek would always produce subject–object ordering.

One possibility is that object–subject ordering might arise if the subject’s word form is difficult to retrieve but the object’s word form is easy. Monitoring processes might trigger the processor to abandon the current syntactic structure and try an alternative structure that places the object before the subject. This account views object–subject ordering as essentially arising from disrupted morpho-phonological processes. But such difficulty would surely occur only infrequently and therefore cannot account for languages in which object–subject order is frequent. Note also that McDonald et al. (1993) found no evidence that word form accessibility influences word order.

Alternatively object–subject ordering might arise because the processor does not always act incrementally. In some circumstances it assigns the subject function but does not then place the subject first. Instead, it buffers the subject until the object function has been assigned and then places the object first. This account views object–subject ordering as involving the disruption of the processes that underlie the construction of constituent structure. However, there is good evidence that speakers do produce utterances incrementally. For example, Ferreira (1996) found that speakers were faster and more accurate to produce utterances containing verbs that allowed more than one syntactic structure (*I gave the toys to the children* or *I gave the children the toys*) than verbs that only allowed one syntactic structure (*I donated the toys to the children*). When producing utterances using a verb that allowed more than one structure, speakers were presumably able to utter whichever noun (*toys* or *children*) they accessed first and then produce a structure compatible with that choice; but when producing utterances using a verb that allowed only one structure, speakers were slower if they first accessed the noun that did not come first in that structure (e.g., *children* with the verb *donate*). This suggests that speakers do not tend to buffer noun phrases, but rather produce utterances incrementally where possible.

The grammatical function model therefore seems unsatisfactory for capturing production in flexible word order languages; there is no way in it for speakers to promote fluency by exploiting word order variations to produce an accessible item while they are retrieving or processing a less accessible item. Rather, in such a model the production of sentences with any order other than subject-initial seems to inherently entail disfluency.

A final reason to question the grammatical function model is that all of the experimental evidence to support it comes from the absence of conjunct ordering effects in English. However, conjunctions have long been recognized as unusual structures in syntactic theory (e.g. Chomsky, 1957). Hence, it is not clear whether the absence of ordering effects in NP conjunctions can be taken as strong evidence for the absence of ordering effects on word order in general. Furthermore, there is some evidence for effects of conceptual accessibility on word order in NP conjunctions even in English (e.g., Kelly et al., 1986). We return to this issue in section 10.

7. Does animacy affect word order only?

An alternative account is the *word order model* of animacy effects. According to this model, animacy affects word order but has no direct effect on choice of grammatical function. It claims that animate entities are more likely to appear in early word order positions than inanimate elements; in languages that allow free word order, this means that animate entities will tend to appear as sentence-initial subjects or objects. However, animacy does not affect grammatical function assignment; there is no independent tendency for animate entities to appear as subjects.

Such an account is consistent with models of production that avoid the restricted incrementality entailed by the grammatical function model (e.g., De Smedt, 1994). In De Smedt's model, word order positions may be assigned before grammatical functions, so that the first lemma to be retrieved can claim the earliest word order position before the processor has assigned it a grammatical function. An object can thus claim an early word order position before the subject function has been assigned. This model therefore allows conceptually more accessible entities to claim early word order positions, irrespective of grammatical function; hence animacy (via conceptual accessibility) directly influences word order. In this model, word orders such as OVS promote fluency through incremental production, by allowing speakers to encode a readily accessible object while they are retrieving a less accessible subject. This contrasts sharply with the grammatical function model, where such variant word orders promote disfluency.

Research on languages with flexible word orders suggests that animacy may be associated with word order variation, independently of grammatical function. For example, Sridhar (1988) reported a cross-linguistic study in which participants were asked to 'just describe' a series of videotaped events (cf. Osgood, 1971). Participants tended to produce word orders that allowed entities with attributed animacy, such as a doll (and conceptually accessible entities in general), to appear first; for some languages, these effects were distinguishable from effects of grammatical function assignment.

Prat-Sala and Branigan (2000) found that participants in a Spanish picture-description task showed a greater tendency to produce animate entities than inanimate entities as both subjects in passive sentences (*La mujer fue atropellada por el tren*, literally 'The woman was run over by the train') and direct objects in left-dislocated object sentences (*A la mujerla atropello el tren*, literally 'The woman, the train ran her over'). Whereas the first effect could be a grammatical function effect or a word order effect, the second must be a word order effect.

However, we cannot be sure from these experiments that animacy can affect word order, since they have other possible explanations. For example, in Prat-Sala and Branigan's (2000) experiments, the animate entities were always named using higher-frequency nouns than the inanimate entities, and this might have affected how speakers chose to encode their descriptions. To investigate the influence of animacy on word order directly, Branigan and Feleki (1999) examined sentence production in Greek. Unlike English, Greek allows a wide range of structures that separate word order from grammatical functions. As already noted, for example, the subject of a sentence can appear preceding or following the verb, and preceding or following the direct object.

Branigan and Feleki (1999) focused on the SVO and OVS orders. Although SVO is the canonical order, OVS is also freely licensed. They used a sentence recall task involving 32 sentences such as those in (1), in which the animacy of the subject noun (animate-subject versus inanimate-subject noun) and the word order of the presented sentence (SVO versus OVS order) were systematically manipulated. Participants heard blocks of eight sentences (six transitive sentences plus two filler [i.e., non-experimental] intransitive sentences) in a randomized order and were then prompted to recall them orally in a different randomized order.

- (1) (a) *Sta dimokratika politevmata, o politis sevete to sindagma.*
 in democratic regimes the citizen-NOM respects the law-ACC
In democratic regimes, the citizen respects the law
- (b) *Sta dimokratika politevmata, to sindagma sevete o politis.*
 in democratic regimes the law-ACC respects the citizen-NOM
In democratic regimes, the citizen respects the law

- (c) Sta demokratika politevmata, to sindagma sevete ton politi.
 in democratic regimes the law-NOM respects the citizen-ACC
In democratic regimes, the law respects the citizen
- (d) Sta demokratika politevmata, ton politi sevete to sindagma.
 in democratic regimes the citizen-ACC respects the law-NOM
In democratic regimes, the law respects the citizen

Under the grammatical function model of animacy effects, participants might prefer to recall the dispreferred OVS sentences (1b) and (1d) in canonical SVO order (1a) and (1c); but this tendency should be unaffected by animacy.² Specifically, participants should not be more likely to recall (1b) as (1a) – allowing the animate entity to appear first in the sentence – than to recall (1d) as (1c).

But if animacy affects word order, such that animate entities are linked to early word order positions, then participants should recall sentences in a form that allowed the animate entity to appear first, irrespective of grammatical function. Hence they should tend to recall inanimate-first sentences such as (1b) and (1c) as animate-first sentences such as (1a) and (1d), respectively, though this tendency might be enhanced when it would also result in production of canonical order (i.e., for 1b).

Branigan and Feleki (1999) found strong evidence that animacy can affect word order: participants preferred to recall sentences in a form that allowed an animate entity to precede an inanimate entity, irrespective of grammatical function, both for preferred SVO order (1c) and dispreferred OVS order (1b) (see left-hand side of Fig. 1). They were significantly more likely to recall OVS sentences as SVO sentences when the subject was animate and the effect was to place the animate entity in first position (i.e., 1b → 1a; 47%) than when the subject was inanimate and the effect was to place the inanimate entity in first position (i.e., 1d → 1c; 36%). Equally, they were significantly more likely to recall SVO sentences as OVS sentences when the subject was inanimate and the effect was to place the animate entity in first position (i.e., 1c → 1d; 10%) than when the subject was animate and the effect was to place the inanimate entity in first position (i.e., 1a → 1b; 2%). Thus, animate entities tended to appear first even when they fulfilled the grammatical function of object.

These results provide no support for the grammatical function model, which predicts that participants should prefer to recall animate entities as subjects but that animate entities should exhibit no independent tendency to appear in early word order positions. Instead, they provide strong support for the word order model, in which animacy influences word order decisions. Branigan and Feleki's (1999) results show that animacy can affect word order independently of grammatical function, but cannot determine whether there is an additional grammatical function effect of some sort, because the possible responses (SVO or OVS) always involved the same grammatical function assignment.

8. Does animacy affect both grammatical function assignment and word order?

More recently, research that has manipulated grammatical function assignment and word order simultaneously within a single construction has challenged both the grammatical function

² Additionally, this account predicts that they might tend to recall (1c) and (1d) in the passive form, allowing the animate entity to appear as the subject. However, participants in this experiment did not do this, probably because they were never presented with passive sentences to recall in the experiment as a whole.

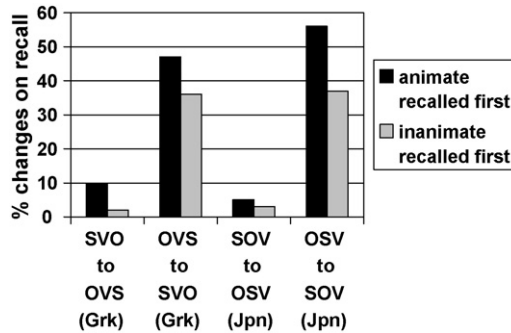


Fig. 1. Data from Branigan and Feleki (1999) and Tanaka et al. (2005): percentage of responses involving correct meaning but changes in form. For instance, *SVO to OVS* means *SVO* utterances recalled as *OVS*. *Grk*, Greek; *Jpn*, Japanese.

and word order accounts. If animacy affects both aspects of structure, then animate entities should be more likely than inanimate entities to appear as subjects (both sentence-initially and sentence-non-initially) and in early word order positions (both as subjects and as objects).

Recent evidence from two recall experiments investigating Japanese transitive sentences suggests that animacy might contribute to both grammatical function assignment and the determination of word order (Tanaka et al., 2005). Participants heard 28 sentences that included an animate and an inanimate noun. In the first experiment, the sentences varied only in word order. The animate noun appeared as either the subject of an *SOV* or *OSV* sentence (2a and b), or as the object of an *SOV* or *OSV* sentence (2c and d). Participants heard blocks of eight sentences (each including 2 or 3 filler [i.e., non-experimental] intransitive sentences) in a randomized order and were then prompted to recall them orally in a different randomized order.

- (2)
- (a) ryokousha-ga takushii-o tukamaeta.
traveller-NOM taxi-ACC pick up-PAST
A traveler picked up a taxi.
 - (b) takushii-o ryokousha-ga tukamaeta.
taxi-ACC traveller-NOM pick up-PAST
A traveler picked up a taxi.
 - (c) takushii-ga ryokousha-o tukamaeta.
taxi-NOM traveller-ACC pick up-PAST
A taxi picked up a traveler.
 - (d) ryokousha-o takushii-ga tukamaeta.
traveller-ACC taxi-NOM pick up-PAST
A taxi picked up a traveler.

Tanaka et al. (2005) replicated Branigan and Feleki's (1999) finding of animacy effects on word order independently of grammatical function in active sentences. Participants tended to recall *OSV* sentences (a dispreferred ordering) as *SOV* sentences (the canonical ordering), but this tendency was reliably stronger when the effect was to place the animate entity in first position (i.e., 2b → 2a; 56%) than when it was to place the inanimate entity in first position (i.e., 2d → 2c; 37%) (see right-hand side of Fig. 1). However, unlike Branigan and Feleki they found no effects of animacy on recall of sentences originally presented in the preferred (*SOV*) order.

In their second experiment, Tanaka et al. (2005) examined whether animacy can also exert an influence on grammatical function assignment. Participants heard 48 transitive sentences involving an animate entity and an inanimate entity, but this time the animate entity appeared as the subject of an active SOV or OSV sentence (2a and b), as the object of an active SOV or OSV sentence (2c and d), as the subject of a passive SOV or OSV sentence (3a and b), or as the object of a passive SOV or OSV sentence (3c and d). Participants heard blocks of eight sentences (five or six transitive sentences plus two or three filler [i.e., non-experimental] intransitive sentences) in a randomized order and were then prompted to recall them orally in a different randomized order.

- (3) (a) ryokousha-ga takushii-niyotte tukamae-rare-ta.
traveller-NOM taxi-OBL pick up-PASSIVE-PAST
A traveler was picked up by a taxi.
- (b) takushii-niyotte ryokousha-ga tukamae-rare-ta.
taxi-OBL traveller-NOM pick up-PASSIVE-PAST
A traveler was picked up by a taxi.
- (c) takushii-ga ryokousha-niyotte tukamae-rare-ta.
taxi-NOM traveller-OBL pick up-PASSIVE-PAST
A taxi was picked up by a traveler.
- (d) ryokousha-niyotte takushii-ga tukamae-rare-ta.
traveller-OBL taxi-NOM pick up-PASSIVE-PAST
A taxi was picked up by a traveler.

If animacy affects only word order, then participants should tend to recall OSV sentences as SOV sentences more often when the result is to place the animate entity in first position, but they should not tend to recall passive sentences as active sentences more often when the result is to make the animate entity the subject. If animacy affects both word order and grammatical function assignment, however, they should tend to recall OSV sentences as SOV sentences more often when the result is to place the animate entity in first position, and also to recall passive sentences as active sentences more often when the result is to make the animate entity the subject.

Tanaka et al.'s (2005) results again showed an effect of animacy upon word order: participants recalled OSV sentences as SOV sentences significantly more often when this resulted in the animate entity appearing first (i.e., 2b and 3b → 2a and 3a; 34%) than when it resulted in the inanimate entity appearing first (i.e., 2d and 3d → 2c and 3c; 15%). They also showed an effect of animacy upon grammatical function assignment (Fig. 2): Participants recalled sentences in the opposite voice to that originally presented (but retained the same word order as originally presented, i.e. SOV or OSV) more often when this resulted in the animate entity appearing as the subject (i.e., 2c → 3a: 14%; 2d → 3b: 41%; 3c → 2a: 6%; 3d → 2b: 35%) than when it resulted in the inanimate entity appearing as the subject (i.e., 2a → 3c: 2%; 2b → 3d: 12%; 3a → 2c: 2%; 3b → 2d: 16%); this effect held for sentences originally presented as SOV- and OSV-actives and for sentences originally presented as SOV- and OSV-passives.

9. Modeling these data

These results suggest that animacy influences both grammatical function and word order in language production. How might these effects be captured within a model of language production? One possibility in keeping with existing models (e.g., Bock and Levelt, 1994; Garrett, 1980) is that animacy influences two separate stages of processing: functional processing

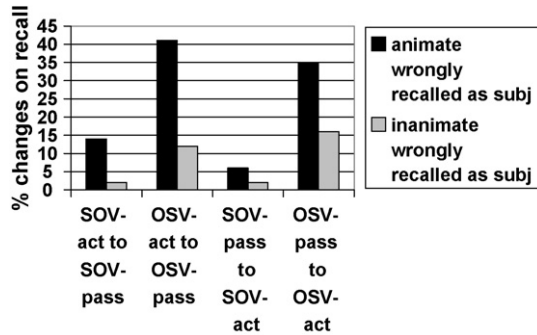


Fig. 2. Data from Tanaka et al. (2005): percentage of responses involving correct meaning but changes in voice. For instance, *SOV-act to SOV-pass* means SOV active utterances recalled as SOV passive.

and positional processing. Under this account, animacy would initially influence the process by which grammatical functions are assigned; during subsequent processing, it would influence the determination of word order. As Kempen and Harbusch (2004) noted, such a model seems unparsimonious.

In an alternative model, grammatical functions and word order would be determined during the same stage of processing, with entities being assigned a grammatical function and a word order position simultaneously. Animacy would exert its effects on this single stage. Conceptually more accessible, hence animate, entities would undergo lemma retrieval earlier than conceptually less accessible, hence inanimate, entities. Thus, animate entities would tend to claim both higher grammatical functions and earlier word order positions.

Such a model of production is compatible with an extension of the account of lexico-syntactic representation developed by Pickering and Branigan (1998). Levelt et al. (1999) proposed a theory of lexical representation in production in which a conceptual representation for a word is linked to a lemma representation, which is in turn linked to a word-form representation. The lemma captures the syntactic properties of the word, for example, its grammatical class and features (e.g., number, gender). Pickering and Branigan proposed that the lemma is also linked to nodes specifying combinatorial potential. For example, the lemma for *give* would be linked to a *combinatorial node* associated with the prepositional object construction (*give the book to the boy*) and a combinatorial node associated with the double object construction (*give the boy the book*). When people produce one of these constructions, they activate the lemma and the relevant combinatorial node. Such a model is compatible with the finding that people tend to repeat syntactic structure (Bock, 1986a), and that this tendency is enhanced when the verb is repeated across sentences (Branigan et al., 2000; Pickering and Branigan, 1998). In Pickering and Branigan's model, this syntactic priming is explained in terms of residual activation of a combinatorial node, and lexical enhancement is explained in terms of strengthening of the link between a combinatorial node and a particular verb lemma.

Further work suggests that such combinatorial nodes are specified for both word order and grammatical function. Pickering et al. (2002) found that people tended to repeat the prepositional object form when they had just produced a prepositional object form with the constituents in the same order (*give the revolting medicine to the patient*) but not when they had just produced a "heavy-shifted" prepositional object form with the constituents in the reverse order (*give to the patient the revolting medicine*). This suggests that there is no tendency to repeat constituents

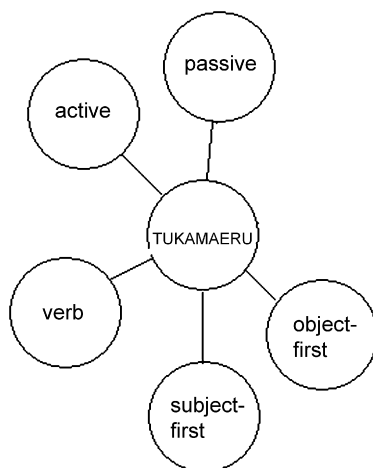


Fig. 3. Fragment of the lemma stratum to incorporate voice and word order information associated with TUKAMAERU ('to pick up') in Japanese.

without also repeating their order, and therefore that there are separate combinatorial nodes corresponding to constituent structures that differ in word order alone. Additionally, [Hartsuiker et al. \(2004\)](#) interpreted the finding of priming from actives to actives and passives to passives (in their case, between languages) as supporting the existence of active and passive nodes linked to the relevant verb lemma. Such nodes of course differ in two respects: the range of grammatical functions with which they are associated (active with subject and direct object; passive with subject and oblique object), and the linking of those roles with particular event roles (e.g., active subject with agent, passive subject with patient). Putting these proposals together, the extended model suggests that both word order and grammatical function are differentiated at the lemma stratum, and people access a verb lemma together with a voice node that is associated with grammatical function specifications and a combinatorial node that specifies constituent structure (including word order); see [Fig. 3](#). In a language such as Japanese, this means that the processor makes a “one-stage” choice between active subject-first; passive subject-first; active subject-final; and passive subject-final.

10. Animacy and conjunction

We noted above that two studies found no effect of concreteness ([Bock and Warren, 1985](#)) or animacy ([McDonald et al., 1993](#)) on conjunct ordering. How might this evidence be reconciled with the strong evidence that animacy does influence word order (e.g., [Branigan and Feleki, 1999](#); [Tanaka et al., 2005](#))?

One possibility is that these differences reflect different processing architectures for strict word order languages such as English versus more flexible word order languages such as Greek and Japanese, with the latter allowing more highly incremental processing. However, we suggest that the differences can be attributed to the structures studied. Recall that Bock and colleagues' experiments crucially relied upon NP conjunctions. Since [Chomsky \(1957\)](#), generative grammar has often assumed special rules for coordination, in keeping with the traditional split between coordination and subordination; for example, some analyses assume that NP conjunctions are

multiply-headed (e.g., Gazdar et al., 1985). Thus, it is possible that they are processed in unusual ways.

In fact, the evidence concerning ordering effects in conjunctions is not clear-cut. Cooper and Ross (1975) suggested that animates tend to precede inanimates in conjunctions whose form is relatively ‘frozen’ (*men and machines; animal, vegetable, or mineral*). Byrne and Davidson (1985) found that children were more likely to correctly recall conjoined proper nouns when the referent of the first conjunct was animate than when it was inanimate. Similarly, it is unclear whether other factors relating to conceptual accessibility affect conjunct order. Although Bock and Warren (1985) and McDonald et al. (1993) did not find effects of conceptual accessibility, Kelly et al. (1986) found that prototypical entities tended to be recalled before non-prototypical entities in a sentence recall task; for example, participants were more likely to recall conjunctions involving an apple (prototypical fruit) and a lemon (non-prototypical fruit) as *an apple and a lemon* than as *a lemon and an apple*.

To address the issue of conjunct ordering directly, Tanaka et al. (2005) examined sentence recall for sentences involving NP conjunctions, as well as for transitive sentences. Their manipulation involved 14 NP conjunctions containing an animate and an inanimate noun. They manipulated whether the animate noun (4a) or the inanimate noun (4b) appeared first. This manipulation was conducted as part of the experiment described in (1) above, and therefore also used randomized blocks of eight sentences for subsequent oral recall.

- (4) (a) ryokousha-to takushii-ga matteita.
 traveler and taxi-NOM were waiting.
A traveler and a taxi were waiting.
- (b) takushii to ryokousha-ga matteita.
 taxi and traveler-NOM were waiting.
A taxi and a traveler were waiting.

Tanaka et al. found strong evidence for animacy effects on word order in transitive sentences. Yet intriguingly, they found no reliable effect of animacy on conjunct order in NP conjunctions. Participants did not incorrectly recall the order of conjuncts significantly more often when the effect was to make the animate entity the first conjunct (18%) than when the effect was to make the animate entity the second conjunct (12%), though there was a trend in this direction. Furthermore, Tanaka et al. found a significant difference between the magnitude of this animacy effect in structures involving NP conjunctions (6%) and SOV/OSV structures (19%). Hence their results provide evidence that conjunct ordering in NP conjunctions is relatively immune to animacy effects; if any such effects exist, they are smaller than those found for transitive structures.

This suggests that NP conjunctions may be processed differently from other syntactic structures. Conjunctive structures differ in an important way from the structures for which animacy effects on word order have been found. Specifically, non-conjunctive NPs involve retrieval of a single noun lemma, which controls syntactic elaboration. Hence as soon as the processor has retrieved just the noun lemma, it can commence syntactic processing. In contrast, NP conjunctions require the processor to retrieve two noun lemmas, one for each conjunct. Crucially, syntactic elaboration of the conjunctive phrase is determined by the syntactic features of both conjuncts, at least in English and Japanese. For example, in many languages agreement is determined with reference to both conjuncts. In syntactically elaborating an NP conjunction, therefore, the processor needs to refer to the syntactic information contained in both lemmas. As such, it seems plausible that conjunctions are not processed incrementally like other phrases. We

suggest that when processing a conjunctive phrase, the processor temporarily suspends fully incremental processing, and delays some syntactic processing until the lemmas associated with both conjuncts have been successfully retrieved and the information that they contain can be used to constrain the syntactic structure that is generated. In keeping with this, Meyer (1996) found that speakers delay initiating articulation of NP conjunctions until the lemmas of both nouns have been retrieved. If NP conjunctions are not processed incrementally like other phrases, it is not surprising that they do not consistently exhibit ordering effects related to the accessibility of each conjunct.

11. Conclusions

There is considerable evidence for a link between animacy and syntactic structure. In this paper we adopted a psycholinguistic approach to explaining this relationship. We suggested that animacy exerts its influence because it correlates with conceptual accessibility, an index of how easily a concept is retrieved from memory. Under this proposal, animacy is not a privileged, binary feature in syntactic processing, but one of a constellation of graded conceptual features that contribute to an overall index of conceptual accessibility. Because language production tends to be incremental, differences in accessibility associated with animate versus inanimate entities impact directly upon processing. We argued that experimental evidence allows us to identify the precise nature of this influence. In contrast to earlier proposals, we suggested that animacy influences the way in which speakers both assign grammatical functions and determine word order. Animate entities are privileged in both aspects of processing. As a result, they tend to be realized both as subjects and in early word order positions; this supports models of language production in which syntactic processing constitutes a single stage of processing. However, they do not reliably influence order of conjuncts. We suggest that psycholinguistic experiments that investigate animacy can cast light on both the nature of the relationship between conceptual factors and syntactic preferences, and the architecture of the human language processing system.

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